

January 23, Week 2

Today: Chapter 2, Instantaneous Velocity and Acceleration

Homework Assignment #2 - Due January 25

Mastering Physics: 6 problems from chapters 1 and 2.

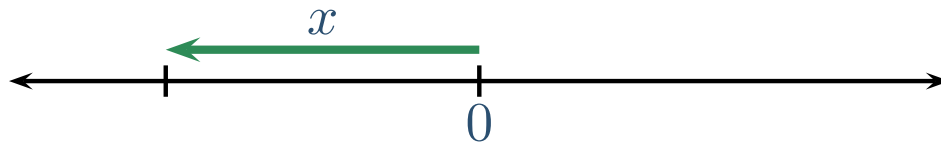
Written Question: 2.75

Box numbers will be posted online tomorrow morning

Friday office hours will be held in Regener Hall 114

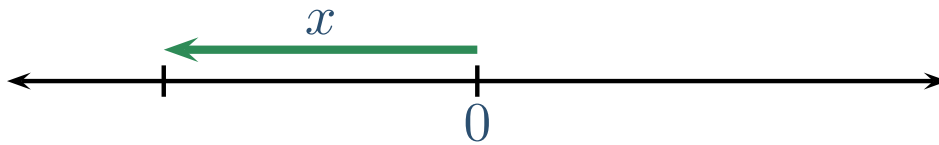
Review

Position, x : - How far and what direction from origin



Review

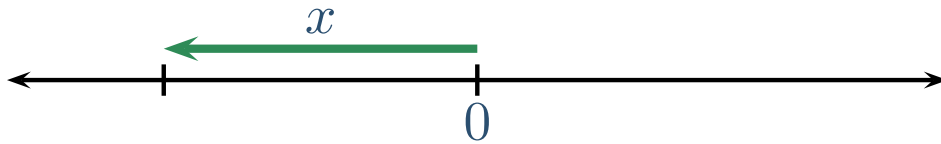
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Displacement, $\Delta x = x_2 - x_1$ - Change in Position

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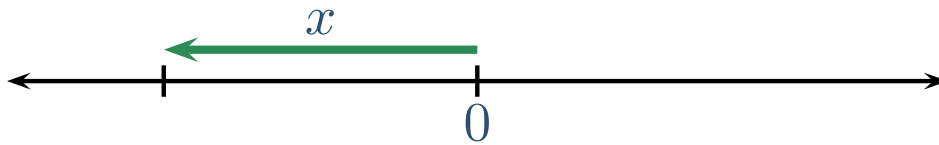


Displacement, $\Delta x = x_2 - x_1$ - Change in Position

Distance, d - how far from initial to final position, always positive

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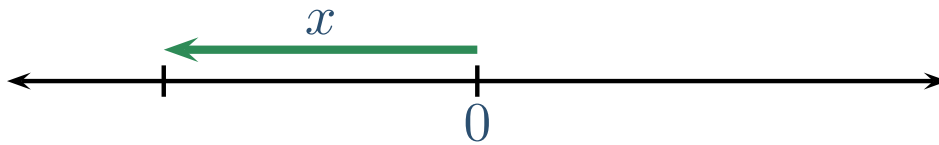
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Average Speed: $sp_{av} = \frac{d}{\Delta t}$

Review

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Displacement, $\Delta x = x_2 - x_1$ - Change in Position

Distance, d - how far from initial to final position, always positive

$$\text{Average Speed: } sp_{av} = \frac{d}{\Delta t}$$

$$\text{Average Velocity: } v_{av} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1} \quad \text{unit: } m/s$$

Average Velocity Exercise

Consider three cars which perform the following motions:

Car #1 travels to the right at 15 m/s .

Car #2 goes to the right for 5 s at 10 m/s , immediately turns around, and goes to the left at 25 m/s for 2 s .

Car #3 travels 90 m to the left every minute.

Which of the following is the correct ranking of the cars' *average velocities* from smallest to largest? (Use the usual sign convention and put negative numbers first.)

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Velocity Exercise Followup

Consider three cars which perform the following motions:

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Car #1: $v_{av} = 15 \text{ m/s}$

Car #2: It travels $(10 \text{ m/s})(5 \text{ s}) = 50 \text{ m}$ to the right and then $(25 \text{ m/s})(2 \text{ s}) = 50 \text{ m}$ to the left. Its displacement for the entire trip is $0 \Rightarrow v_{av} = 0$

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$$\text{Car \#3: } v_{av} = \frac{-90 \text{ m}}{1 \text{ min}} = \frac{-90 \text{ m}}{60 \text{ s}} = -1.5 \text{ m/s}$$

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

Significant Figures Exercise

A car travels from $x = -70 \text{ km}$ to $x = -57 \text{ km}$ in 7 minutes .
What is the car's average velocity, in kilometers per minute,
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(a)
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$$\frac{5 \text{ cm}}{\text{s}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{60 \text{ s}}{1 \text{ h}} = 118 \text{ in}/\text{hr}$$

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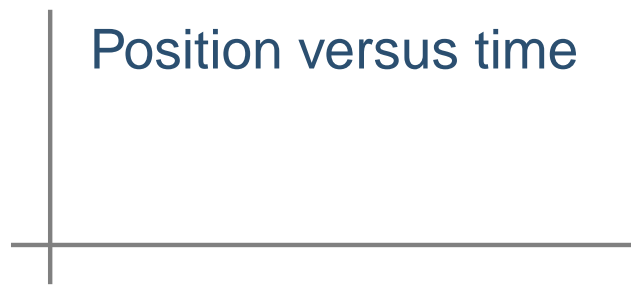
Instantaneous velocity v_x - how fast and the direction of motion for one instant of time.

Motion Graphs

Physicists like to make graphs to describe motion.

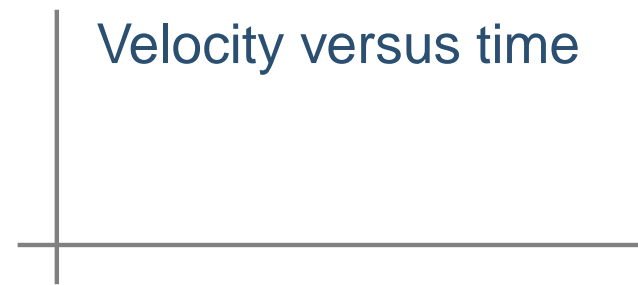
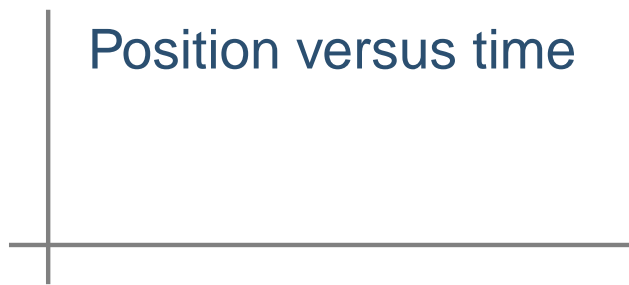
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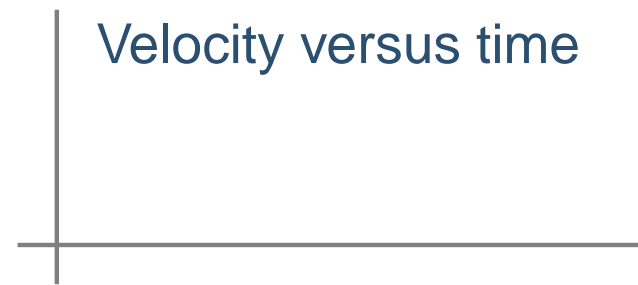
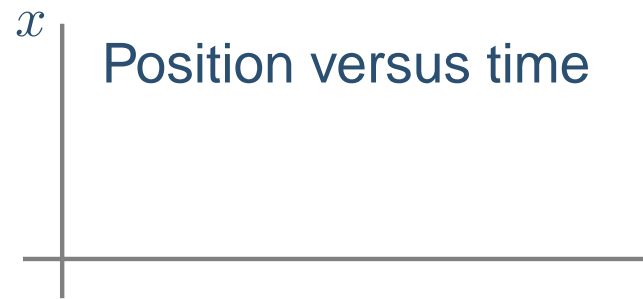
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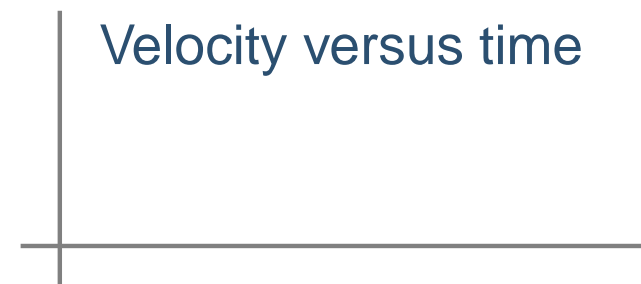
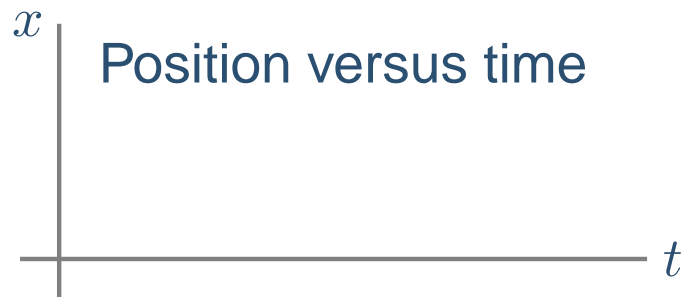
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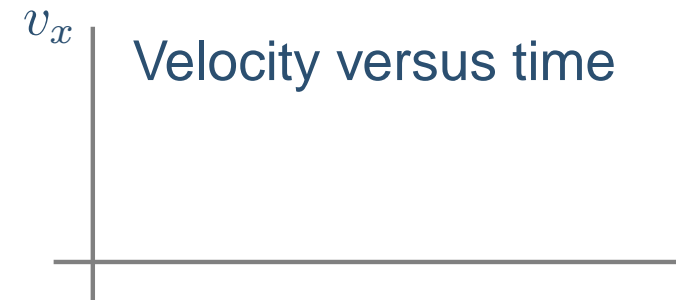
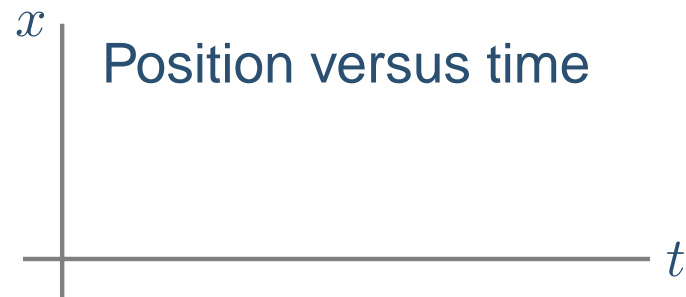
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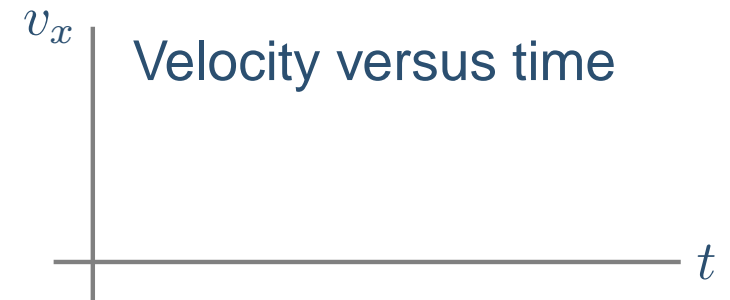
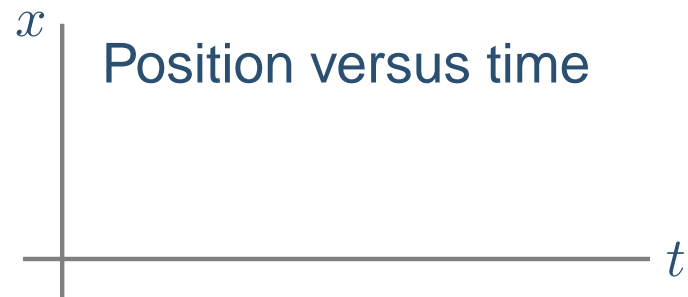
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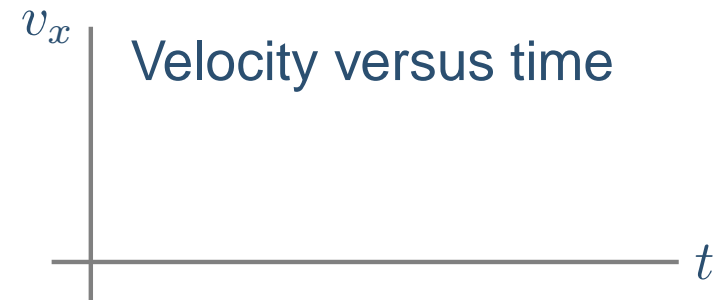
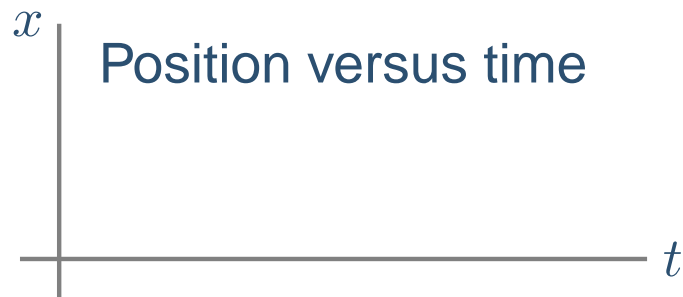
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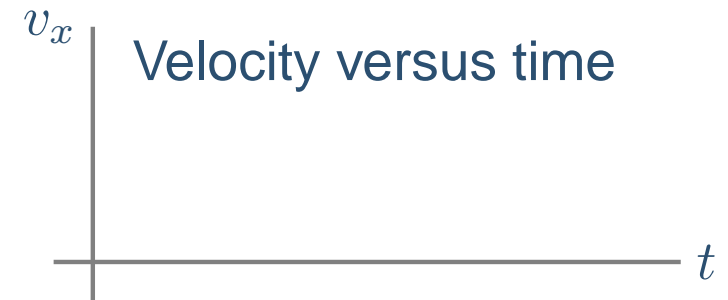
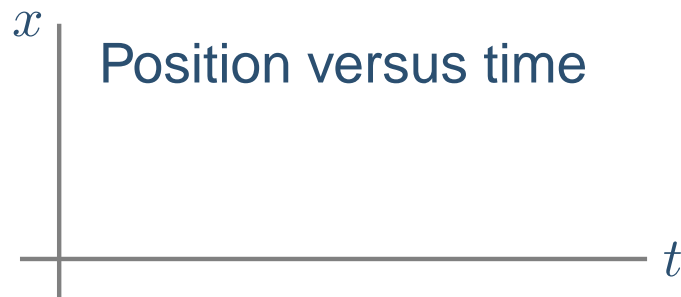
Horizontal Motion



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Horizontal Motion

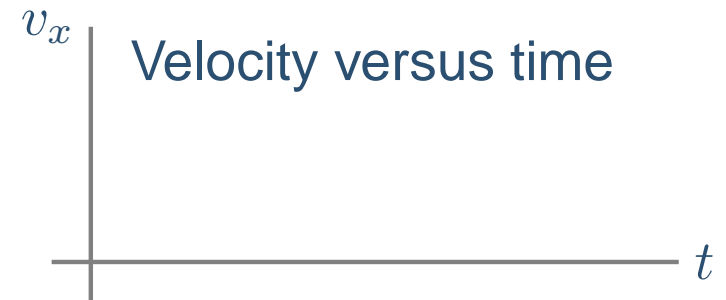
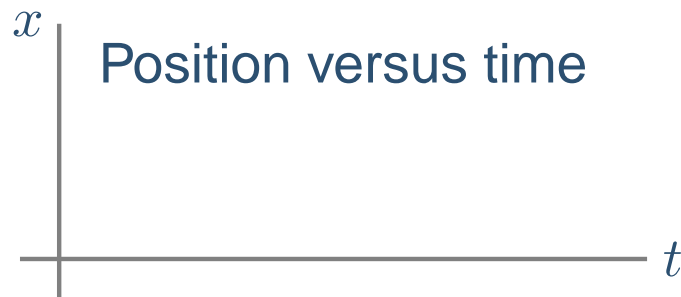


Vertical Motion

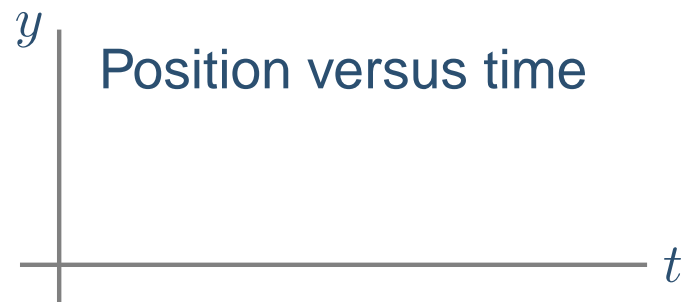
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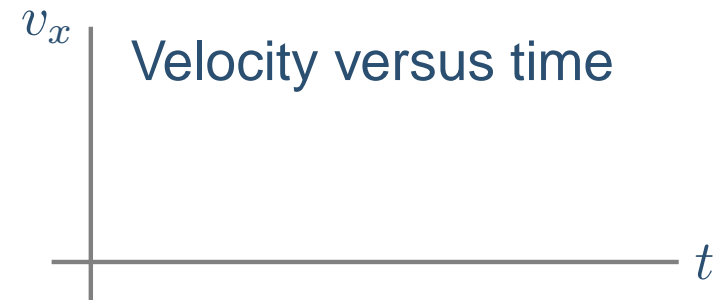
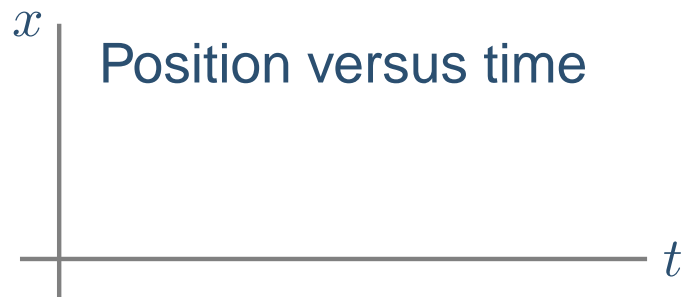
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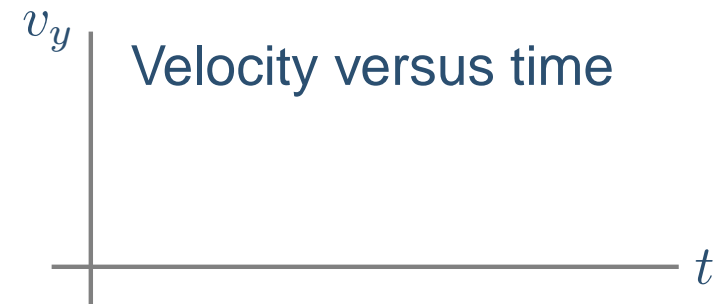
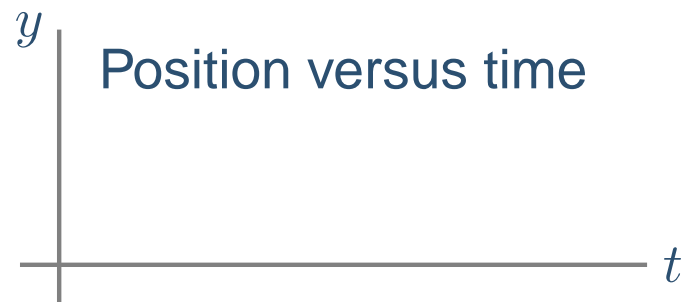
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Horizontal Motion



Vertical Motion



Uniform Motion Position Graph

Uniform Motion - Constant velocity

Uniform Motion Position Graph

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Walking to right motion diagram:

Uniform Motion Position Graph

Uniform Motion - Constant velocity

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Uniform Motion Position Graph

Uniform Motion - Constant velocity

Walking to right motion diagram: 

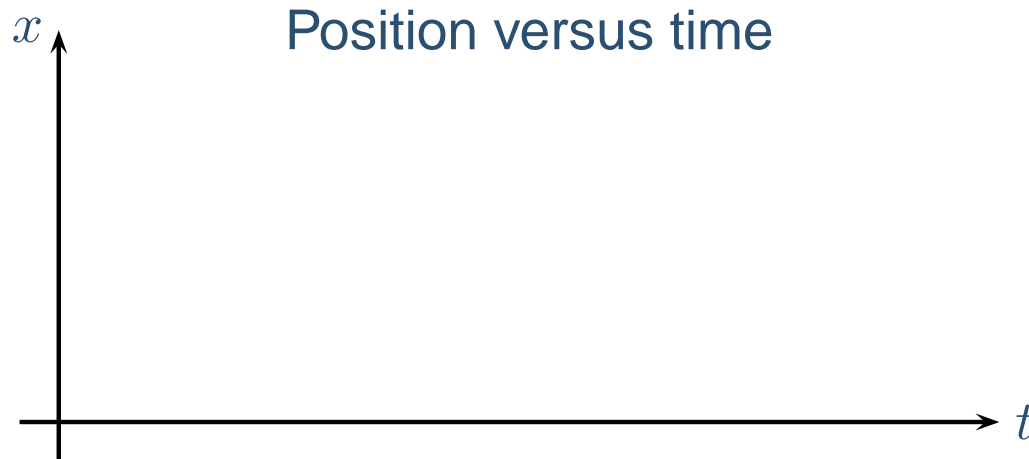
Equal spacing between dots because with constant velocity the object travels the same distance during equal elapsed times.

Uniform Motion Position Graph

Uniform Motion - Constant velocity

Walking to right motion diagram: ● → ● → ● → ●

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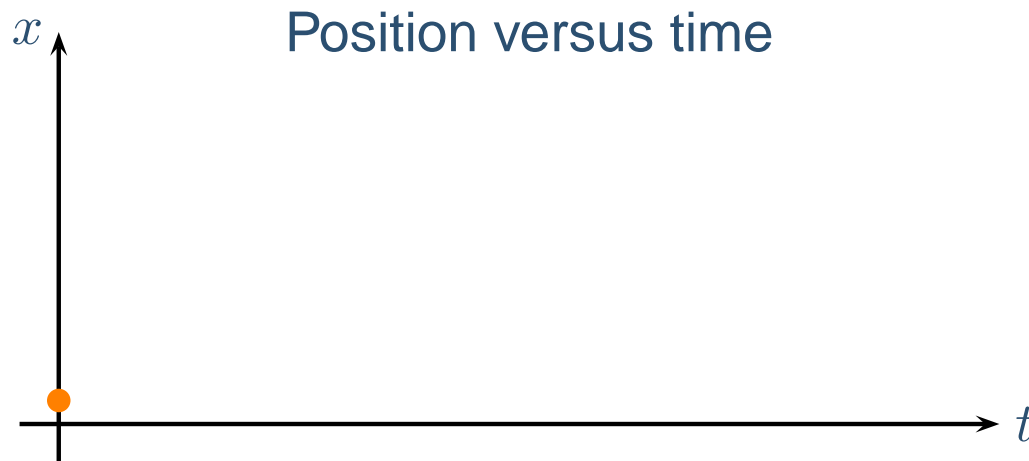


Uniform Motion Position Graph

Uniform Motion - Constant velocity

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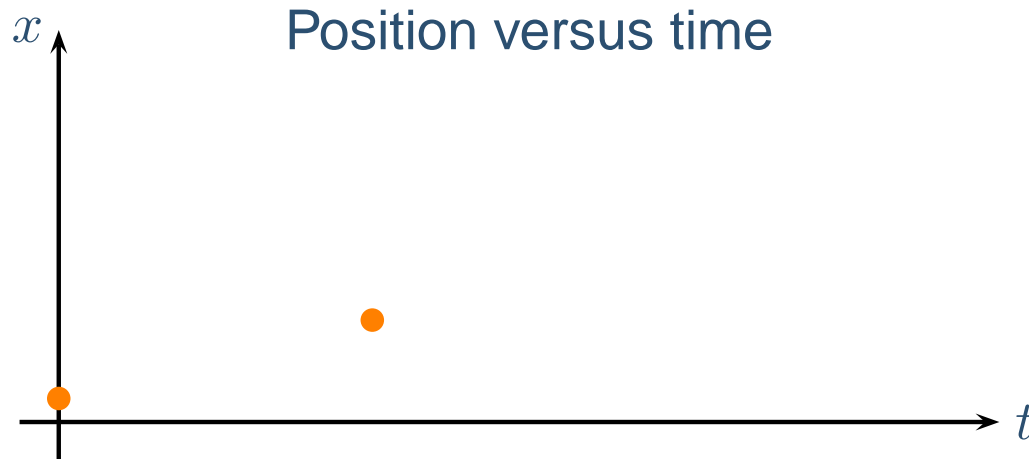


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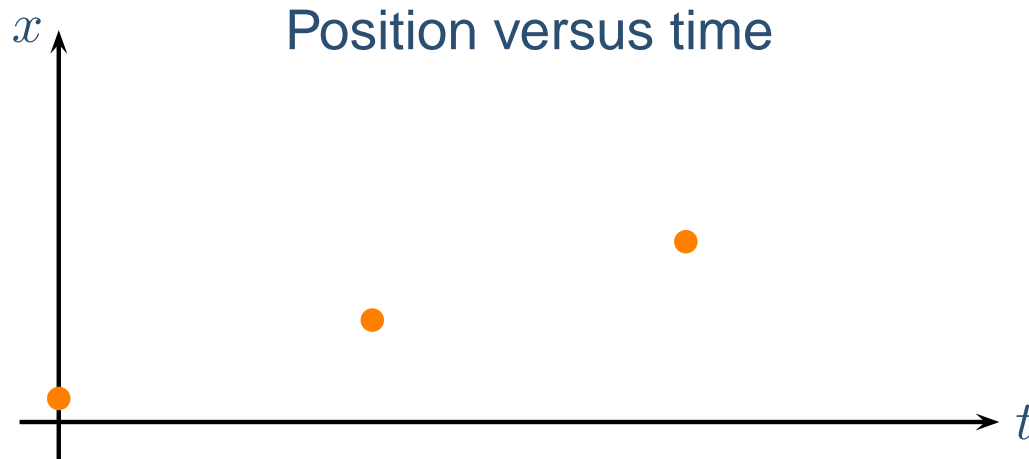


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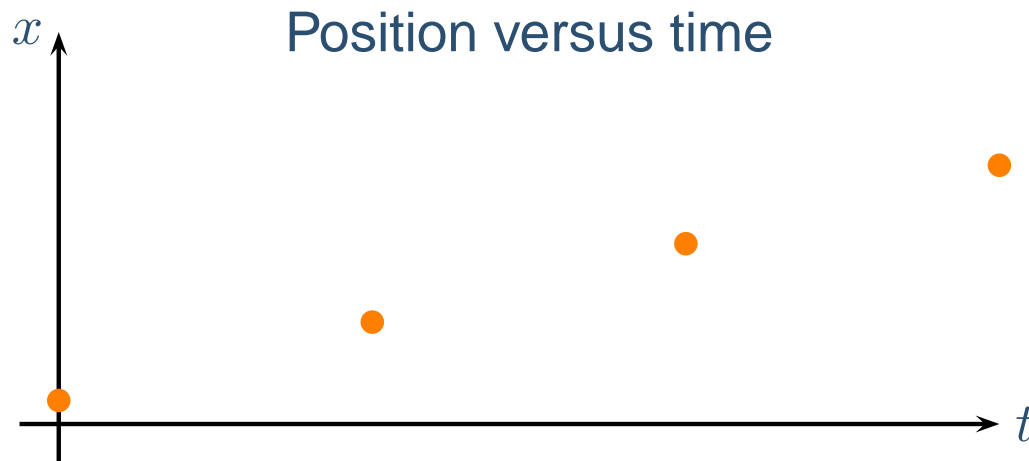


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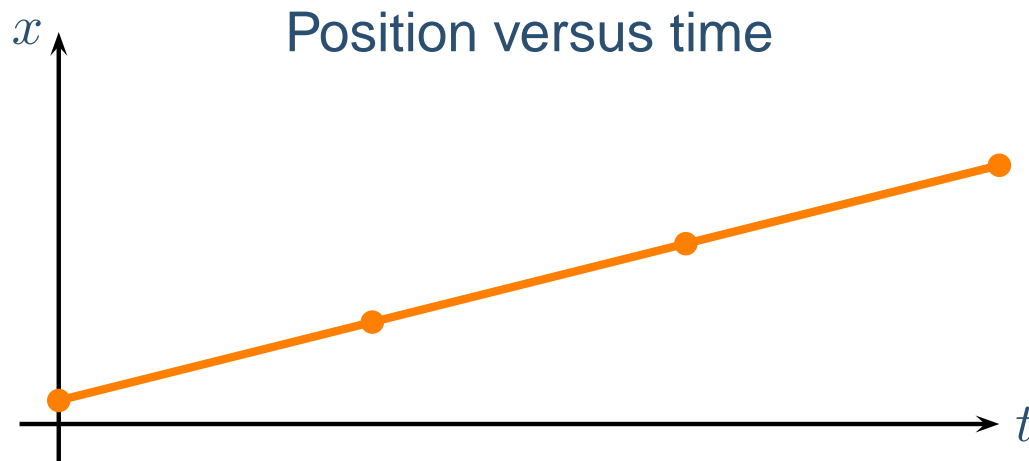


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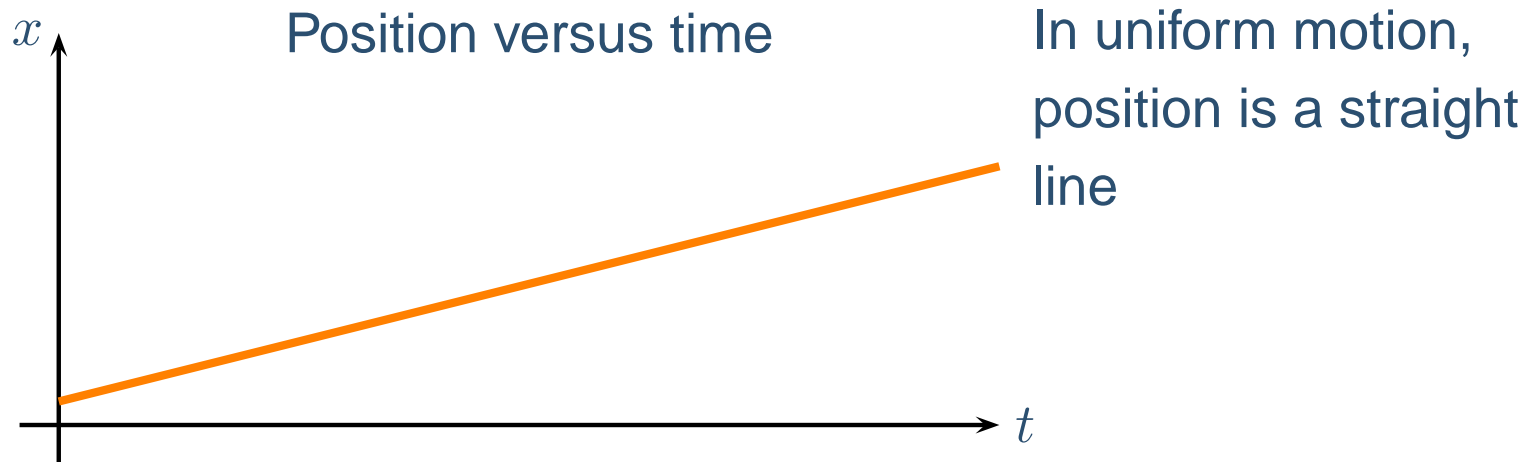


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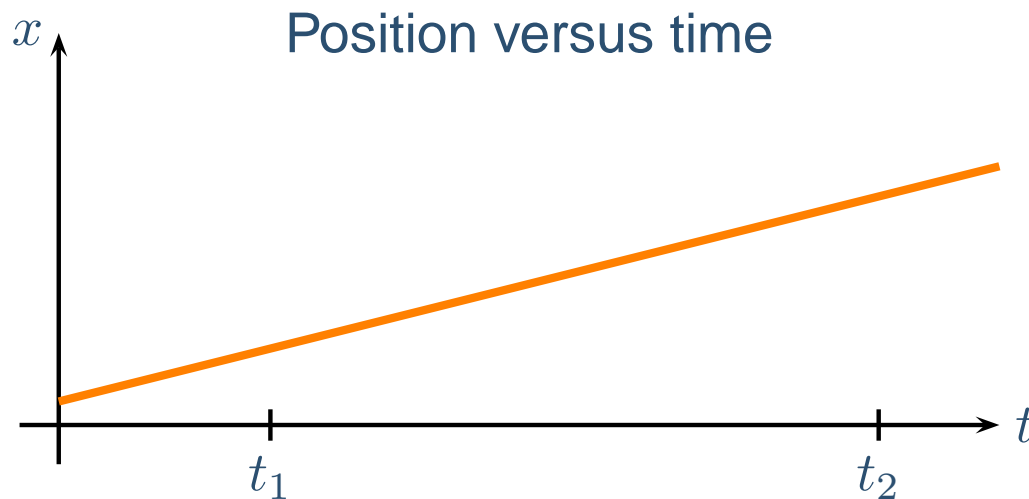


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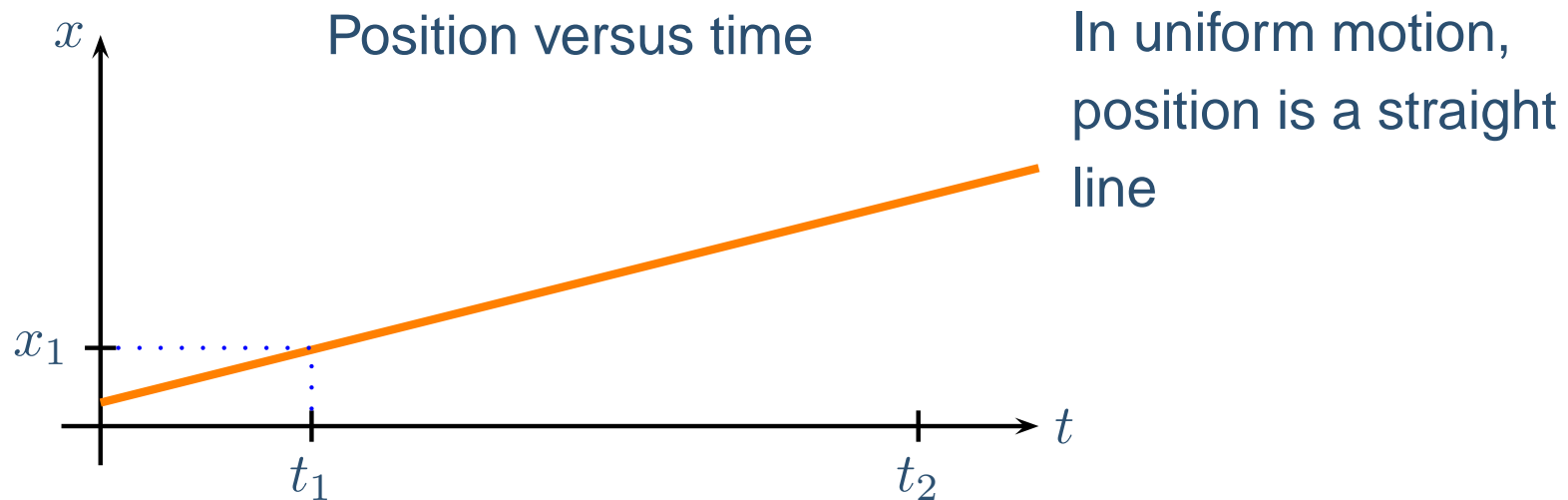


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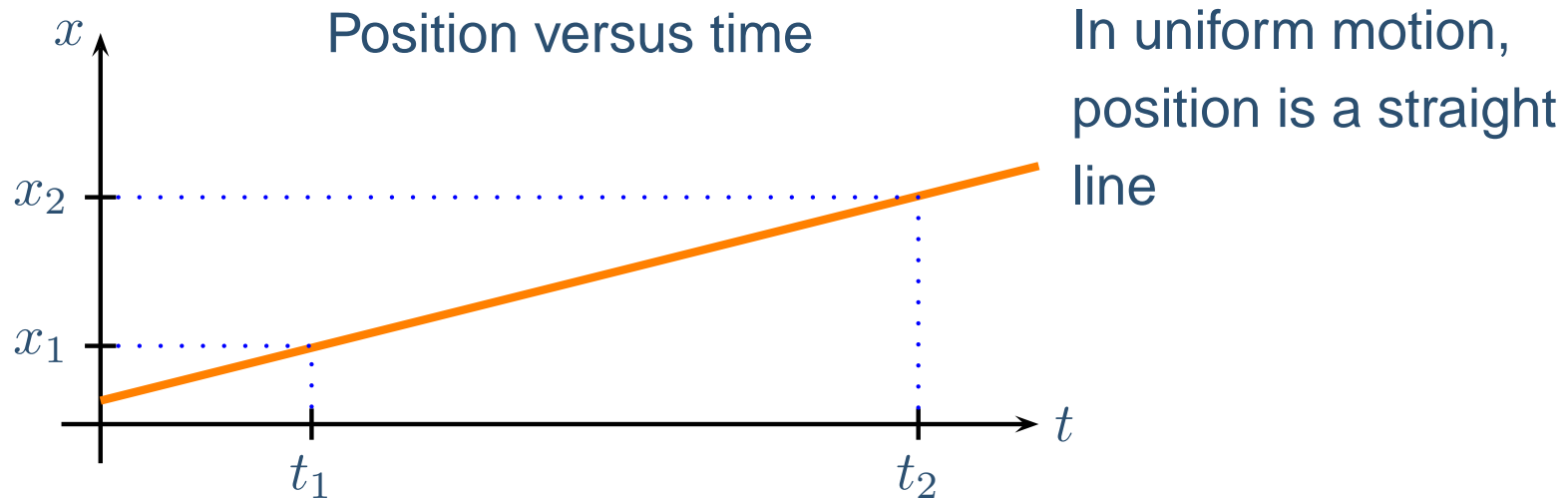


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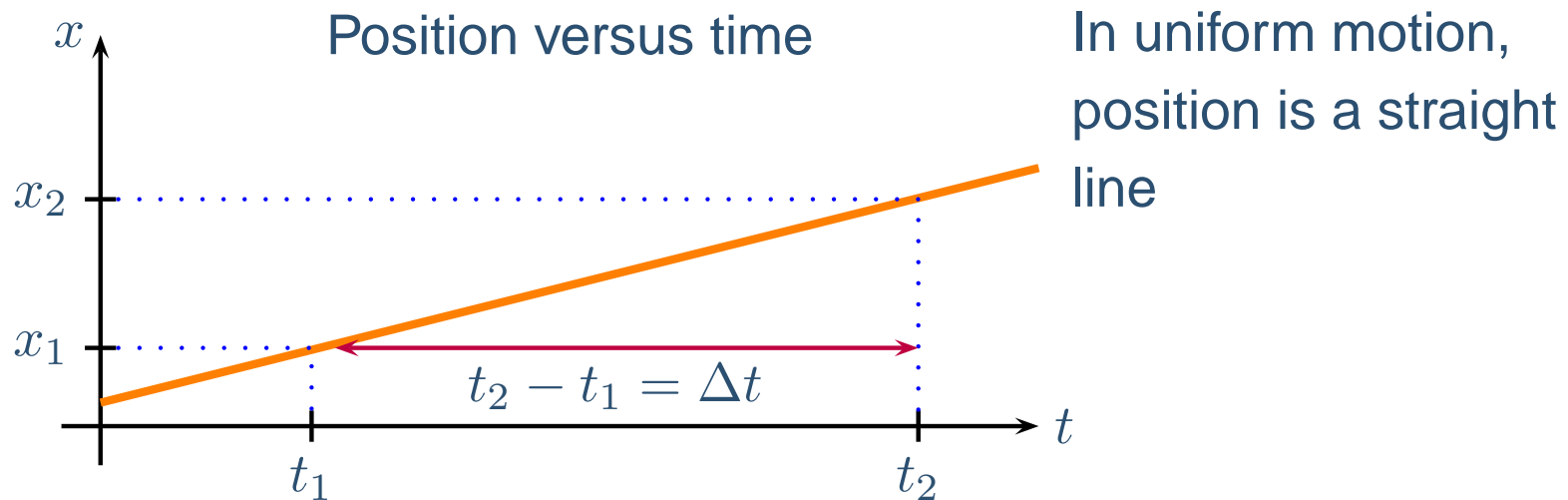


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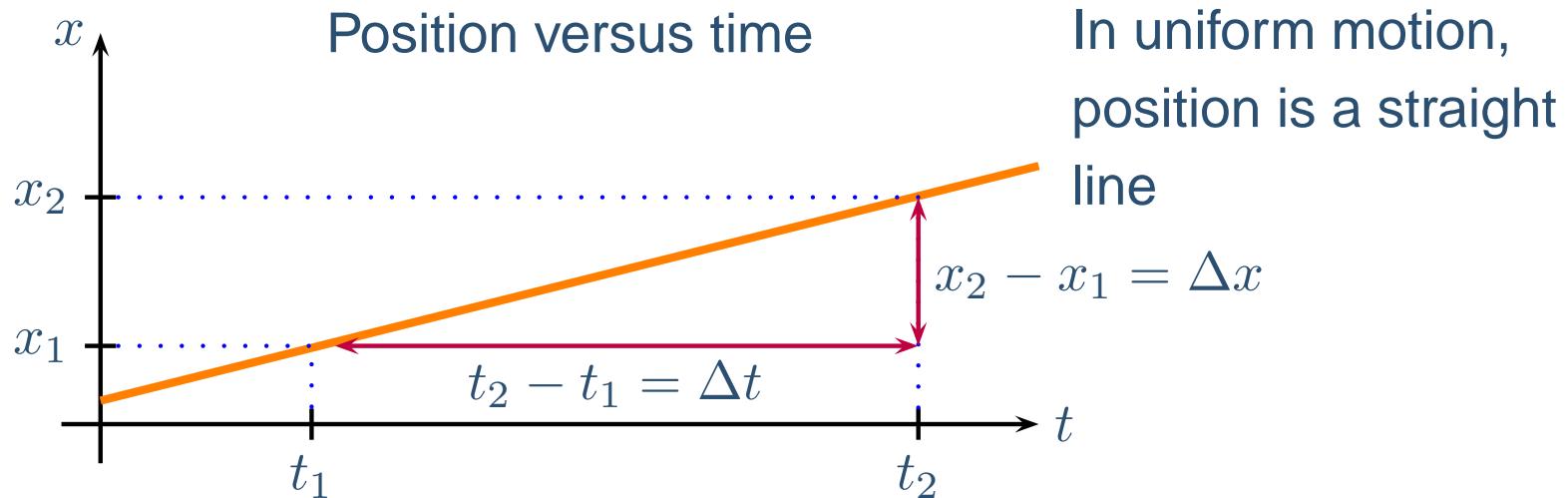


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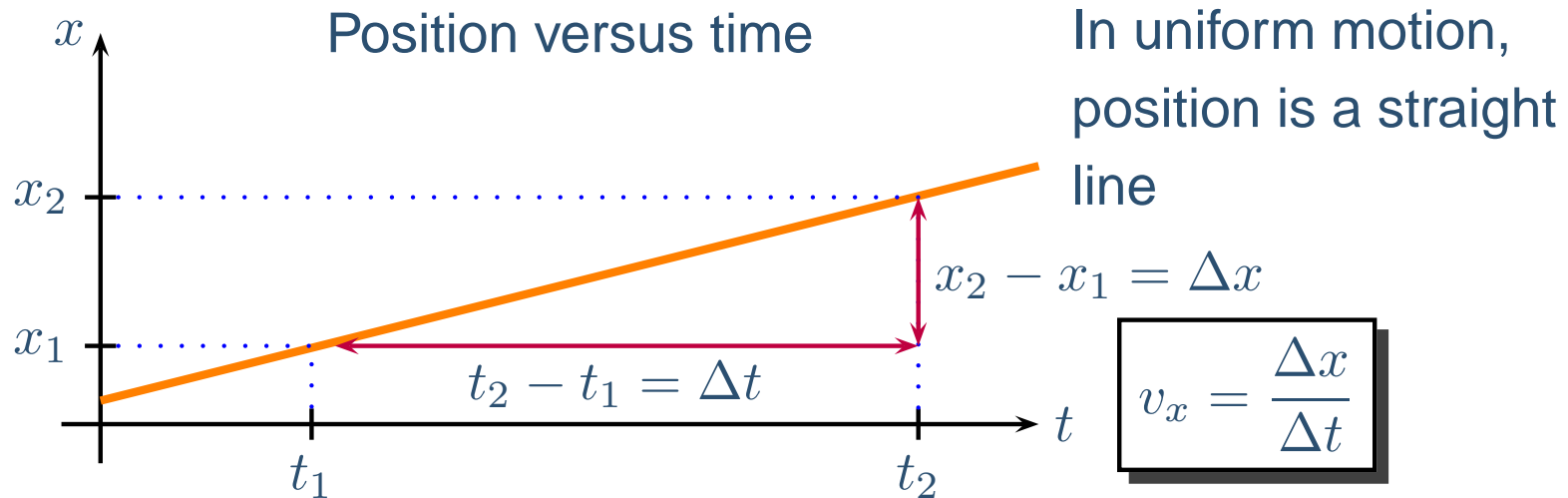


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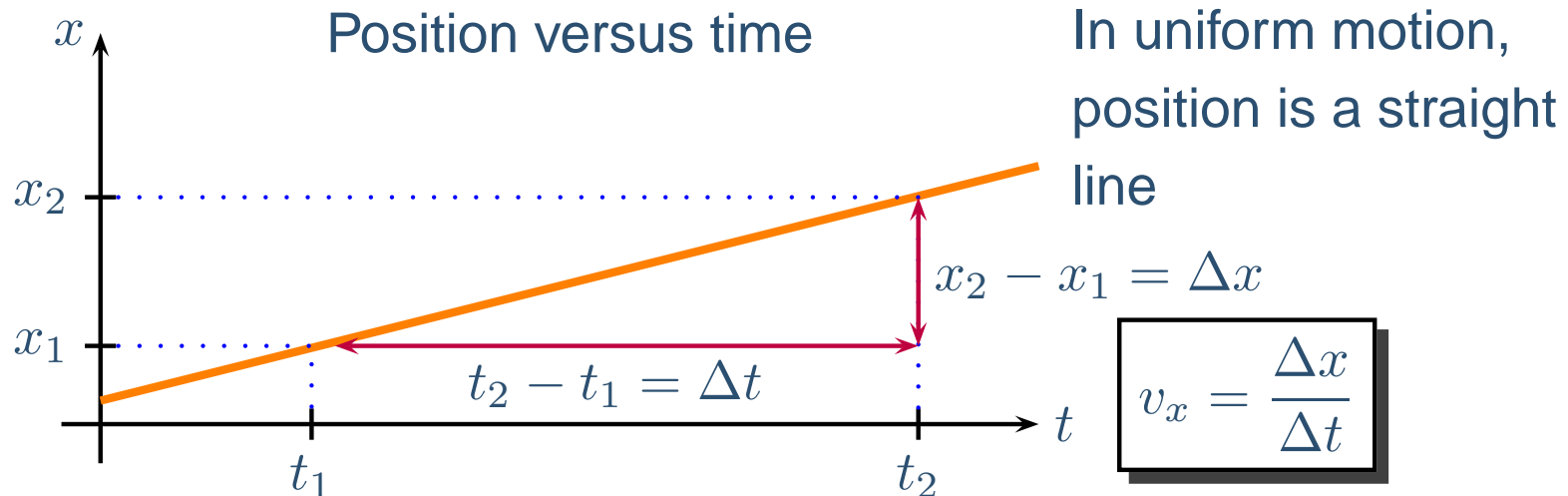


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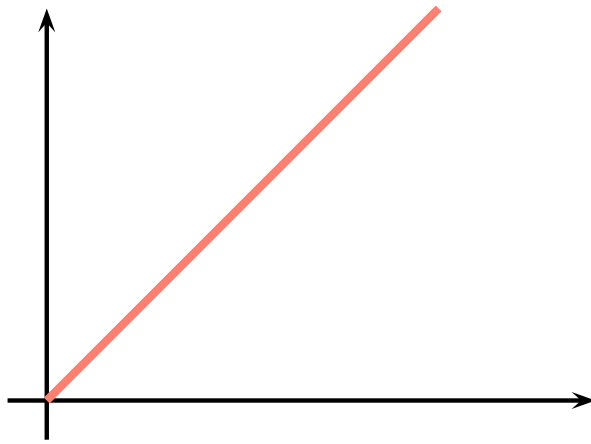
Velocity is the slope of the position versus time graph

Math and Physics Slopes

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

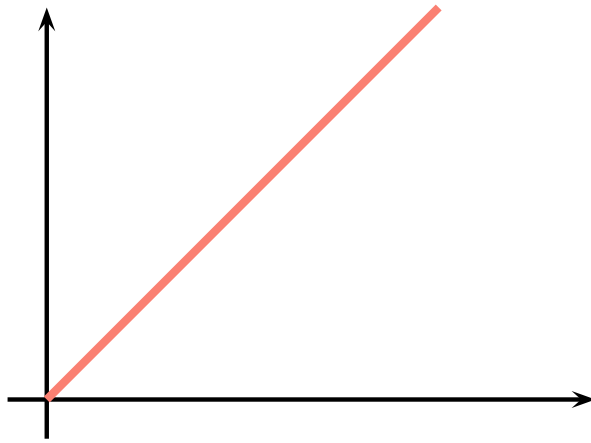
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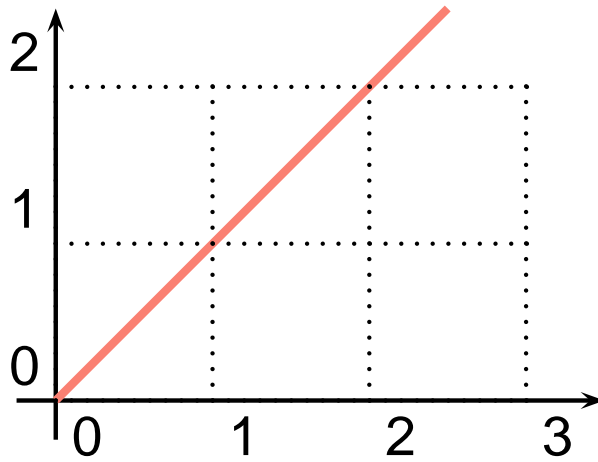
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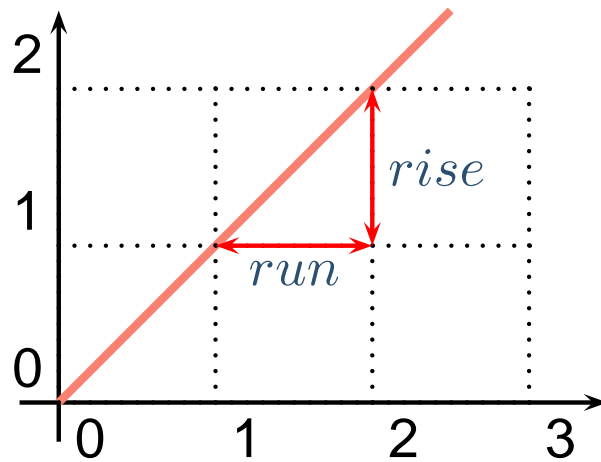
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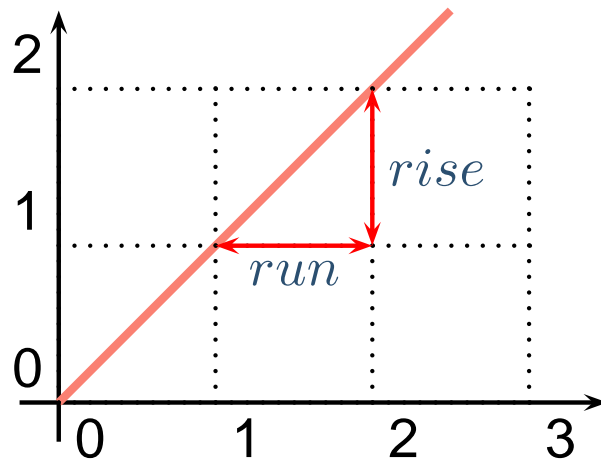
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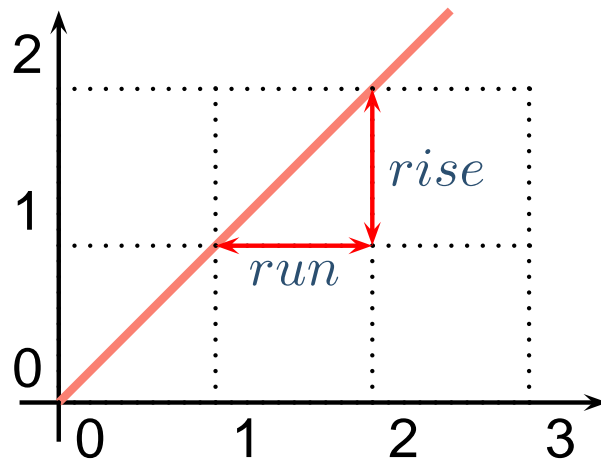


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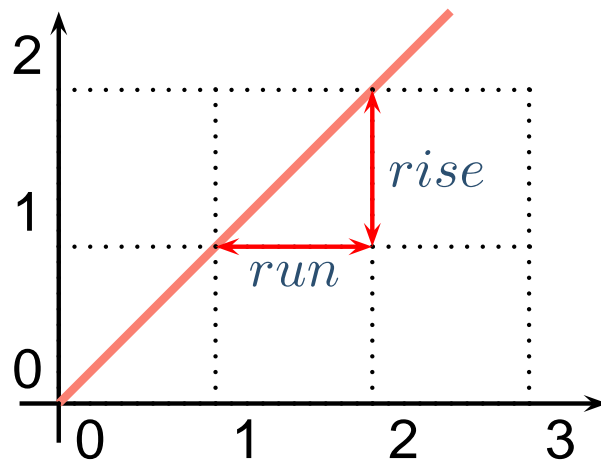
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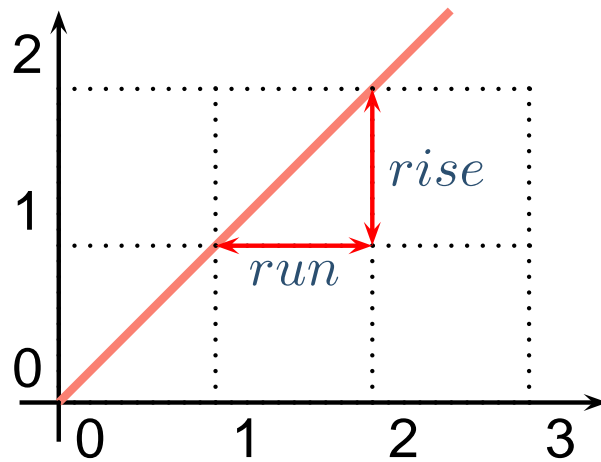
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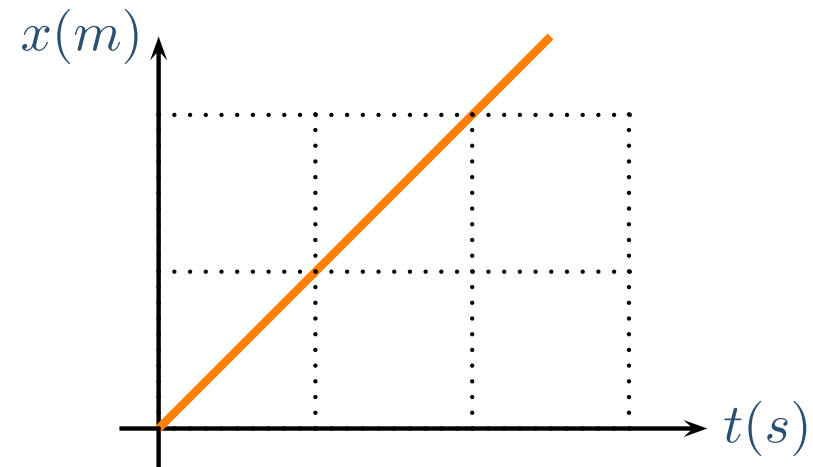
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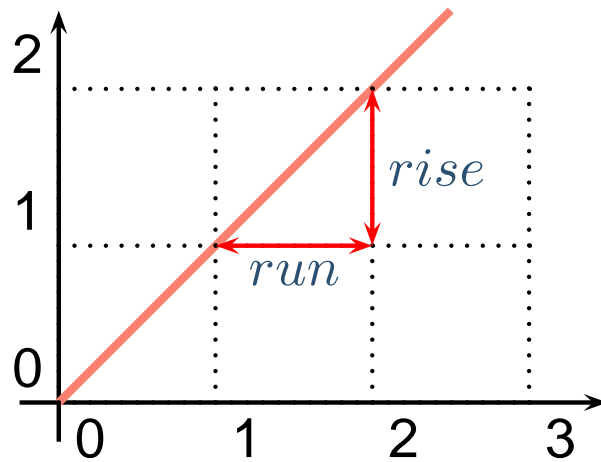
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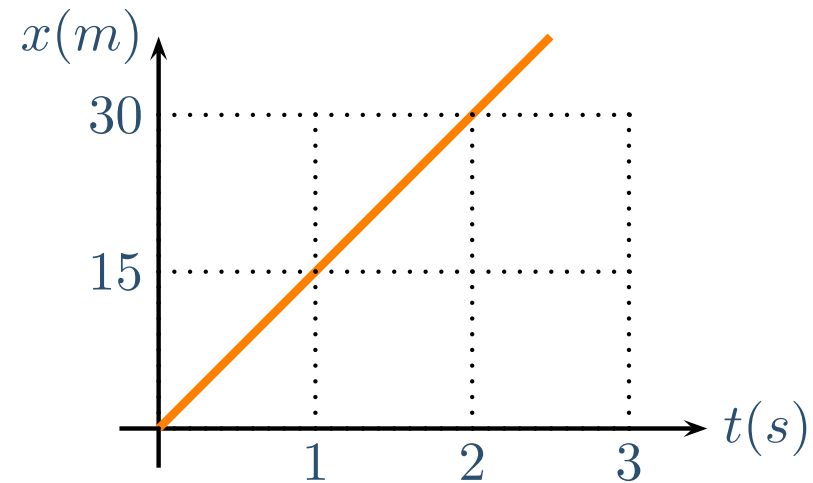
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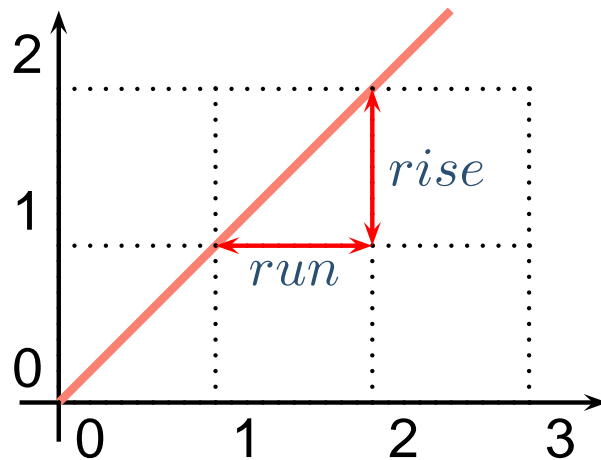
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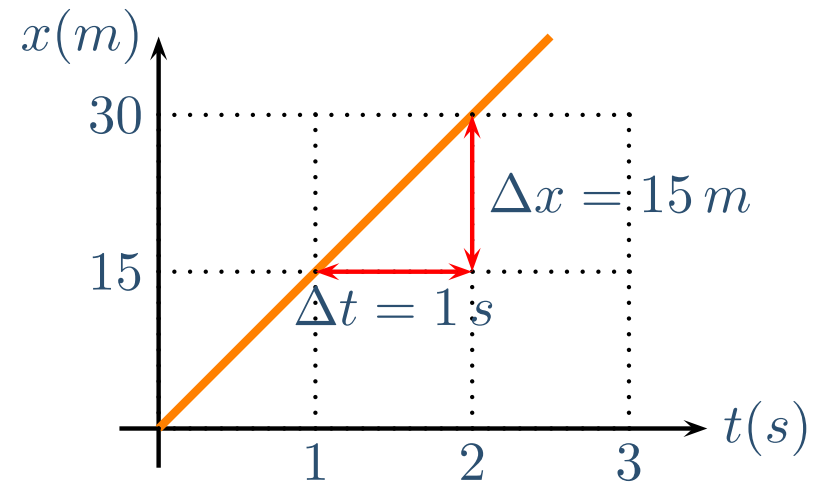
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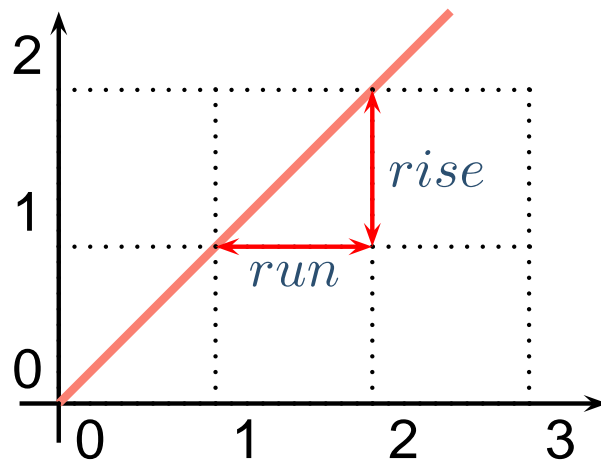
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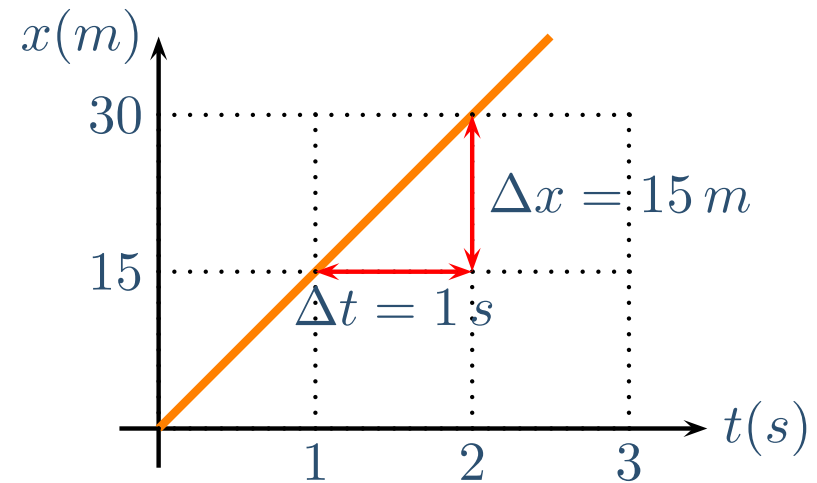
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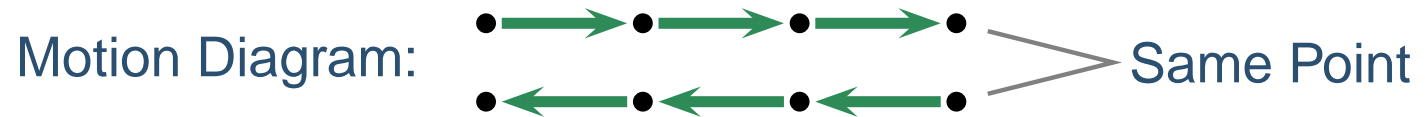


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$$\text{Slope = Velocity: } v_x = \frac{\Delta x}{\Delta t} = \frac{15 \text{ m}}{1 \text{ s}} = 15 \text{ m/s}$$

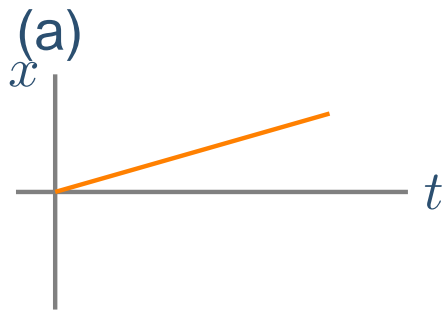
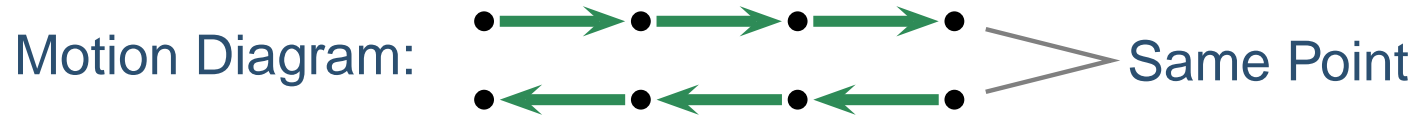
Position Graph Exercise

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?



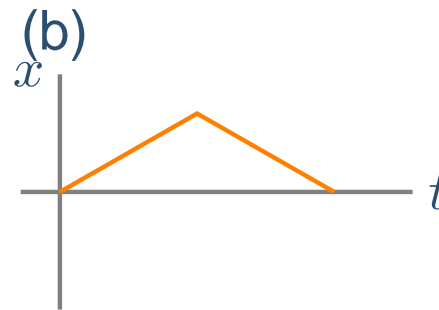
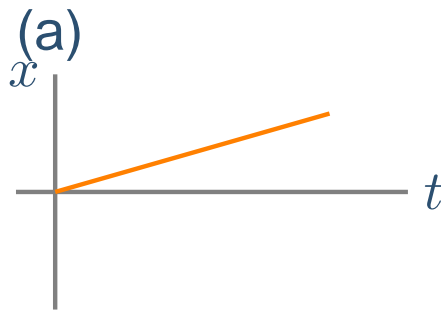
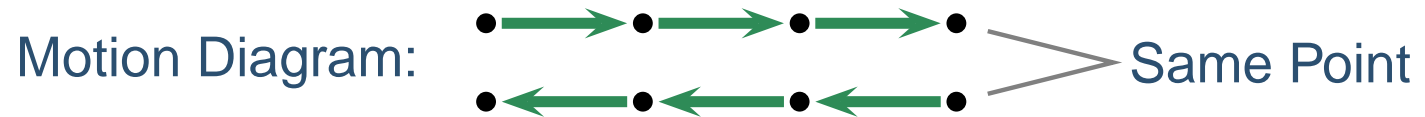
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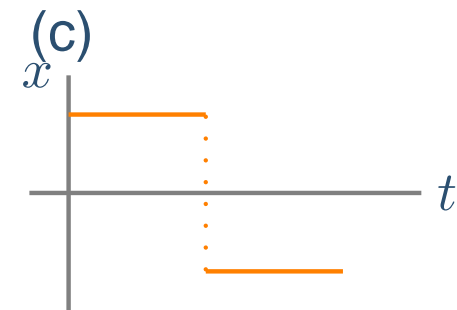
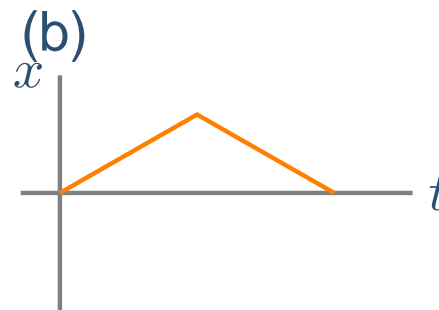
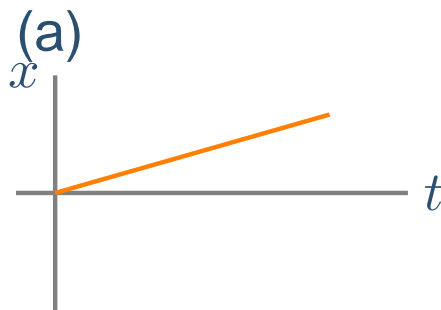
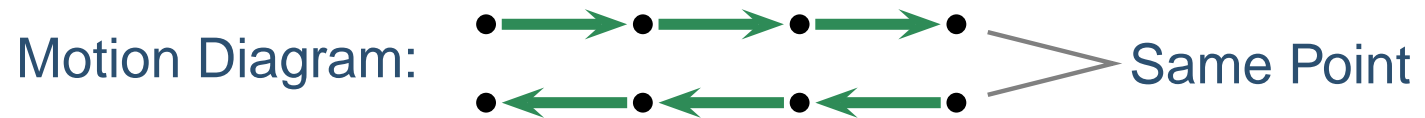
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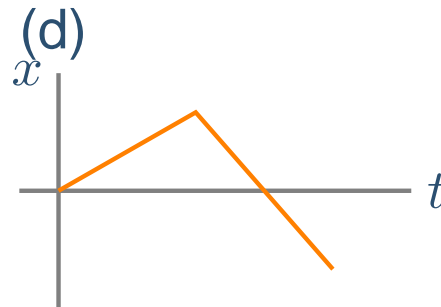
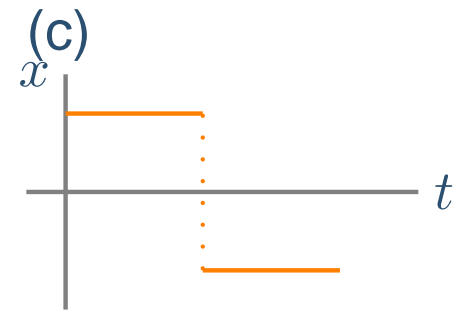
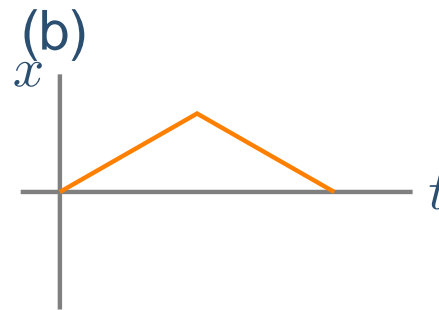
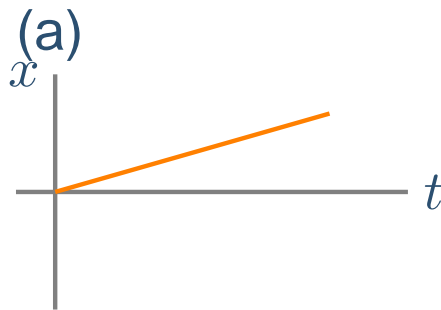
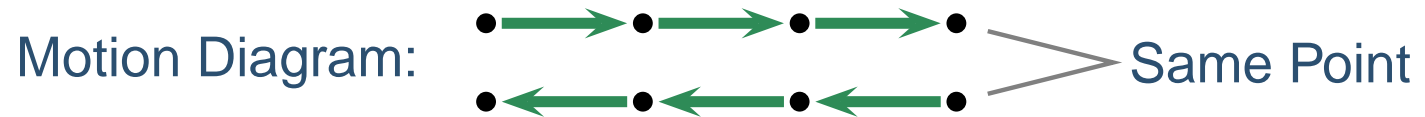
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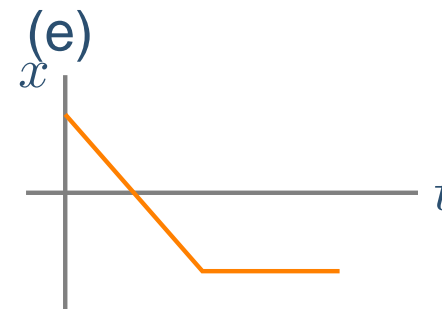
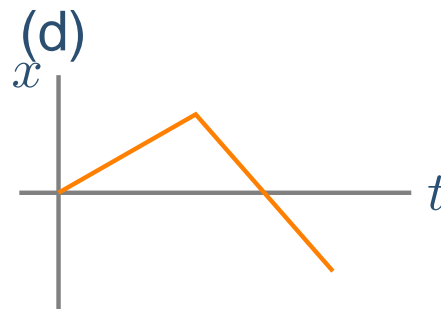
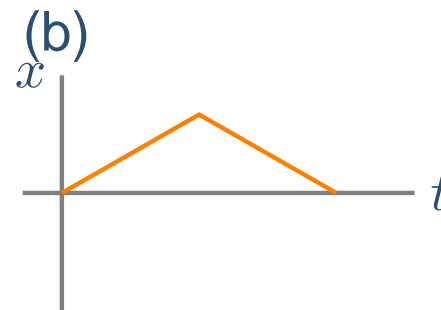
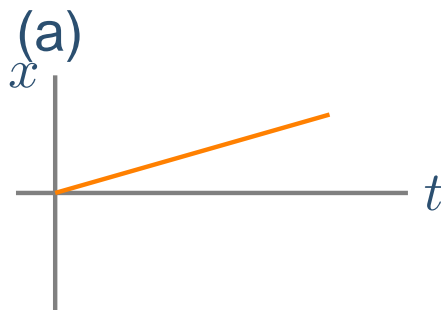
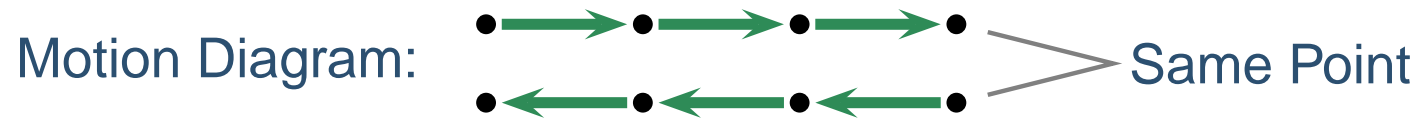
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