Fun Physics Fact of the Day

The average speed of a molecule in our atmosphere is:

$$450 \text{ m/s}$$

Or....

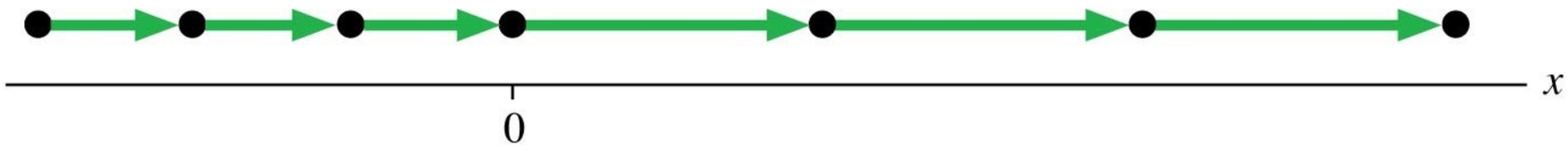
$$\approx 1000 \text{ mph}$$

A collision with another molecule happens every

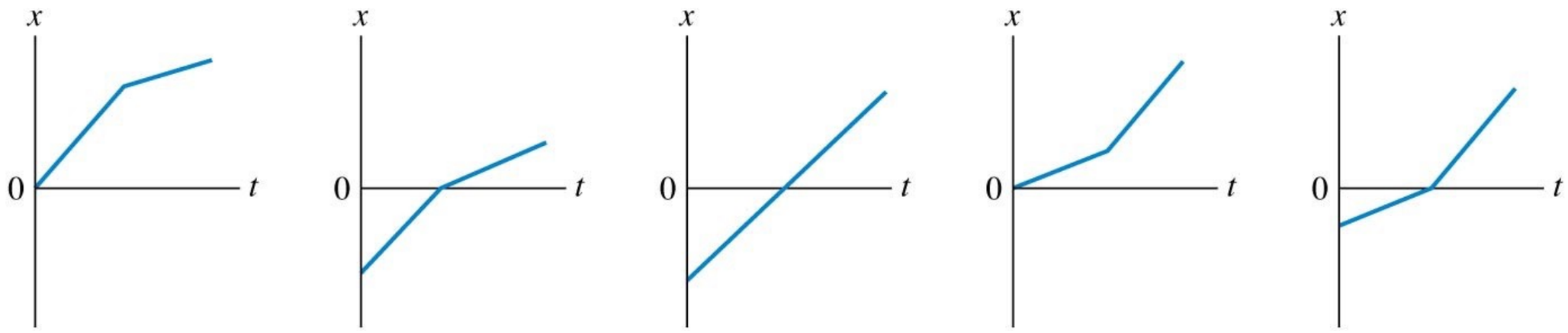
$$2.36 \times 10^{-7} \text{ s}$$

Question #1

Here is a motion diagram of a car moving along a straight road:



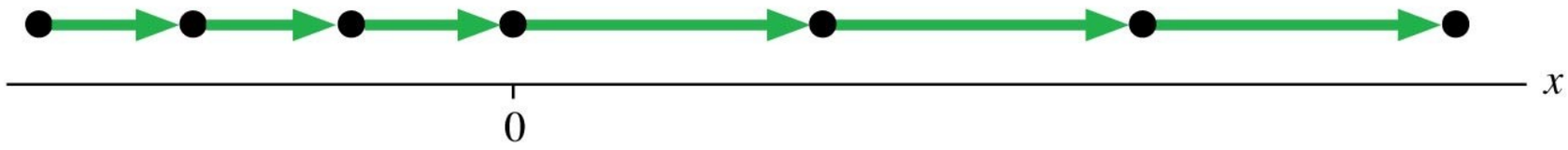
Which **position-versus-time** graph matches this motion diagram?



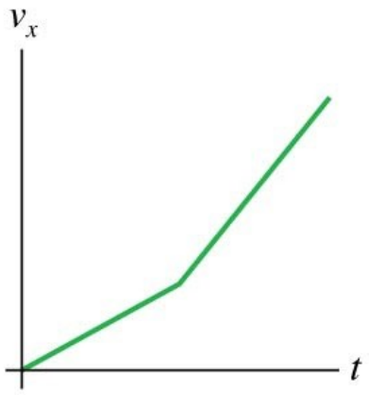
C D A B E

Question #2

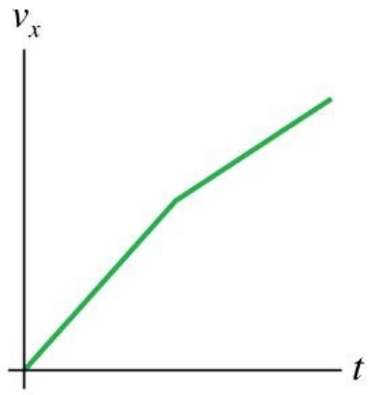
Here is a motion diagram of a car moving along a straight road:



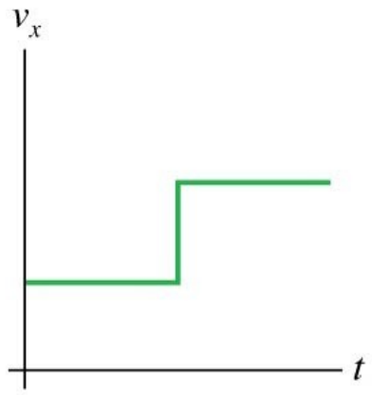
Which **velocity-versus-time** graph matches this motion diagram?



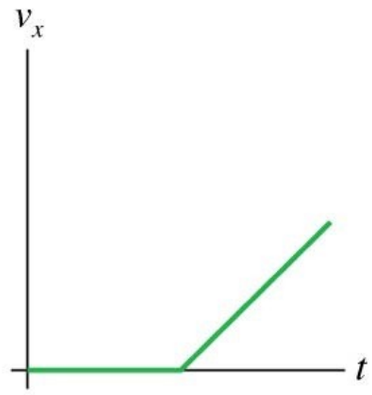
C



B



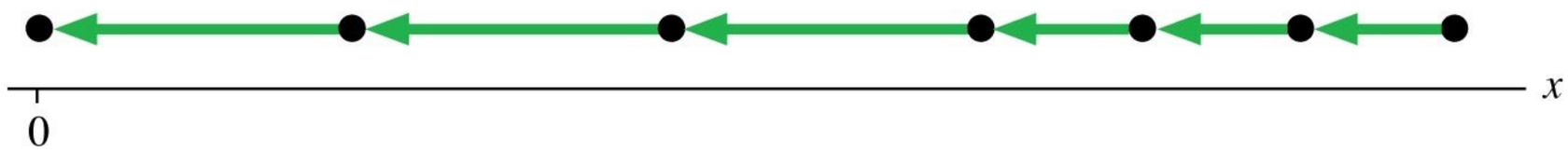
A



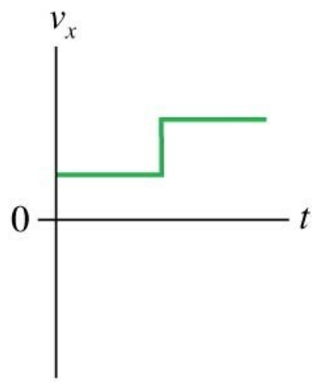
E

Question #3

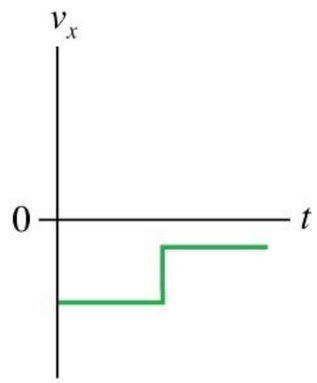
Here is a motion diagram of a car moving along a straight road:



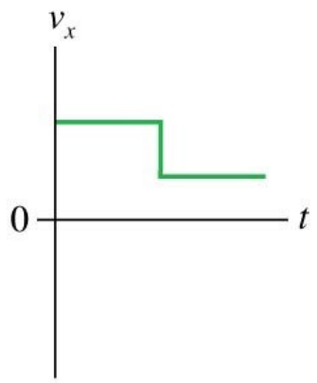
Which **velocity-versus-time** graph matches this motion diagram?



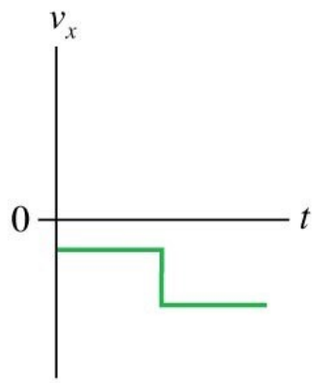
D



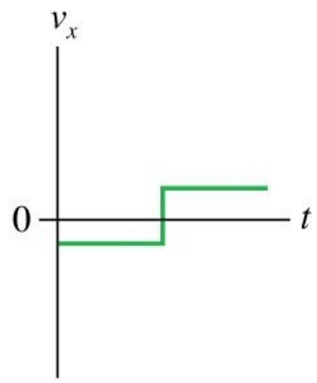
B



A



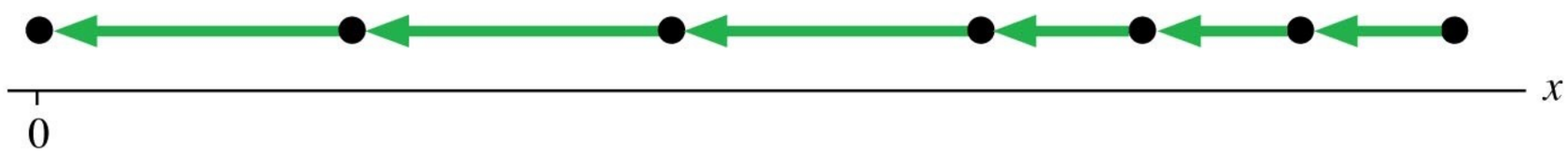
C



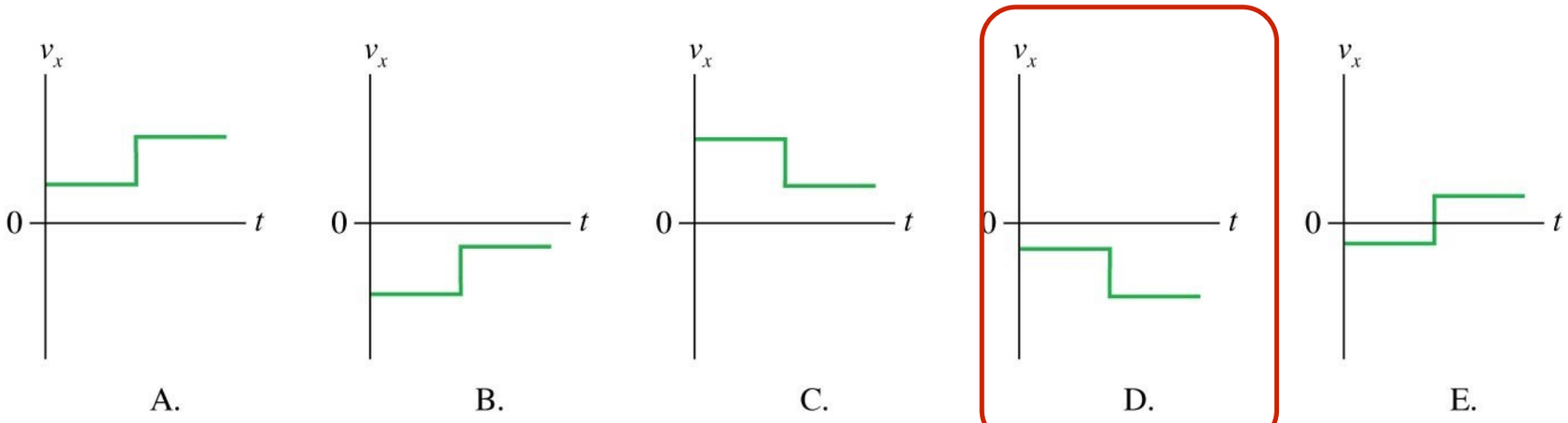
E

Quiz

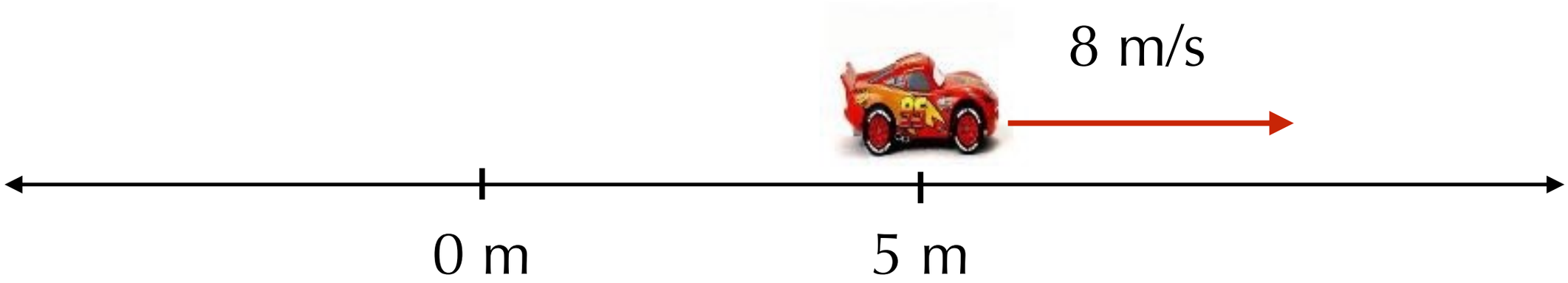
Here is a motion diagram of a car moving along a straight road:



Which velocity-versus-time graph matches this motion diagram?



You notice Lightning Mcqueen traveling to the right at a constant speed of 8 m/s. When you first notice him, he is located 5 m to the right of where you are standing. What function would you use to find Mcqueen's position/ velocity at a future time? Can you draw a picture of these functions? Motion diagram?



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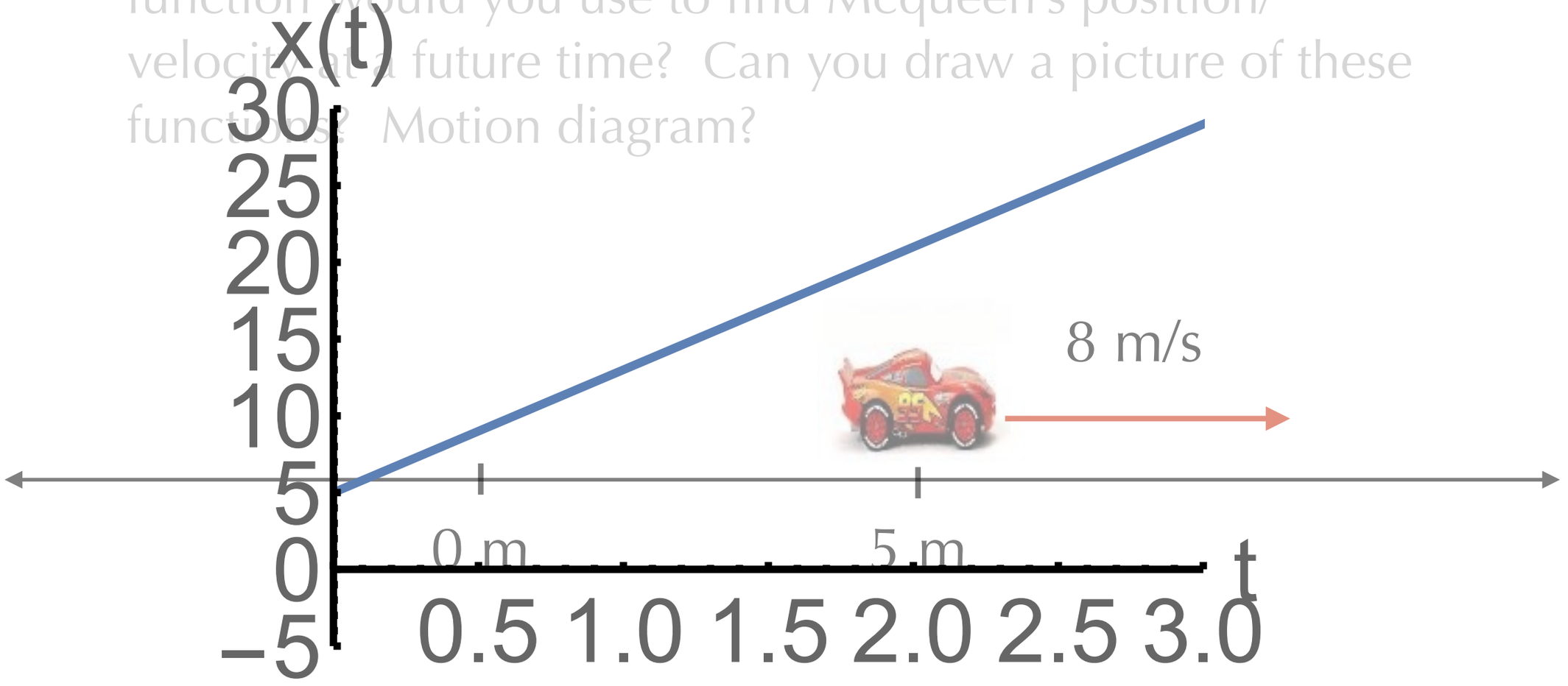

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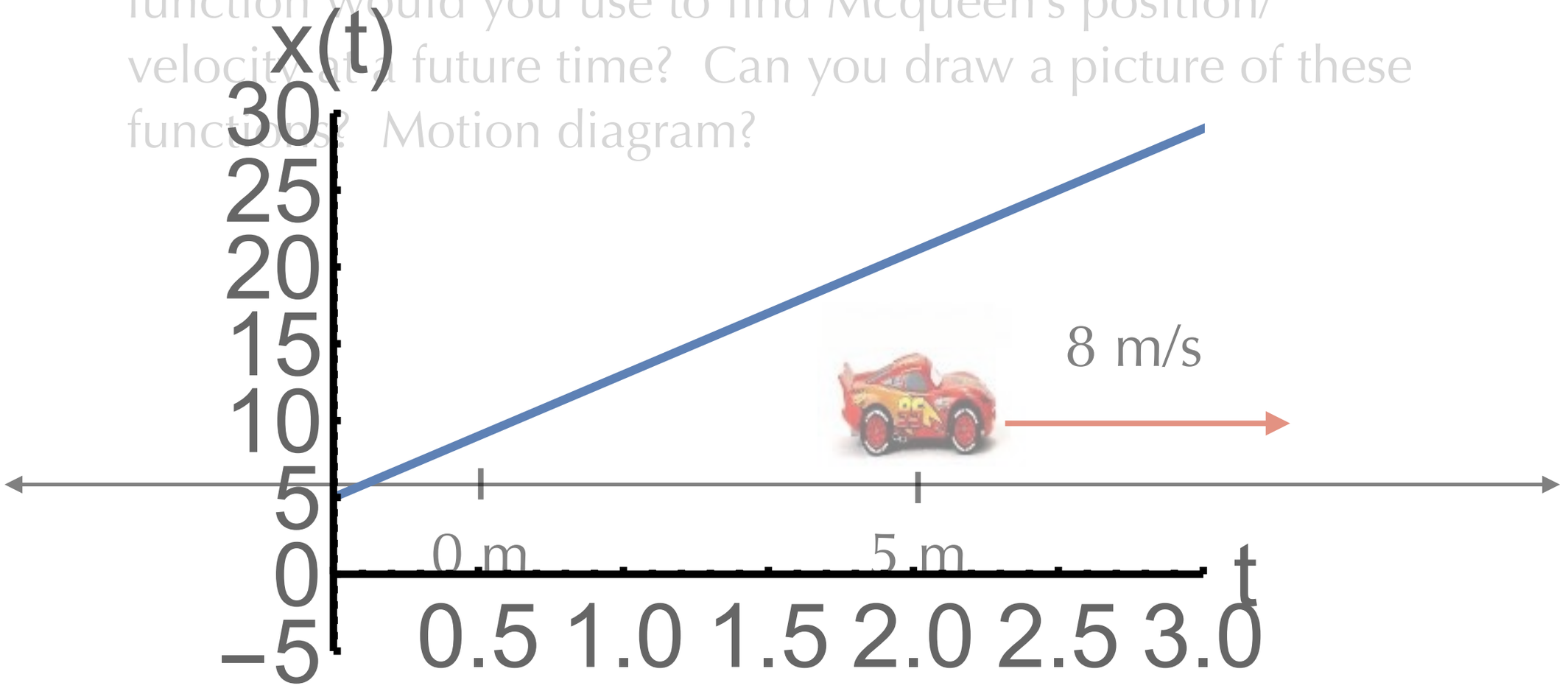

$$x(t) = x_i + v\Delta t$$

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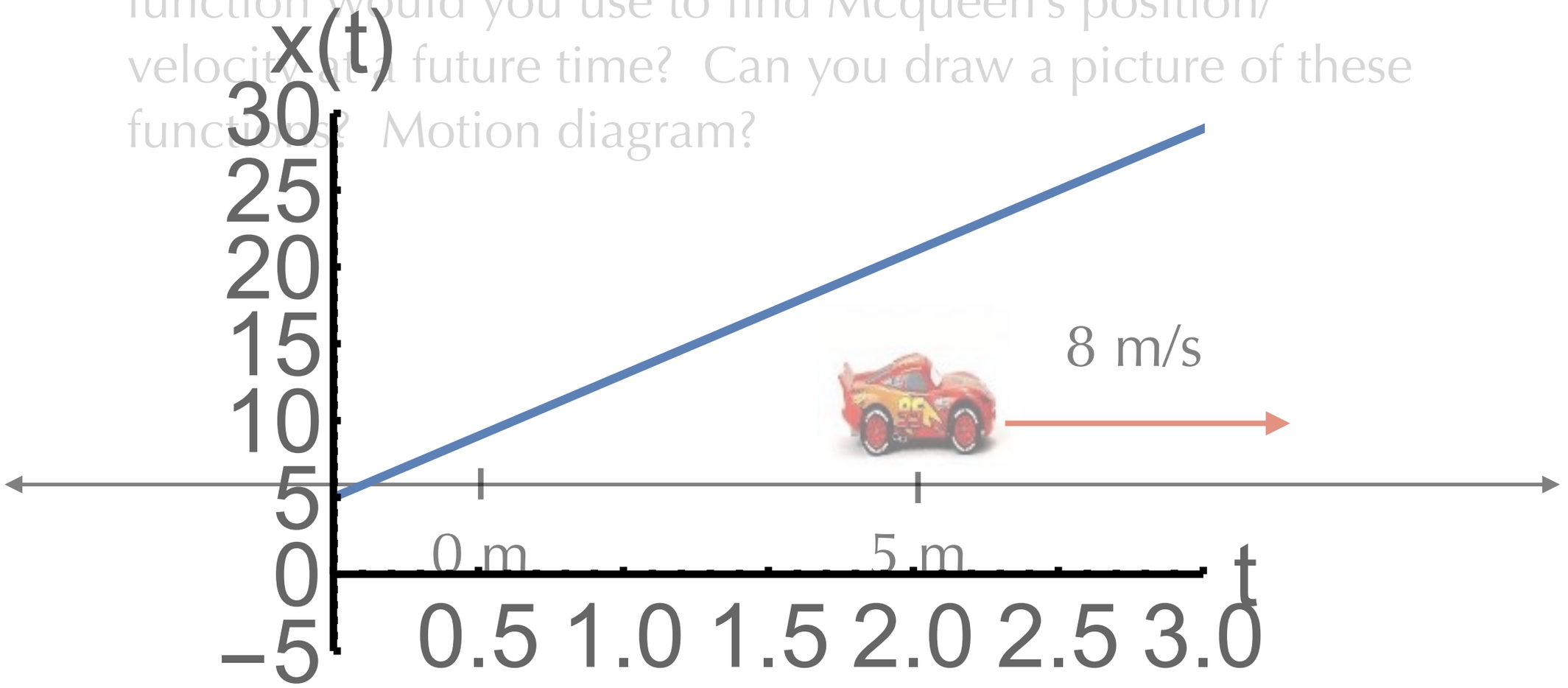


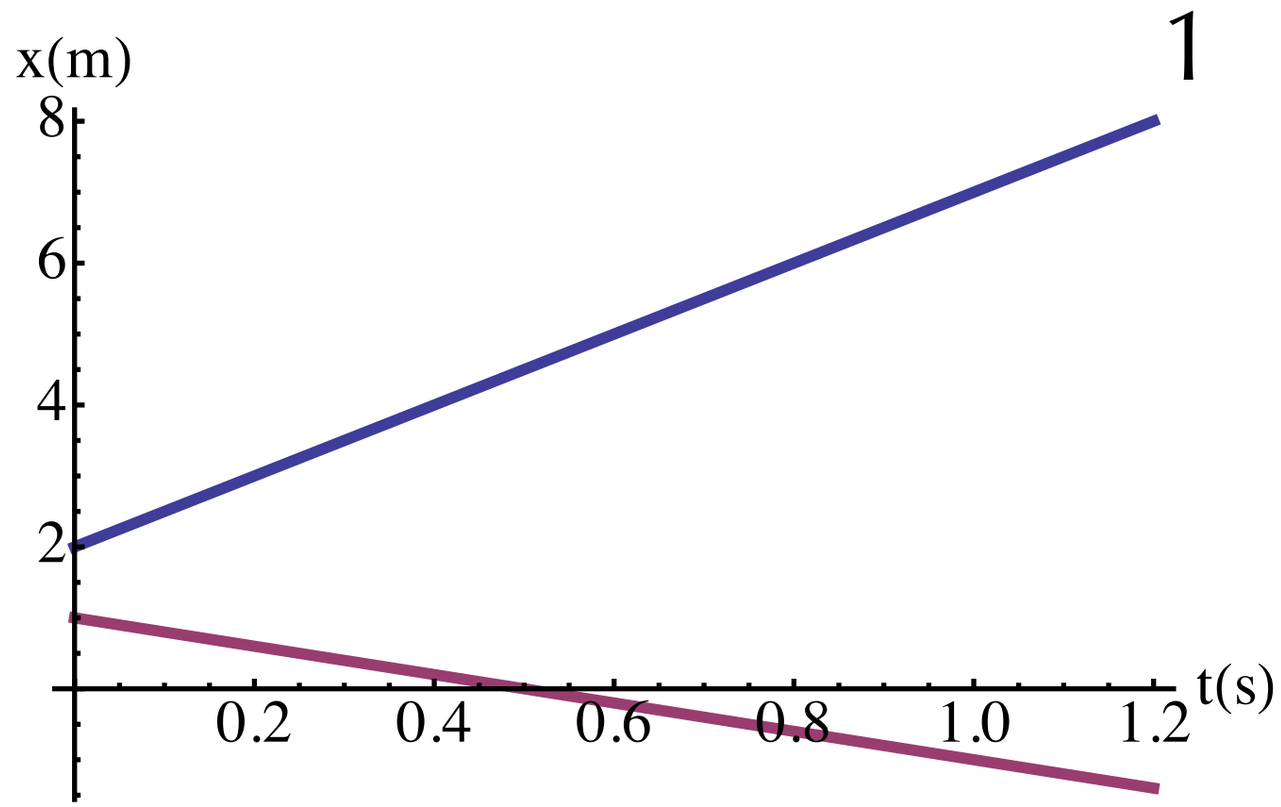
$$x(t) = x_i + v\Delta t$$

$$x(t) = 5 + 8t$$

Question #4

Consider the position vs. time graphs below

Which object has the larger **speed**?

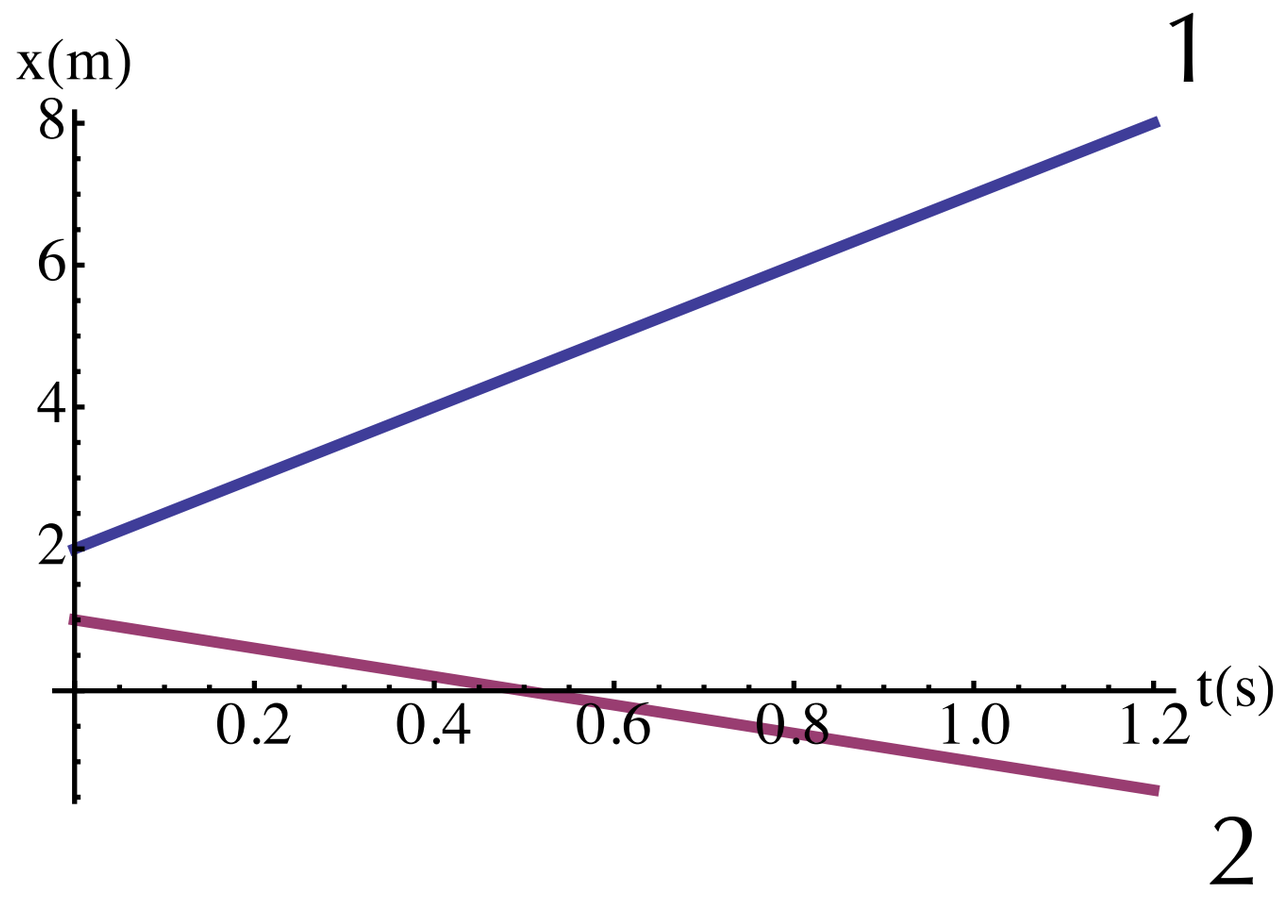


c) object 2
d) object 1
e) They both have the same speed.

Question #5

Consider the position vs. time graphs below

For which object does the velocity vector point in the negative direction? (leftward)

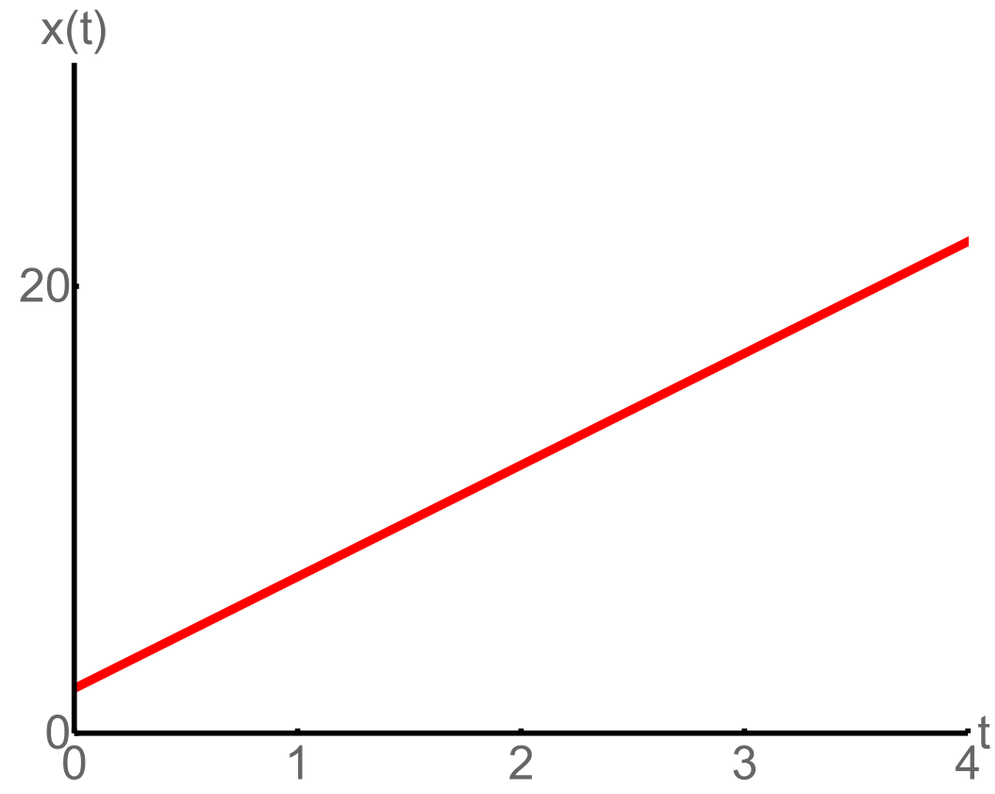


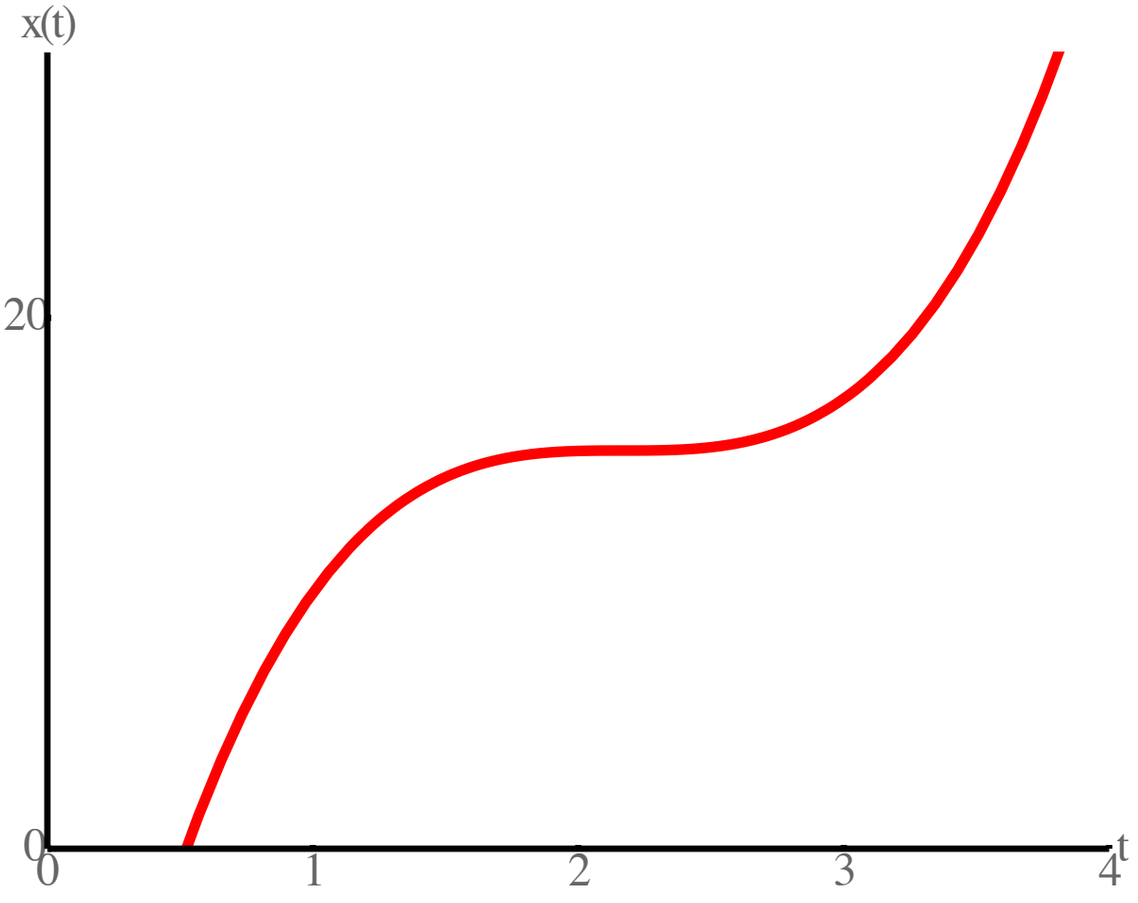
a) object 2
b) object 1
c) Neither velocity vector points in the negative direction

Instantaneous Velocity

$$v_{\text{avg}} = \frac{\Delta x}{\Delta t}$$

$$x(t) = 5t + 2$$





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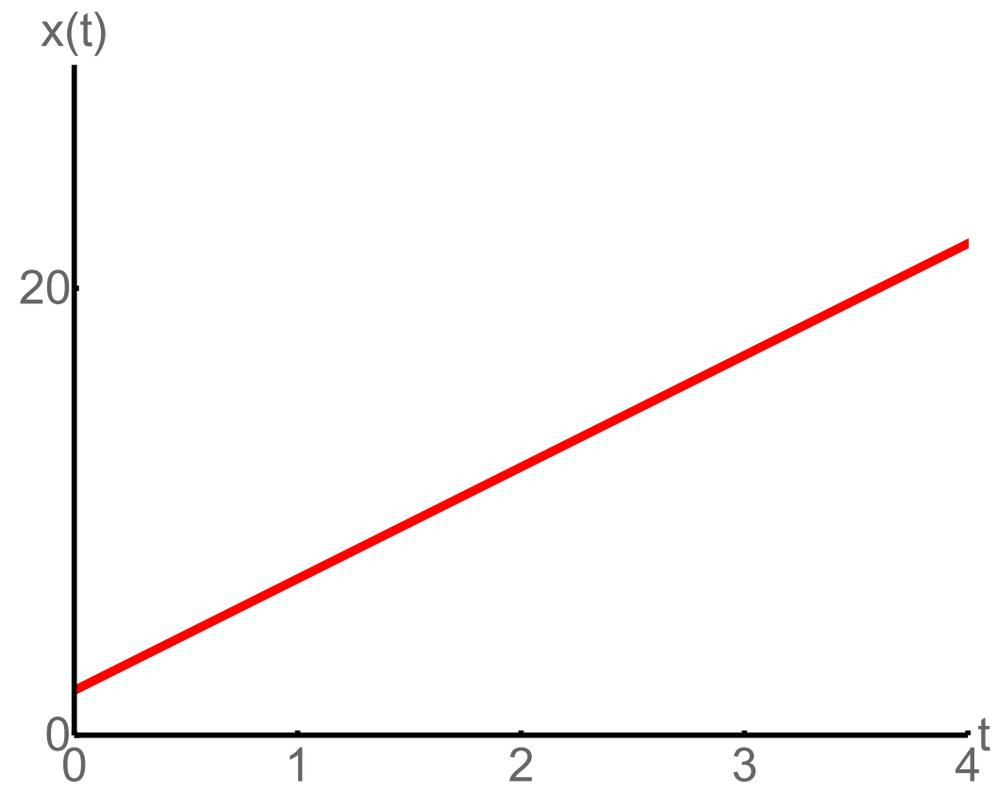

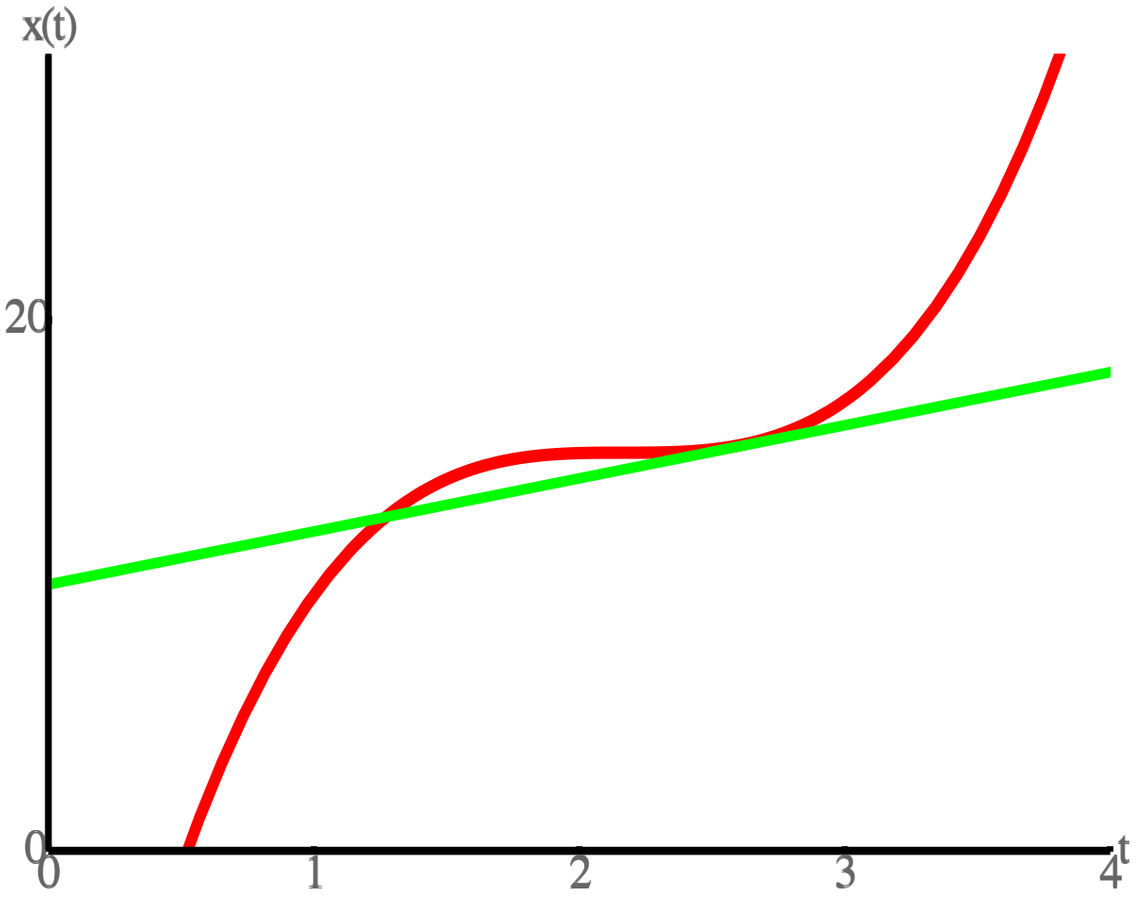

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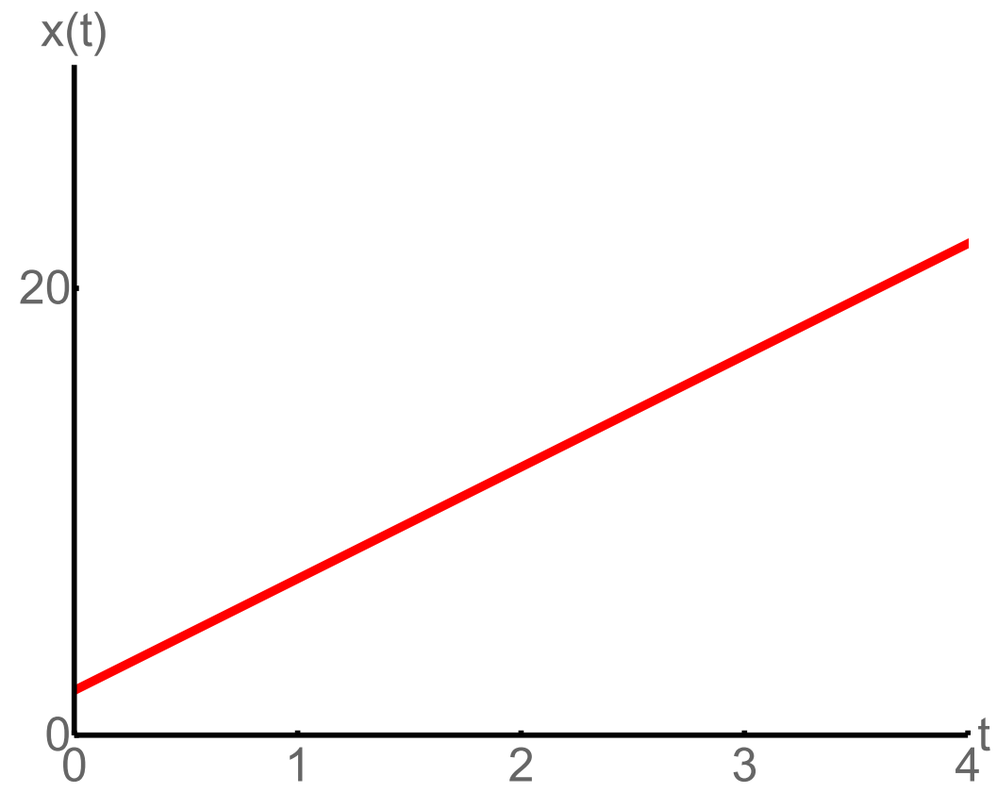

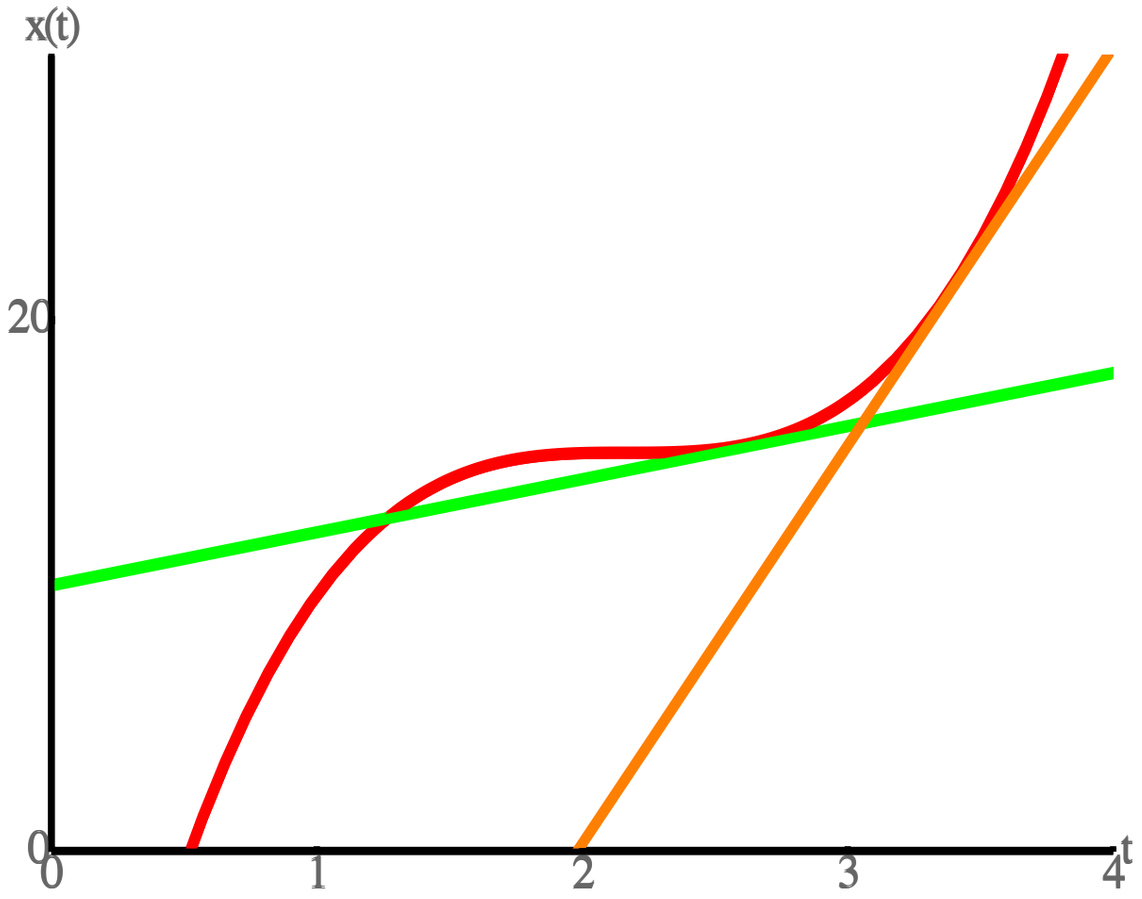

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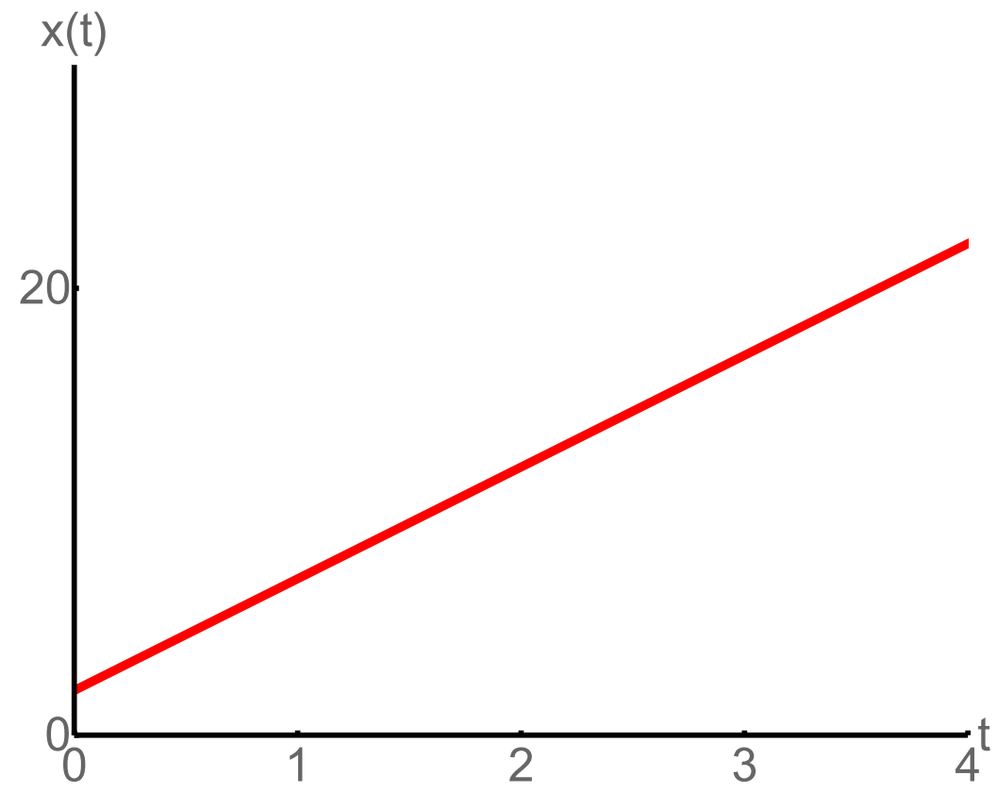
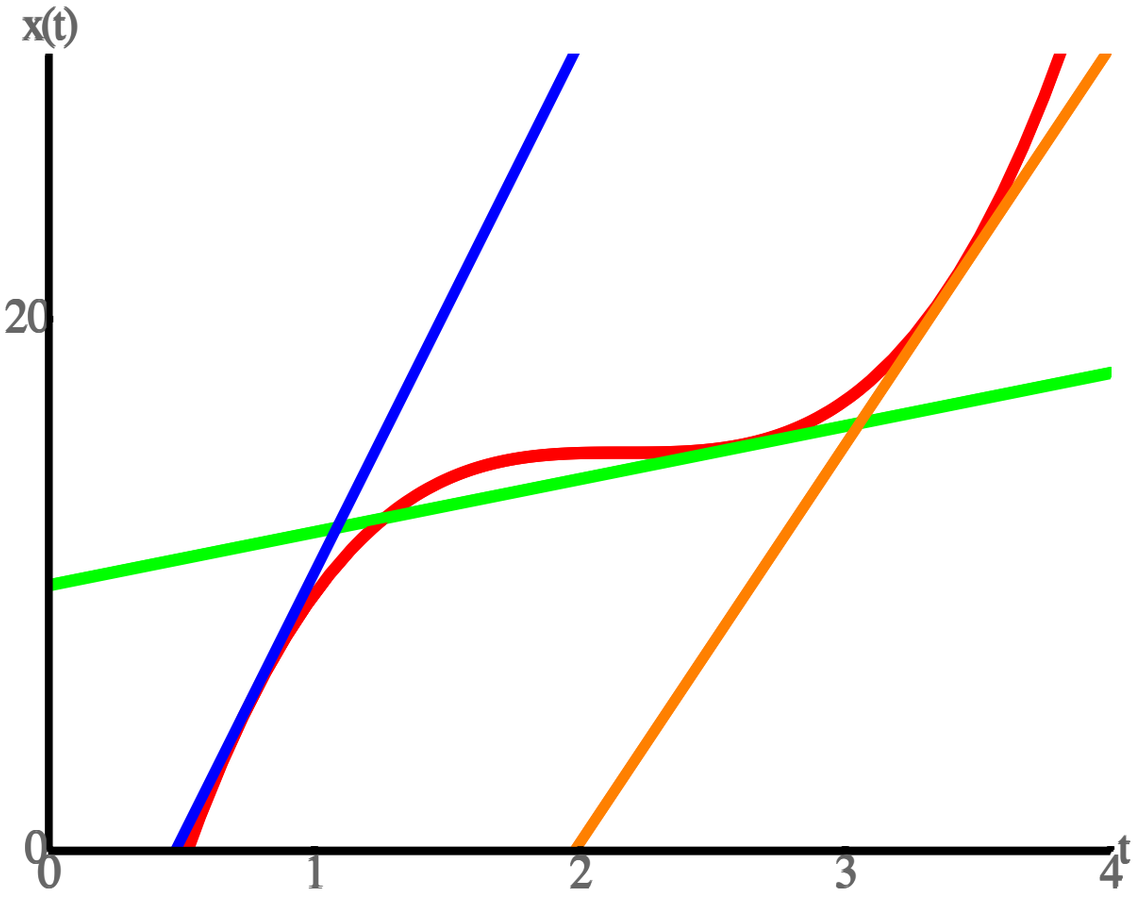


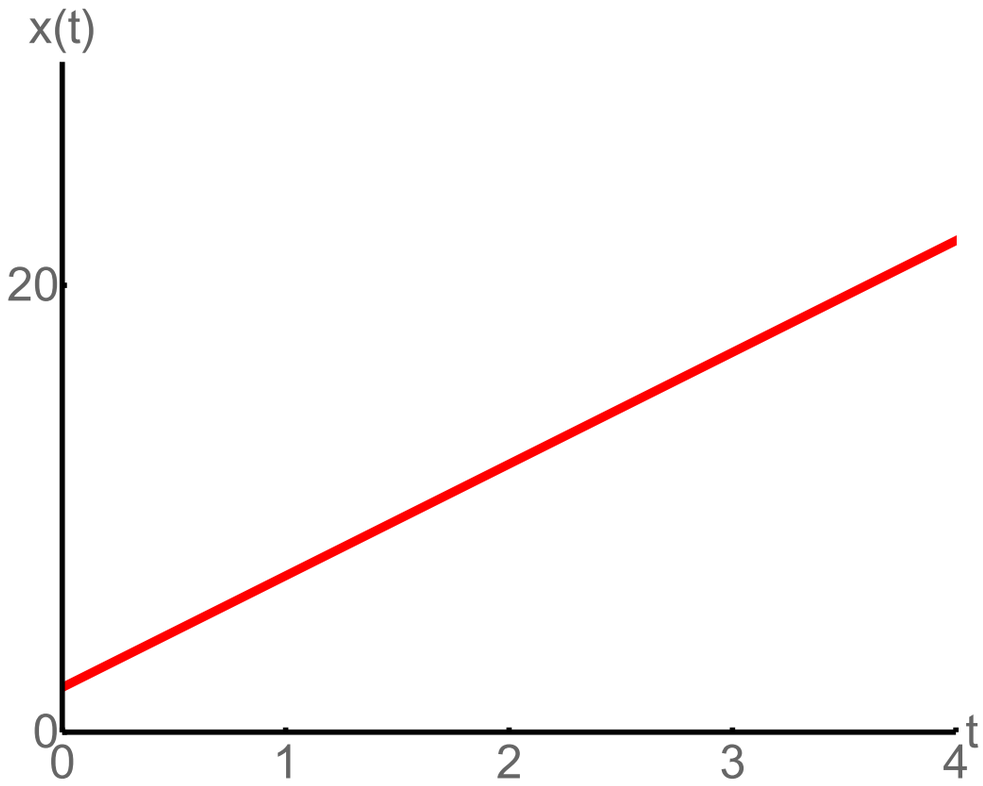


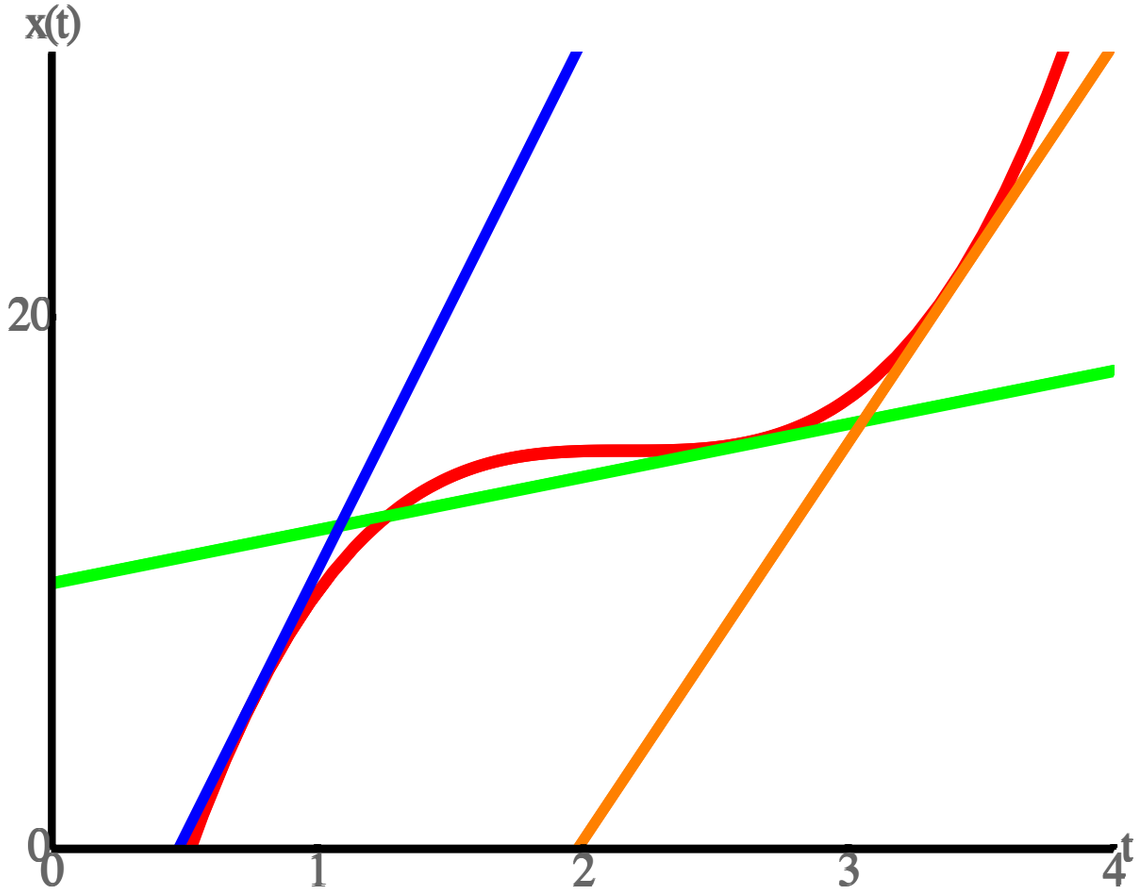
Instantaneous Velocity

$$v_{\text{avg}} = \frac{\Delta x}{\Delta t}$$

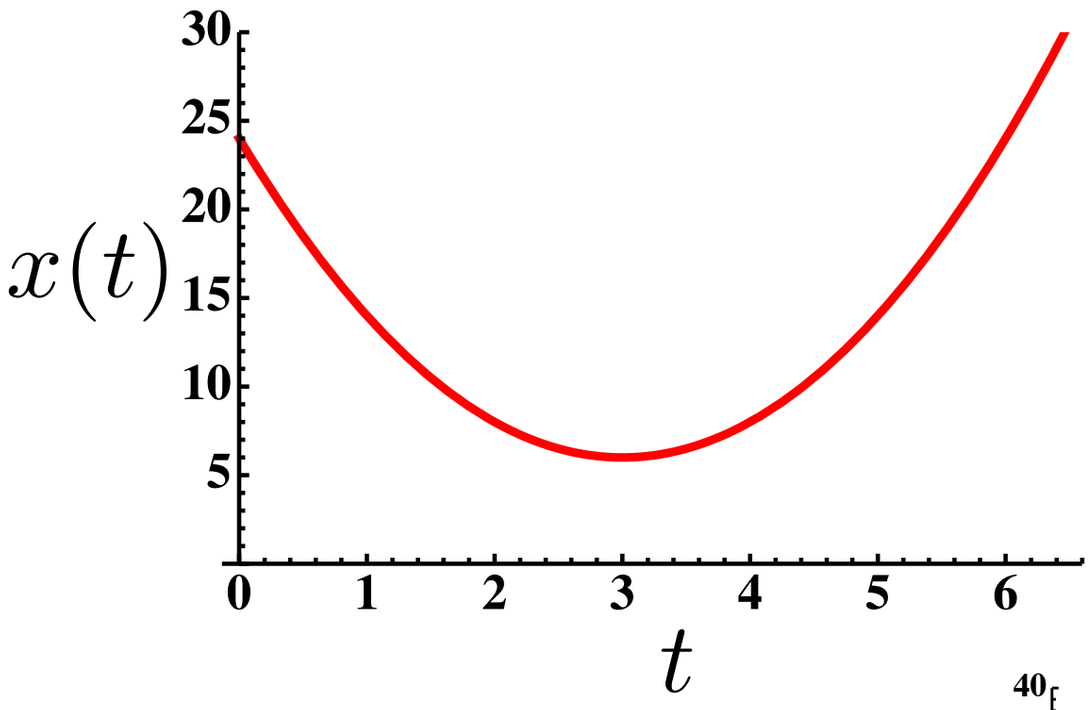
$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} \equiv \frac{dx}{dt}$$

$$x(t) = 5t + 2$$

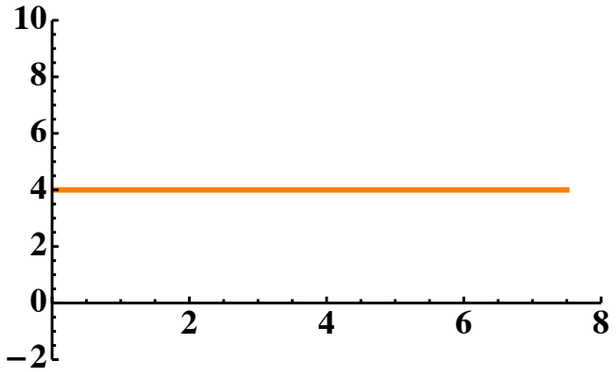


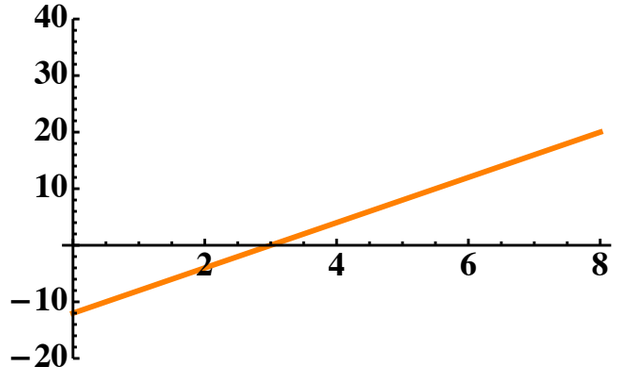


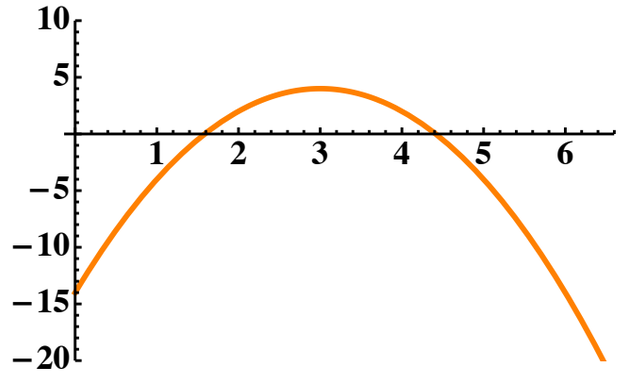
Question #6



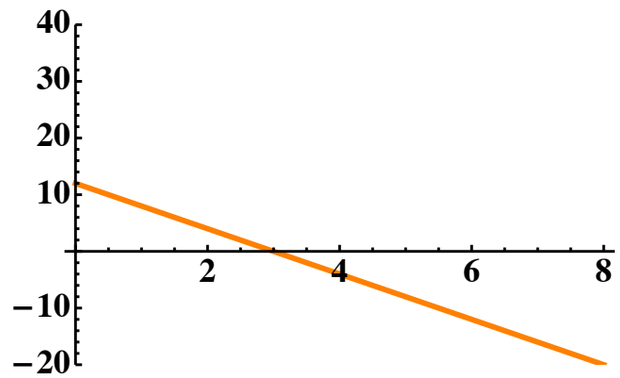
Find the velocity vs. time graph that corresponds to the position vs. time graph seen at left.

a)


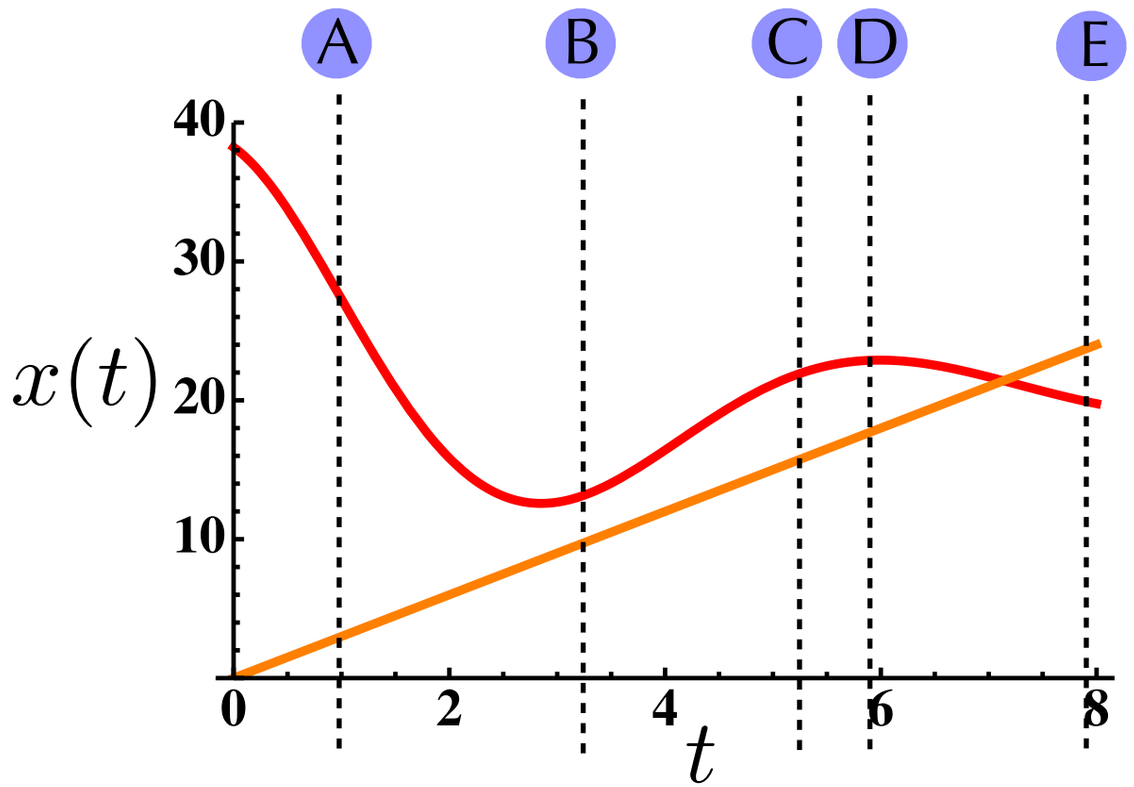
b)


c)


d) none of the above

e)


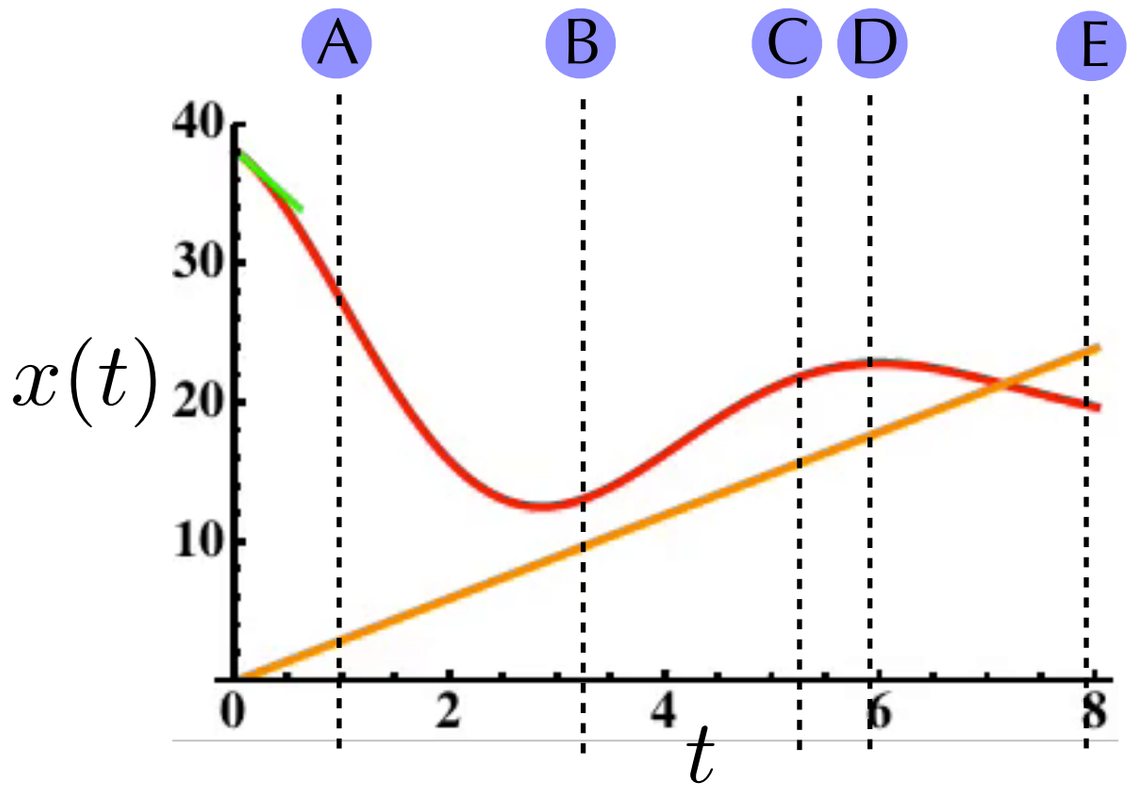
Question #7



At what time(s) do these two objects have the same **<u>speed</u>**?

a) A & E
b) B only
c) B,C, & E
d) B & C
e) C only
f) The two objects never have the same speed

Question #7



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a) A & E
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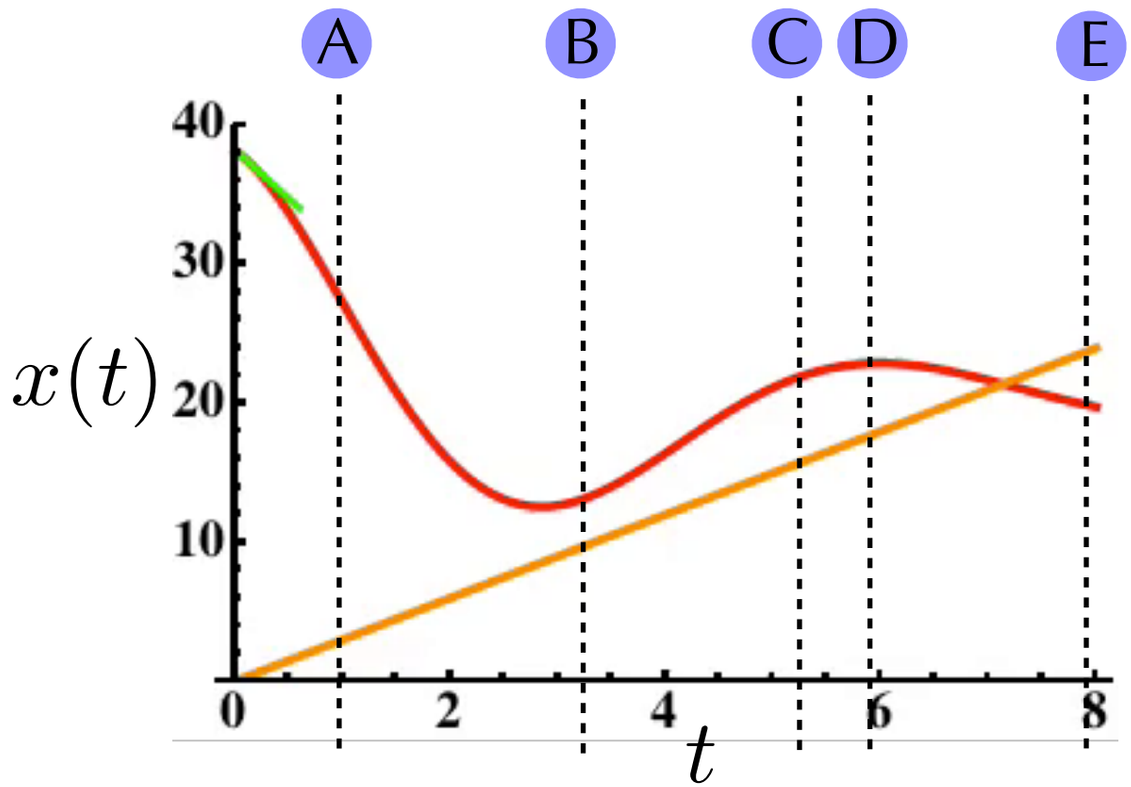

At what time(s) do these two objects have the same **speed**?

a) A & E
b) B only
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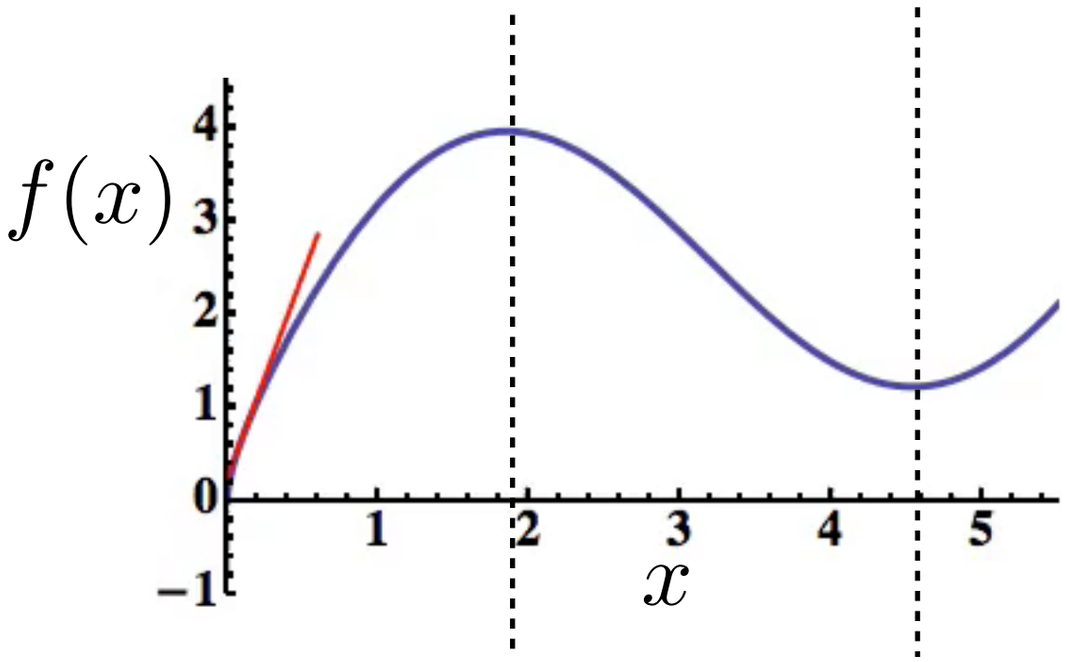
Calculus review: The derivative



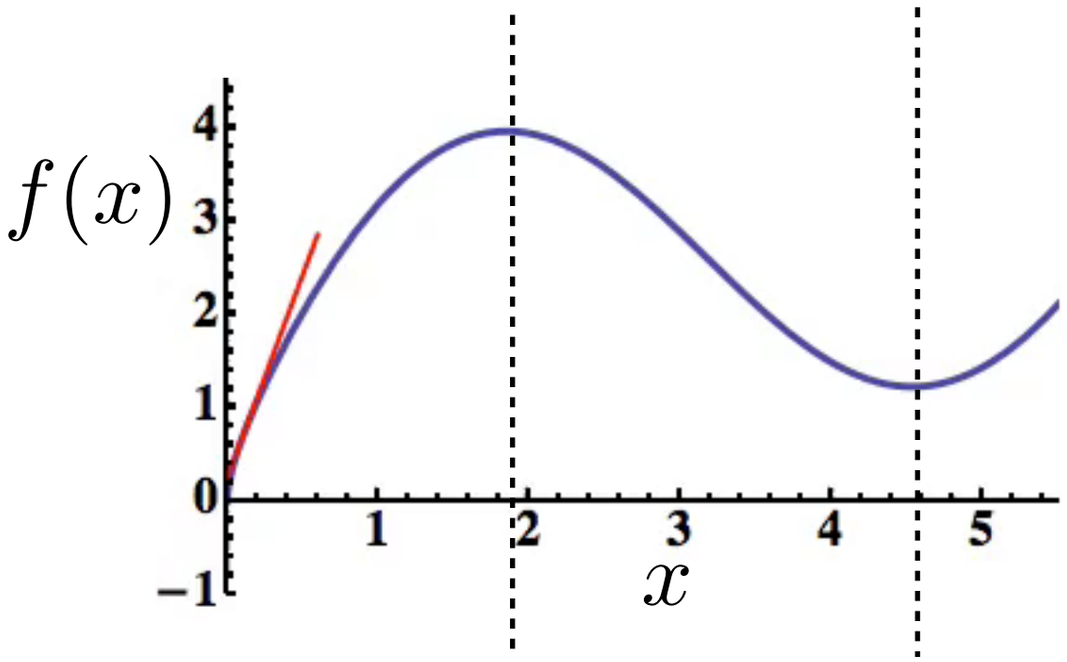
$$u(t) = ct^n$$

$$\frac{du(t)}{dt} = nct^{n-1}$$

$$\frac{d}{dt}\sin(t) = \cos(t)$$

$$\frac{d}{dt}\cos(t) = -\sin(t)$$

Calculus review: The derivative



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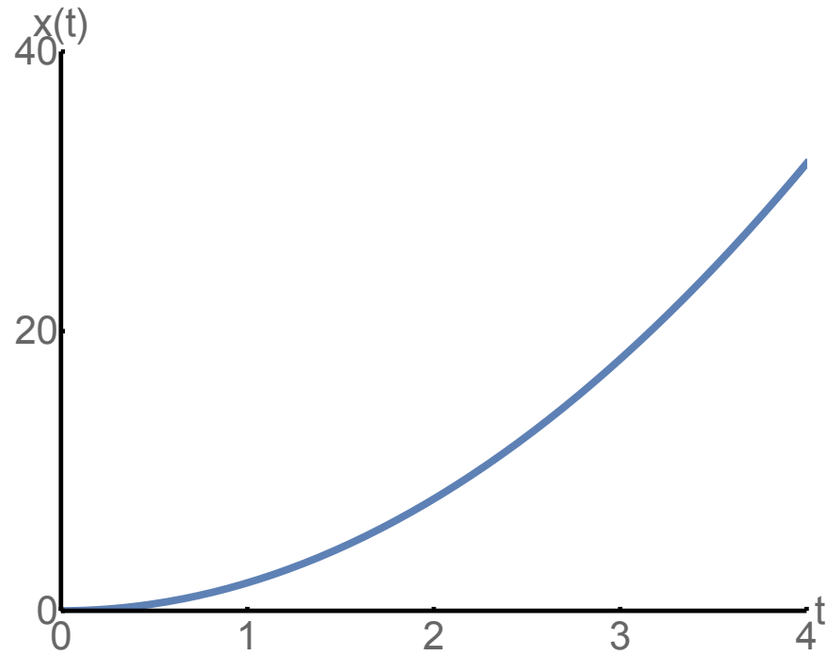
Derivative Example

Find the velocity for this position function.

$$x(t) = 2t^2$$



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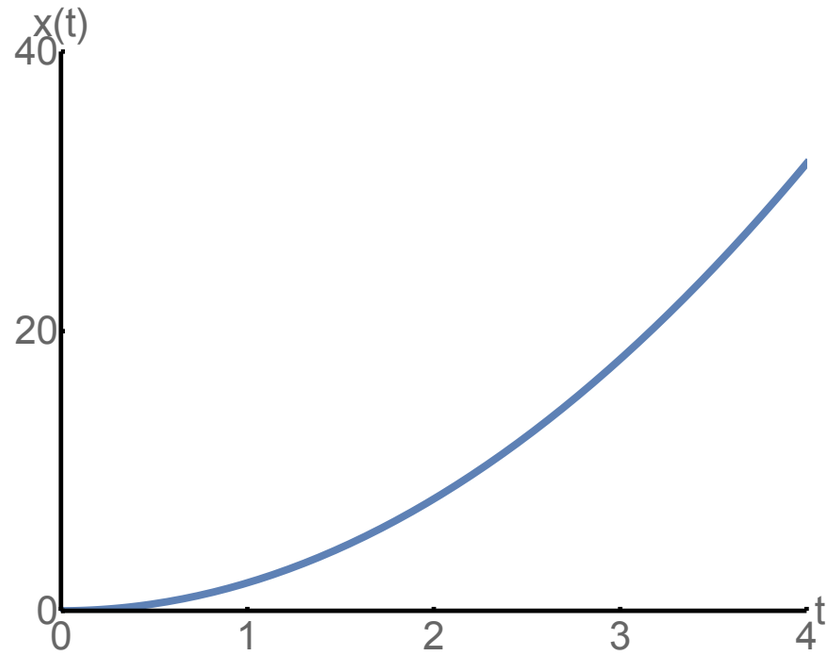
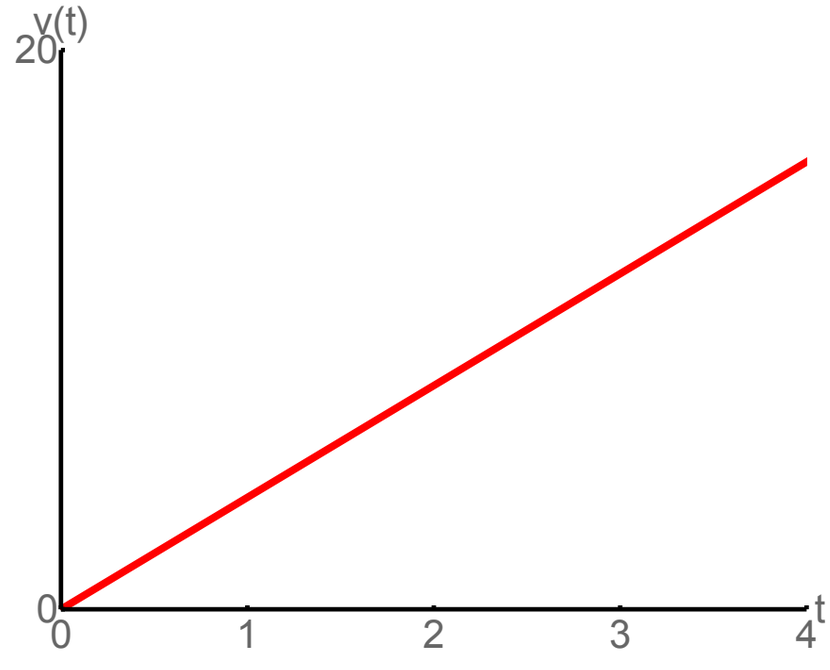


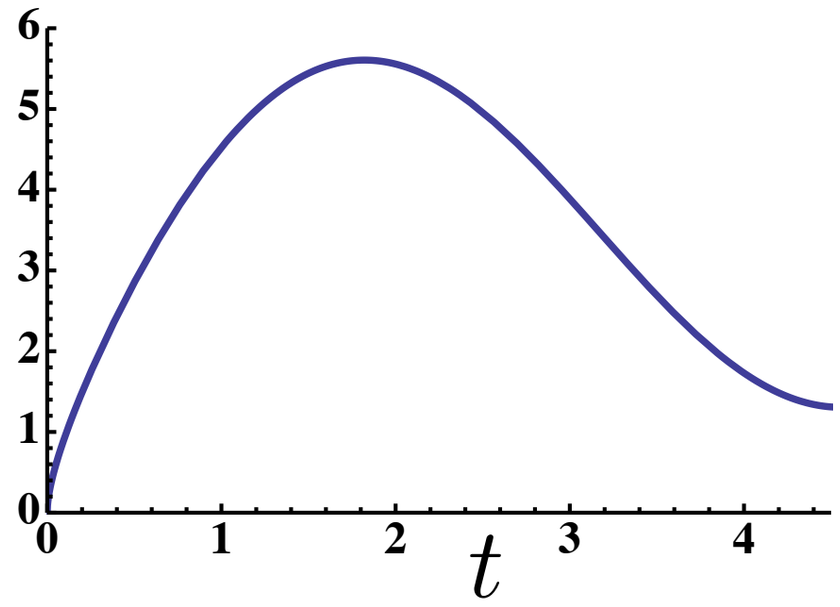
$$v = \frac{dx}{dt} = 4t$$



Question #8

$$x(t) = 2\sqrt{t} + 3\sin(t)$$

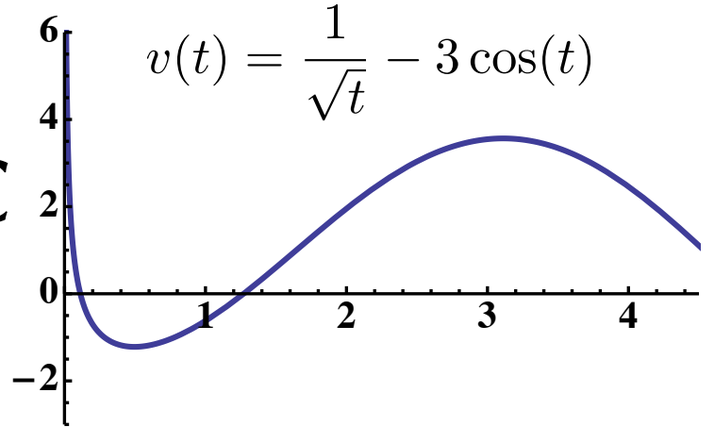
$x(t)$



Which of the following is the velocity vs. time graph for the bus?

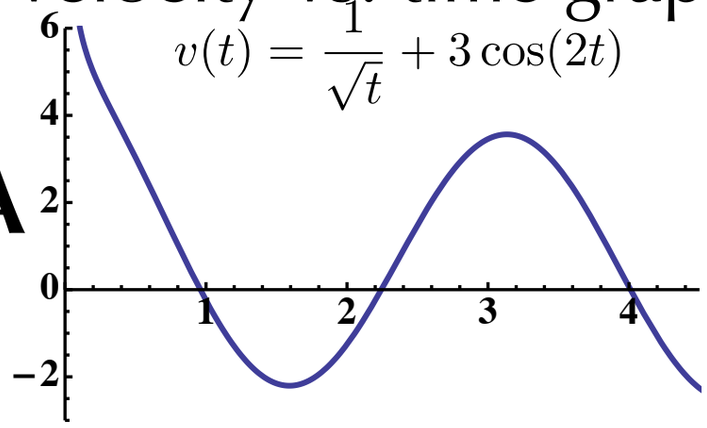
C

$$v(t) = \frac{1}{\sqrt{t}} - 3\cos(t)$$



A

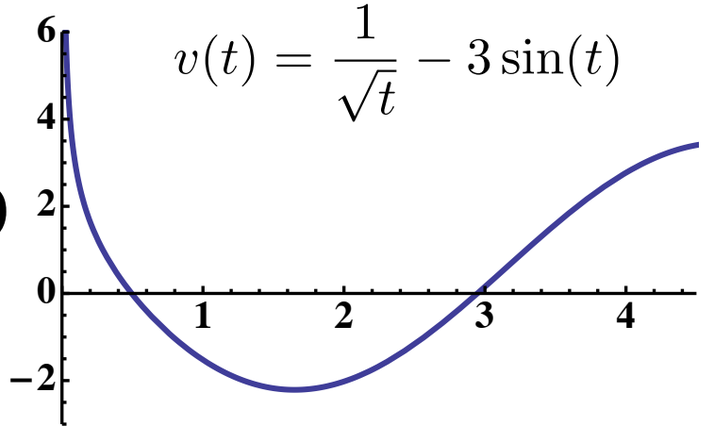
$$v(t) = \frac{1}{\sqrt{t}} + 3\cos(2t)$$



e) b & c are both correct

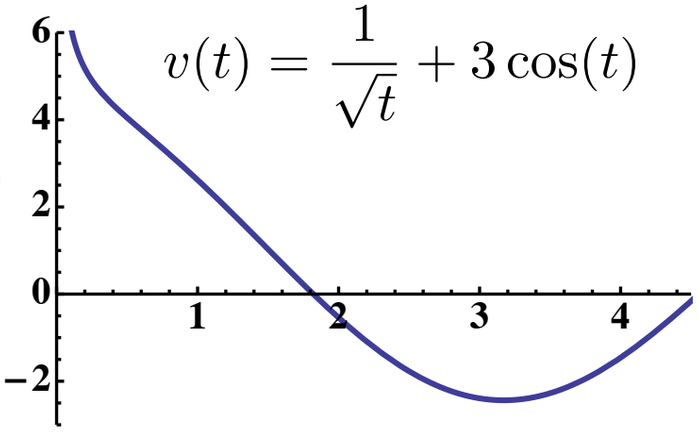
D

$$v(t) = \frac{1}{\sqrt{t}} - 3\sin(t)$$

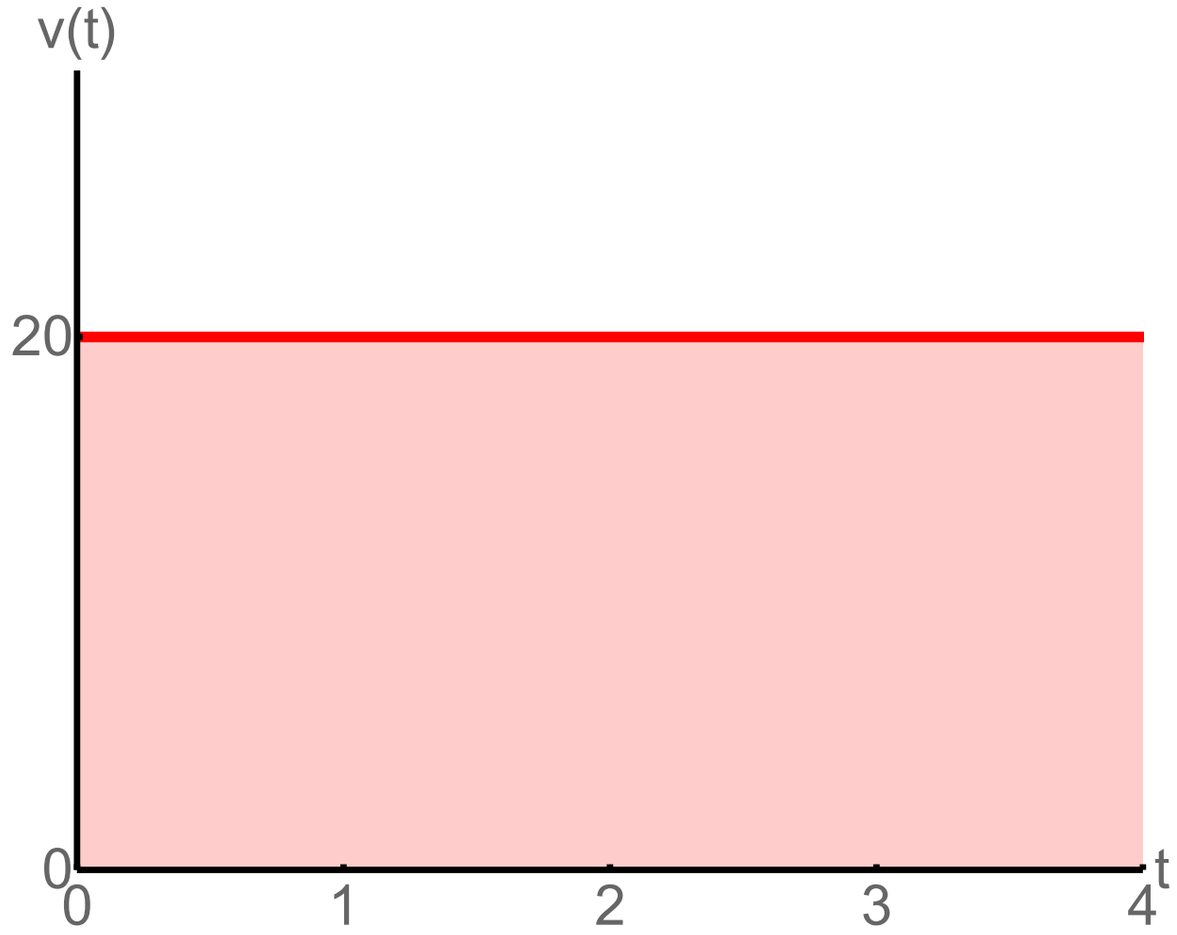


B

$$v(t) = \frac{1}{\sqrt{t}} + 3\cos(t)$$

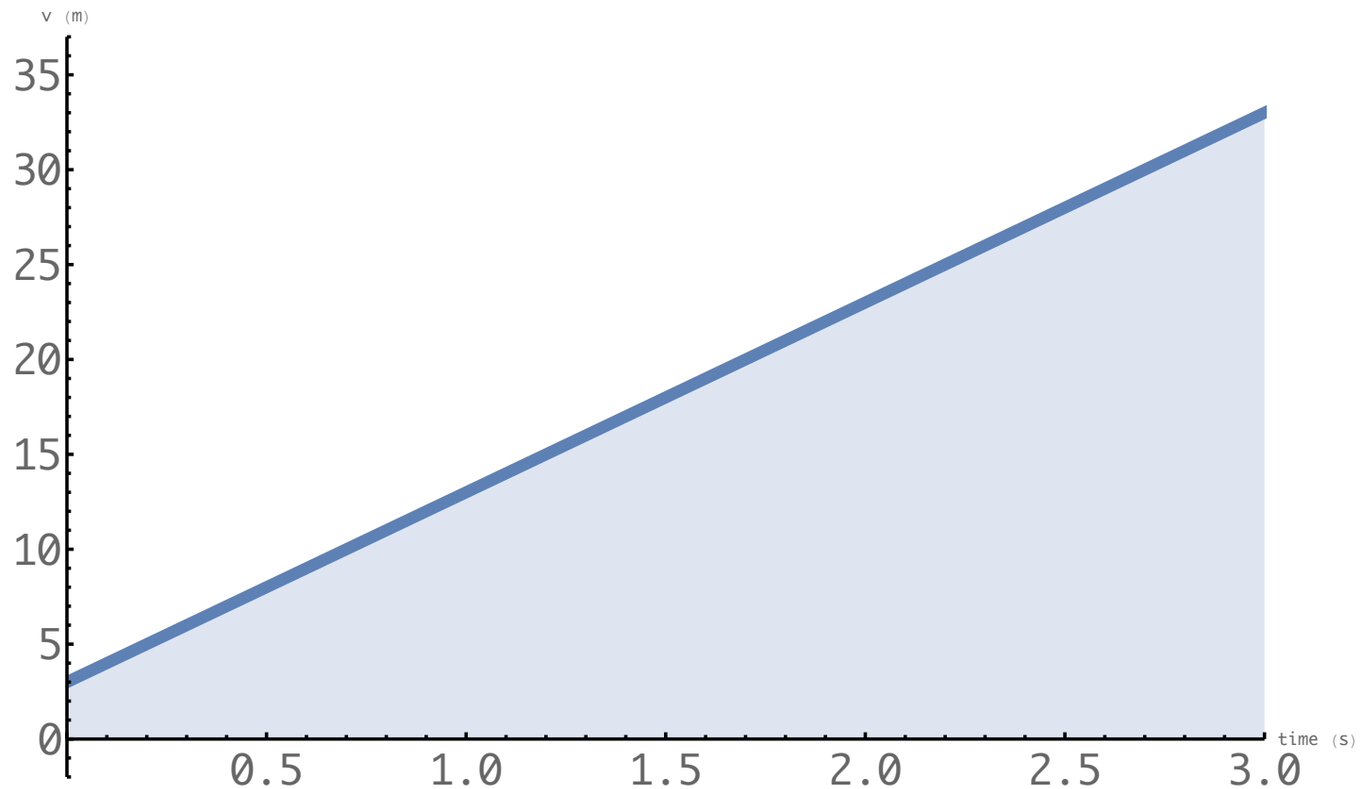


Finding Position from Velocity



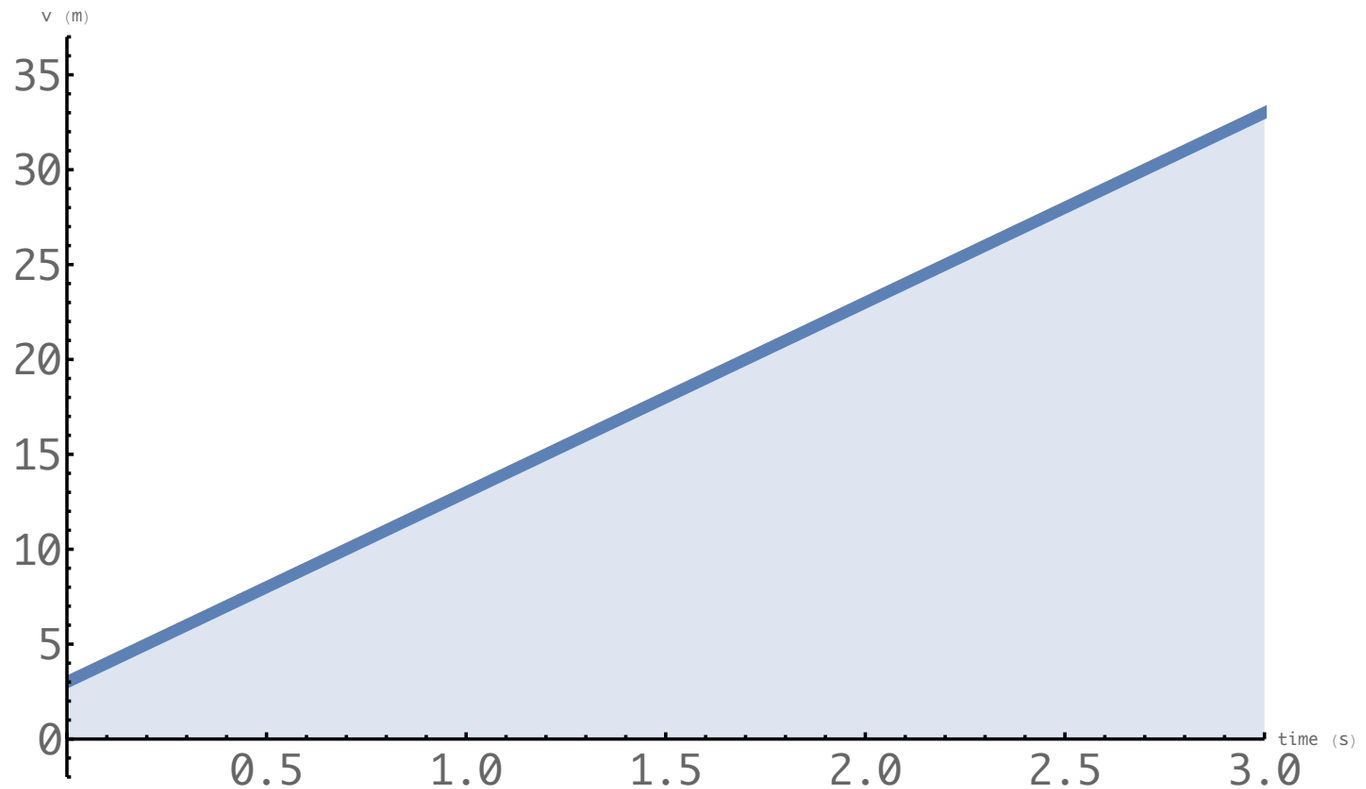
$$s_f = s_i + v_s \Delta t$$

Finding Position from Velocity



$$s_f = s_i + v_s \Delta t$$

Finding Position from Velocity



$$s_f = s_i + \text{area under curve}$$

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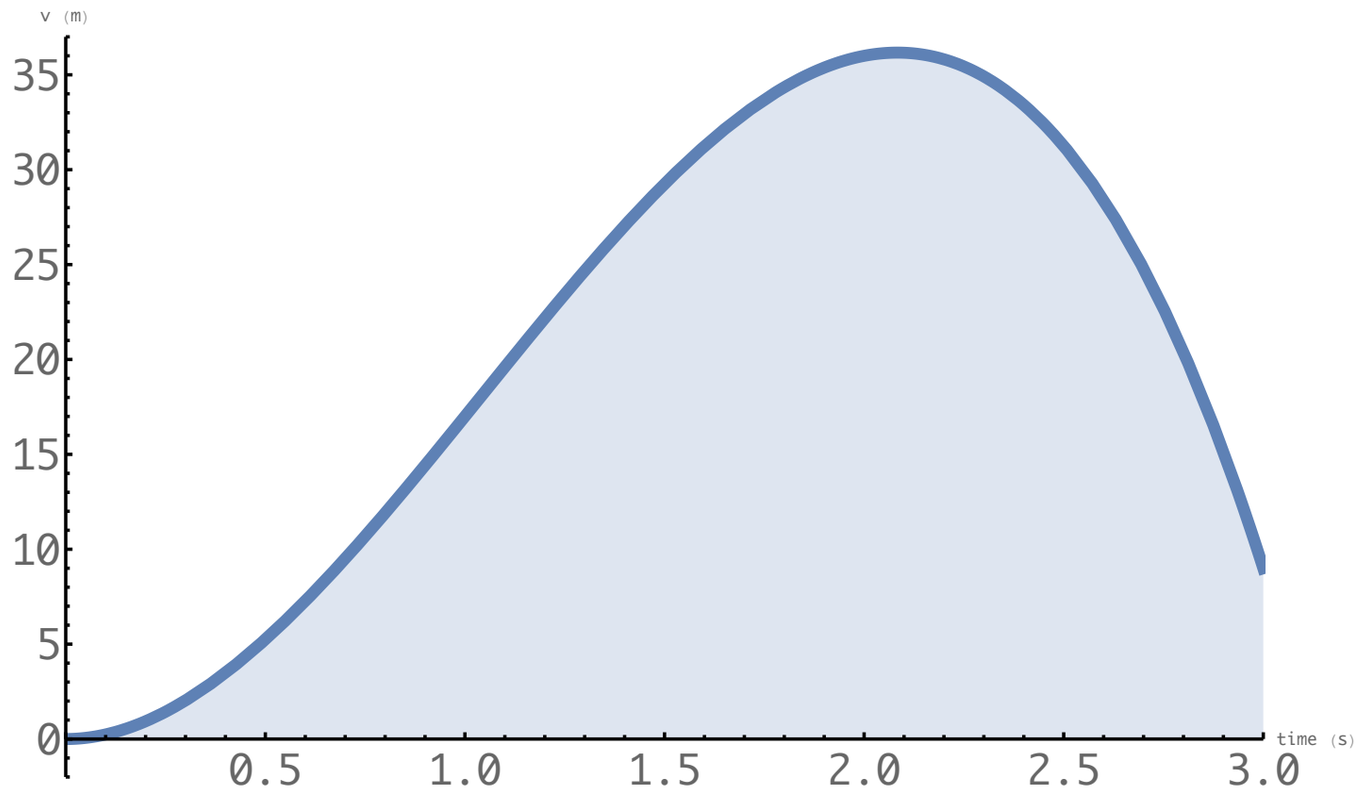
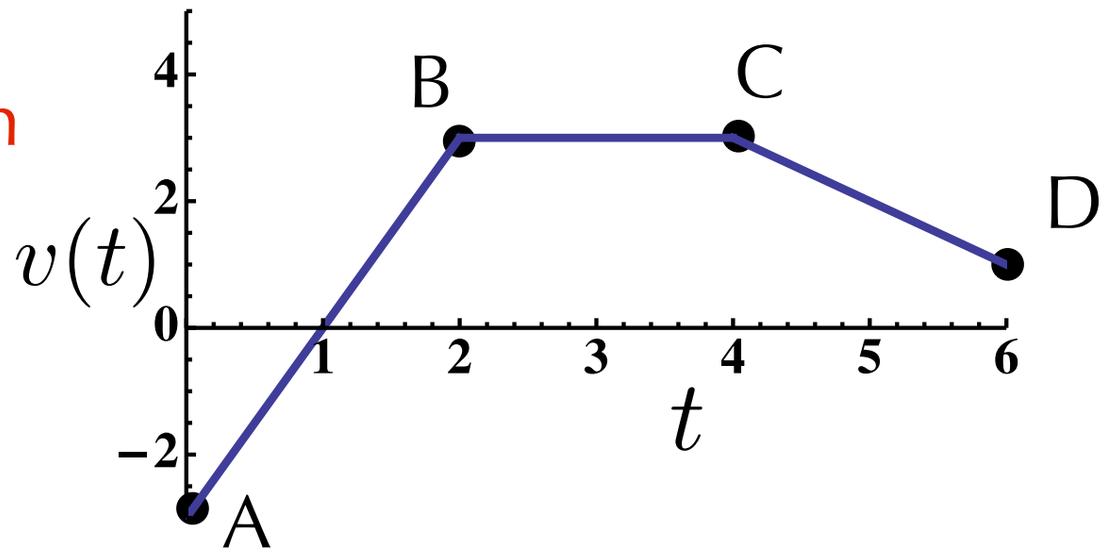


$$s_f = s_i + \text{area under curve}$$

The object is located at x = 5 m at t = 0 s. What is the object's location at t = 1 s

$$v(t) \rightarrow x(t)$$

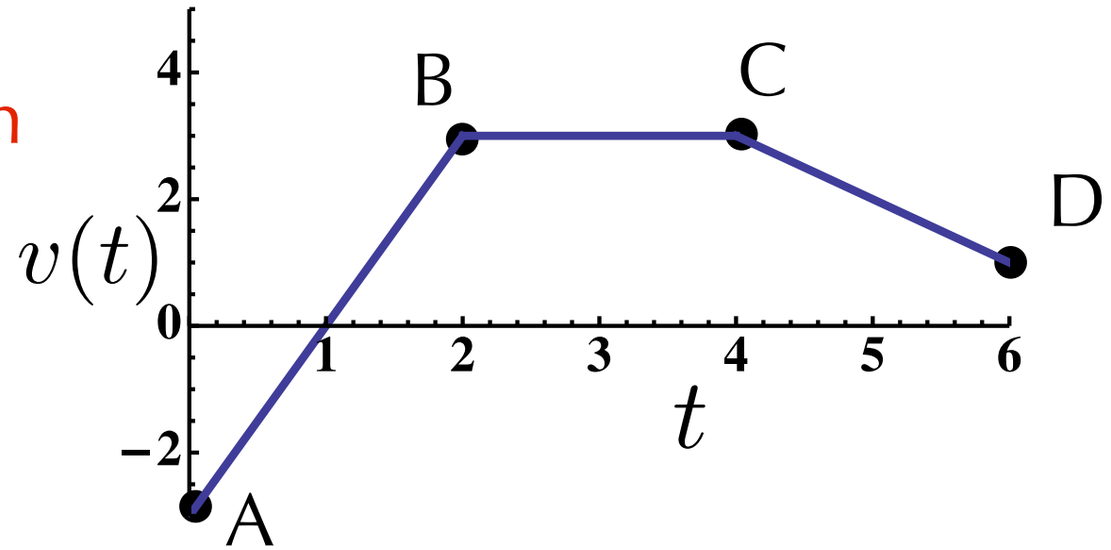


Question #9

a) 6.5 m
b) 1.5 m
c) 3.5 m
d) 0 m
e) 8 m

The object is located at x = 5 m at t = 0 s. What is the object's location at t = 1 s

$$v(t) \rightarrow x(t)$$



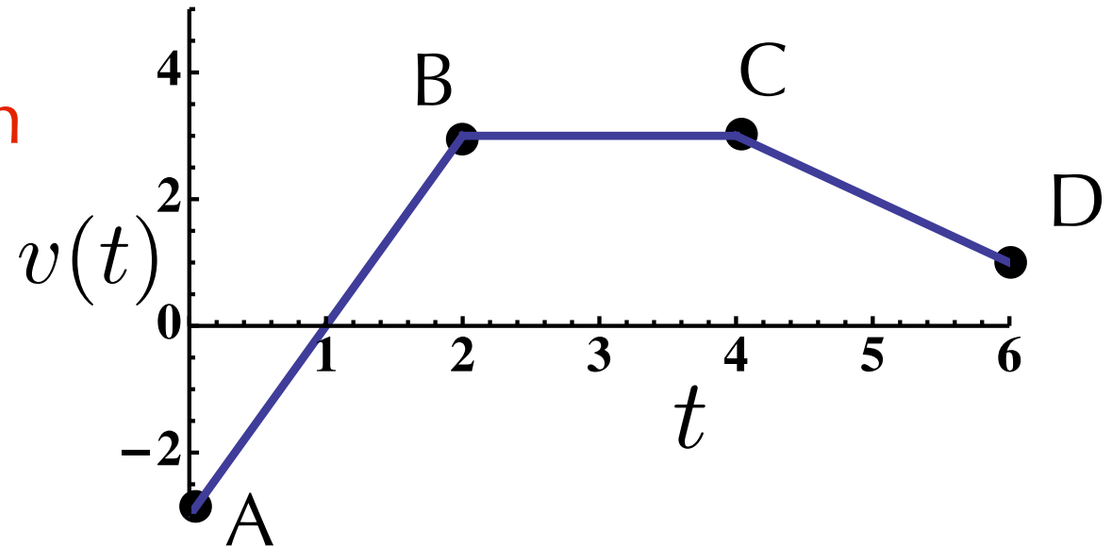
at t = 2 s?

Question #10

a) 3.5 m
b) 1.5 m
c) 6.5 m
d) 8 m
e) 5 m

The object is located at x = 5 m at t = 0 s. What is the object's location at t = 1 s

$$v(t) \rightarrow x(t)$$



at t = 2 s?

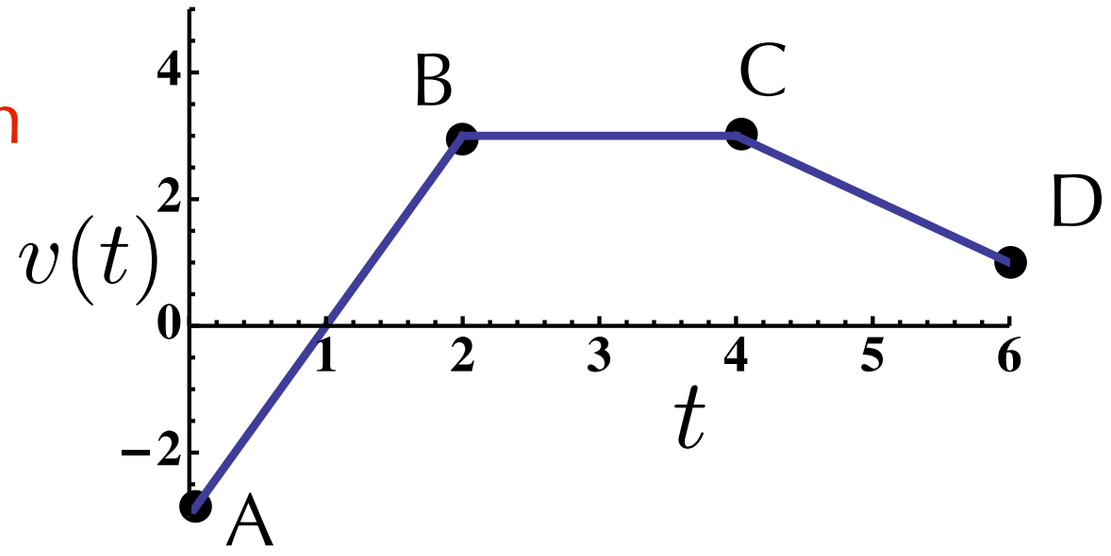
at t = 4 s?

Question #11

a) 3.5 m
b) 5m
c) 6 m
d) 11 m
e) 8 m

The object is located at x = 5 m at t = 0 s. What is the object's location at t = 1 s

$$v(t) \rightarrow x(t)$$



at t = 2 s?

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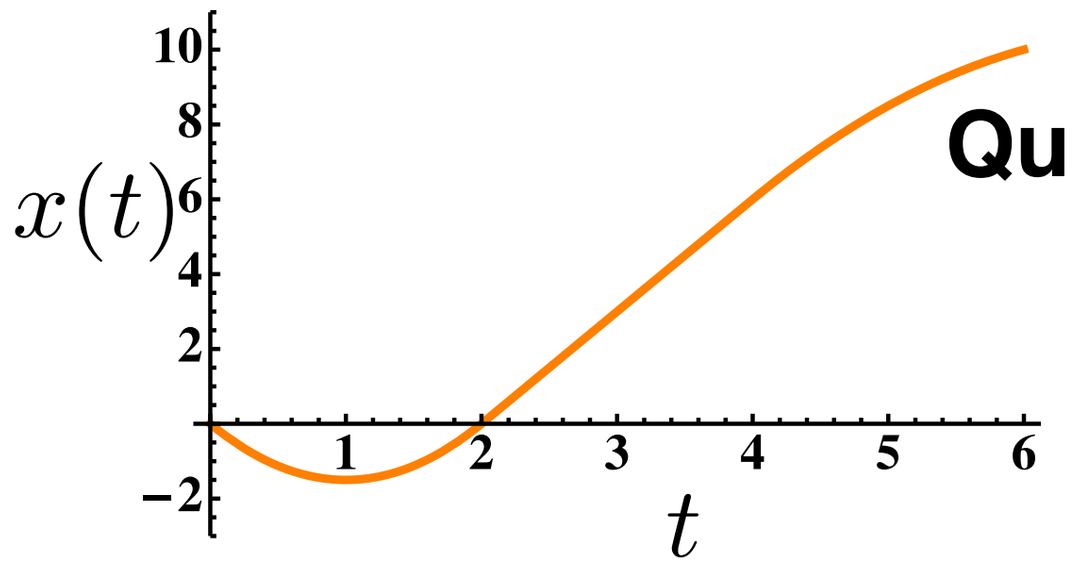
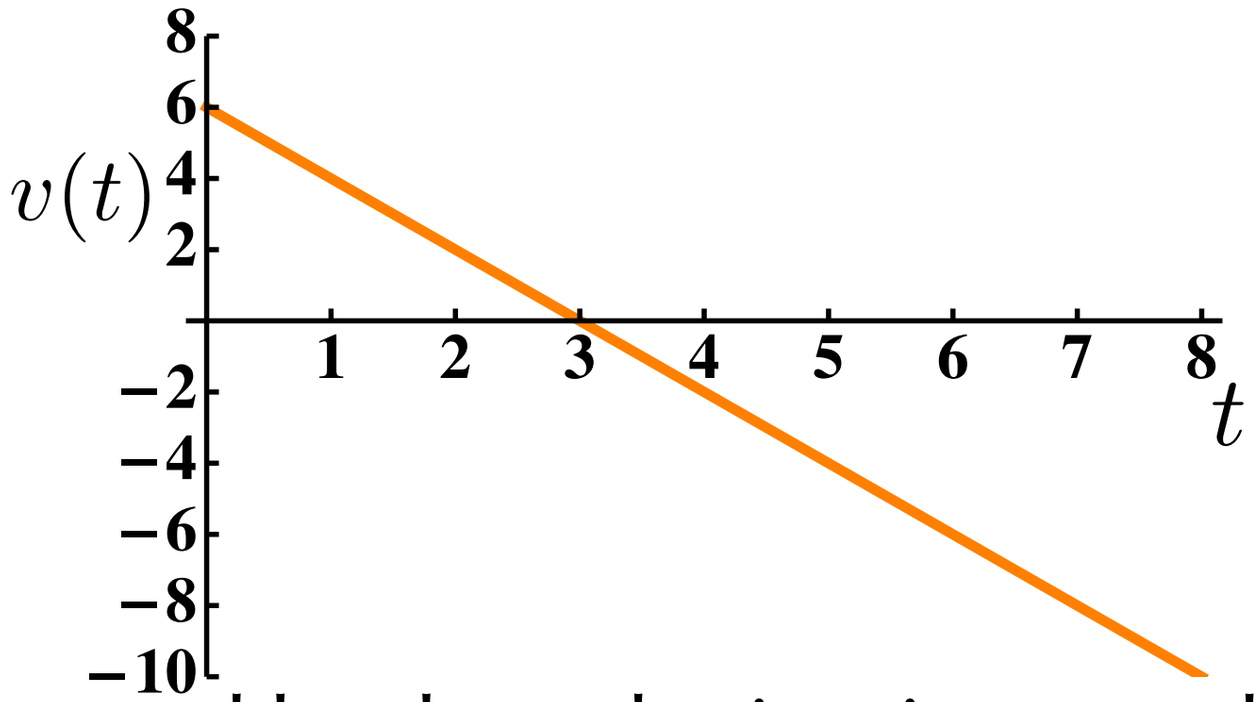


Question #11

a) 3.5 m
b) 5m
c) 6 m
d) 11 m
e) 8 m

Question #12



The object represented by the velocity-time graph above is at x=7 at t=0. Does the object ever reach x=0? If so, at what time does this happen?

b) The object never reaches the origin.

c) The object reaches the origin at t = 3.

d) The object reaches the origin at t = 6.

e) The object reaches the origin at t = 7.

Techniques for integration

$$\int_{t_i}^{t_f} ct^n dt = \left. \frac{ct^{n+1}}{n+1} \right|_{t_i}^{t_f} = \frac{c}{n+1}(t_f^{n+1} - t_i^{n+1})$$

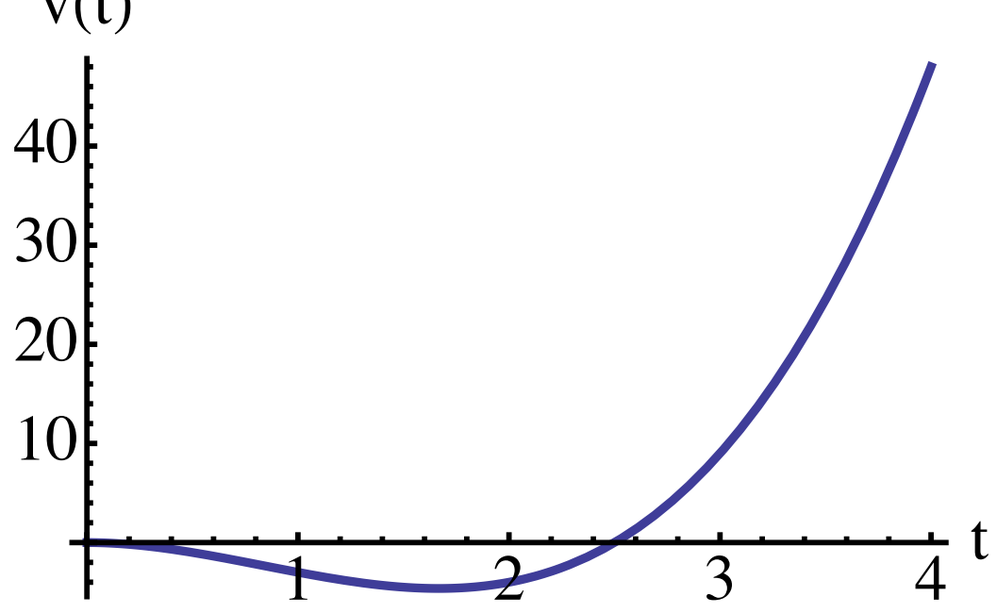
$$\int_{t_i}^{t_f} (u+w)dt = \int_{t_i}^{t_f} udt + \int_{t_i}^{t_f} wdt$$

Example Problem

The velocity of a particle is given by the expression

$$v(t) = 2t^3 - 5t^2$$

If the object's position at $t = 1$ is $x = 5$,
what is it's position when $t = 3$?



a) -10/3
b) 5/3
c) 5
d) -10
e) 3

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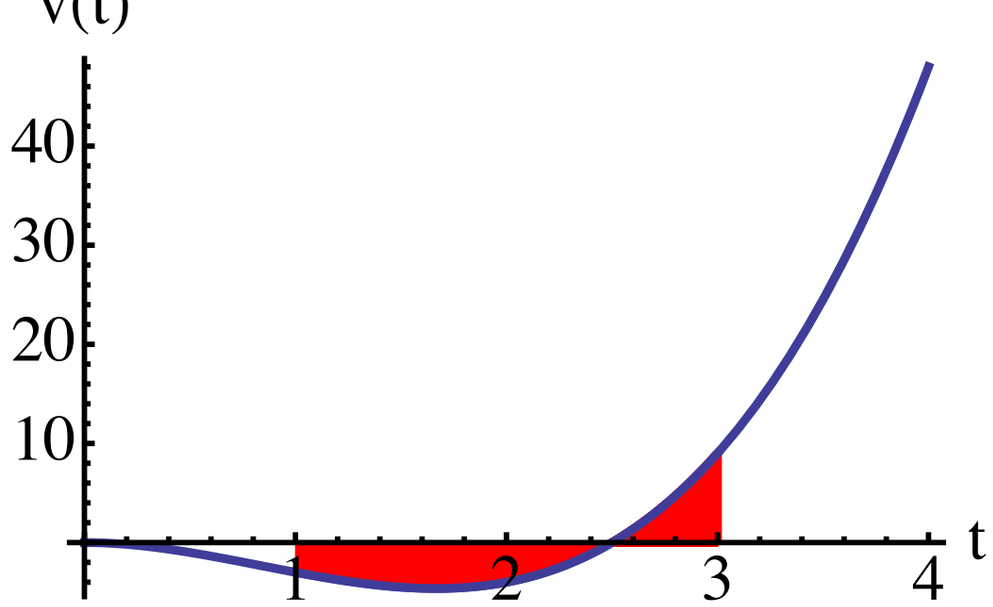

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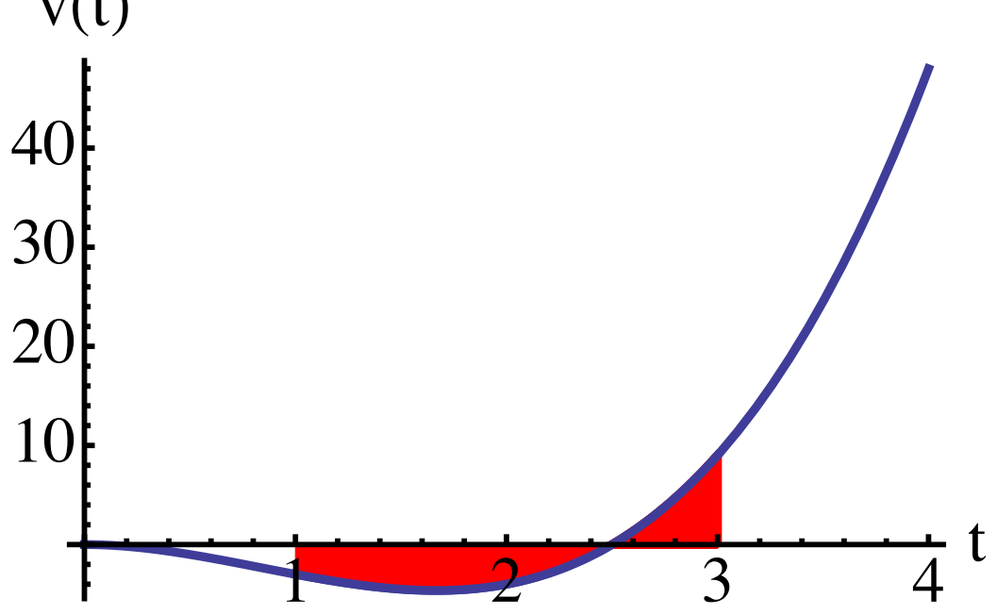

a) -10/3
b) 5/3
c) 5
d) -10
e) 3

$$\Delta x = \int_1^3 2t^3 - 5t^2 dt = \frac{1}{2}t^4 - \frac{5}{3}t^3\Big|_1^3 = -\frac{10}{3}$$