You can draw here

Physics 111 - Class 3B
Kinematics II

Do not draw in/on this box!

September 22, 2021

You can draw here

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Class Outline

- Logistics / Announcements
- Anonymous Feedback
- From Position to Velocity
- Tutorial Problem this week
- Clicker Questions & HW3 Tips
- Activity & Debrief: Simulation

Logistics/Announcements

- Lab this week: Lab 1
- HW due this week on Thursday at 6 PM
- Learning Log 2 due on Saturday at 6 PM
- HW and LL deadlines have a 48 hour grace period
- Test/Bonus Test: Test 1 available this week
  - Test Window: Friday 6 PM - Sunday 6 PM

Logistics/Announcements

- Tutorials start this week !
    - Anybody can go to ANY Tutorial, all the links to the Zoom sessions are on Canvas
    - Attendance is not required in Tutorials
    - I recommend attending to meet your TA and work on stuff in groups
    - The TAs will guide you through a long problem each week

Anonymous Feedback

AnonymousFeedbackBot

Anonymous Feedback: Physics 111

To: Firas Moosvi,

Reply-To: Firas Moosvi

Inbox - Exchange 10:19 PM

Feedback:

I would like for the class to be more teach and then apply. I feel lost in the homework when I have no clue how to do it I just mindlessly use ed discussion to get answers. I feel we need more teaching because at this rate im just guessing and hoping someone said how to do the question and I dont think thats the best way to learn.

Response:

Yes, and I give permission to use your comments as-is.

Tutorial Problem this week

2. A position vs. time graph is shown. On the velocity versus time graph below it sketch the corresponding velocity as a function of time. Show all calculations, and label the axes appropriately. /9

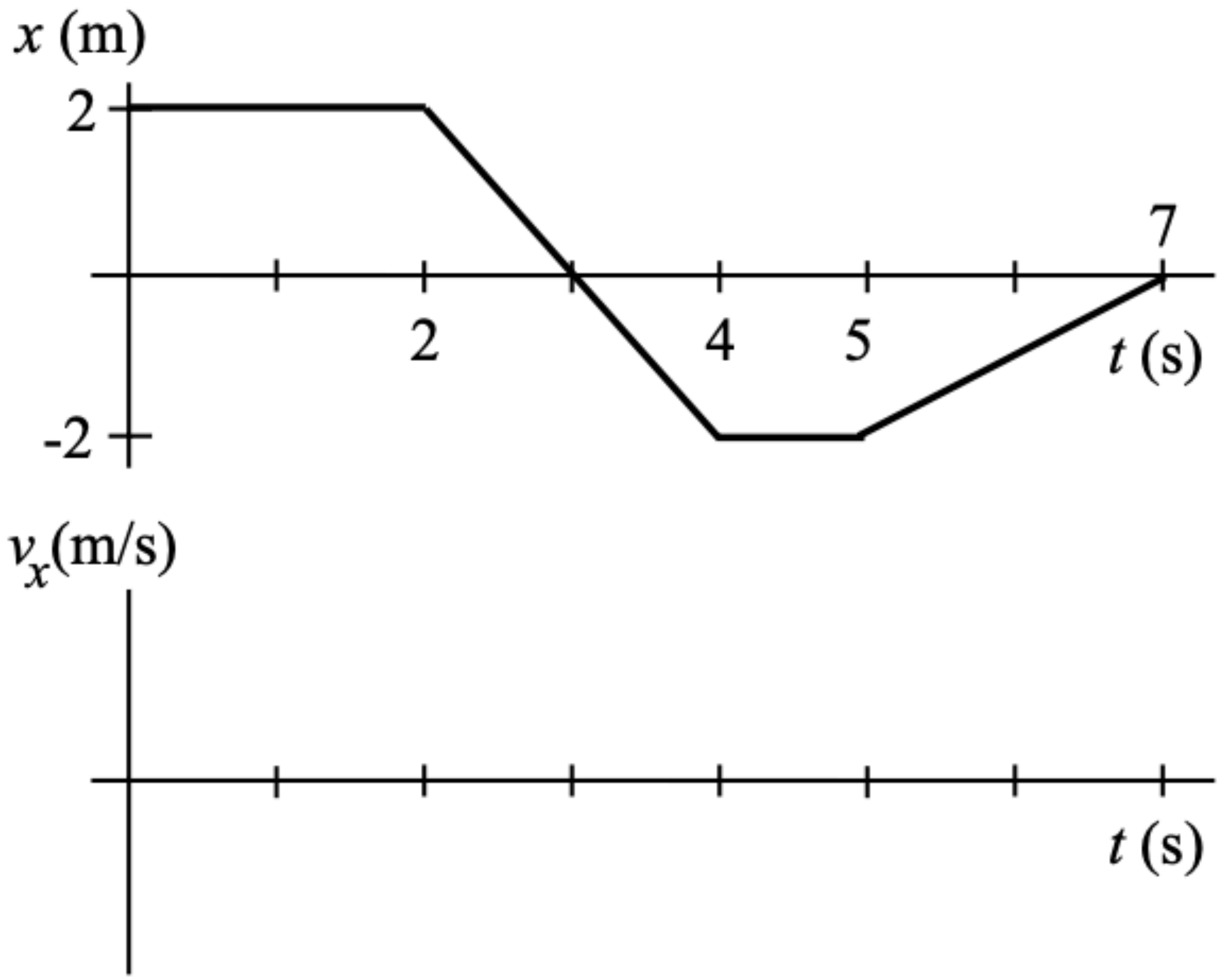

FIG. 1:

Tutorial Problem this week

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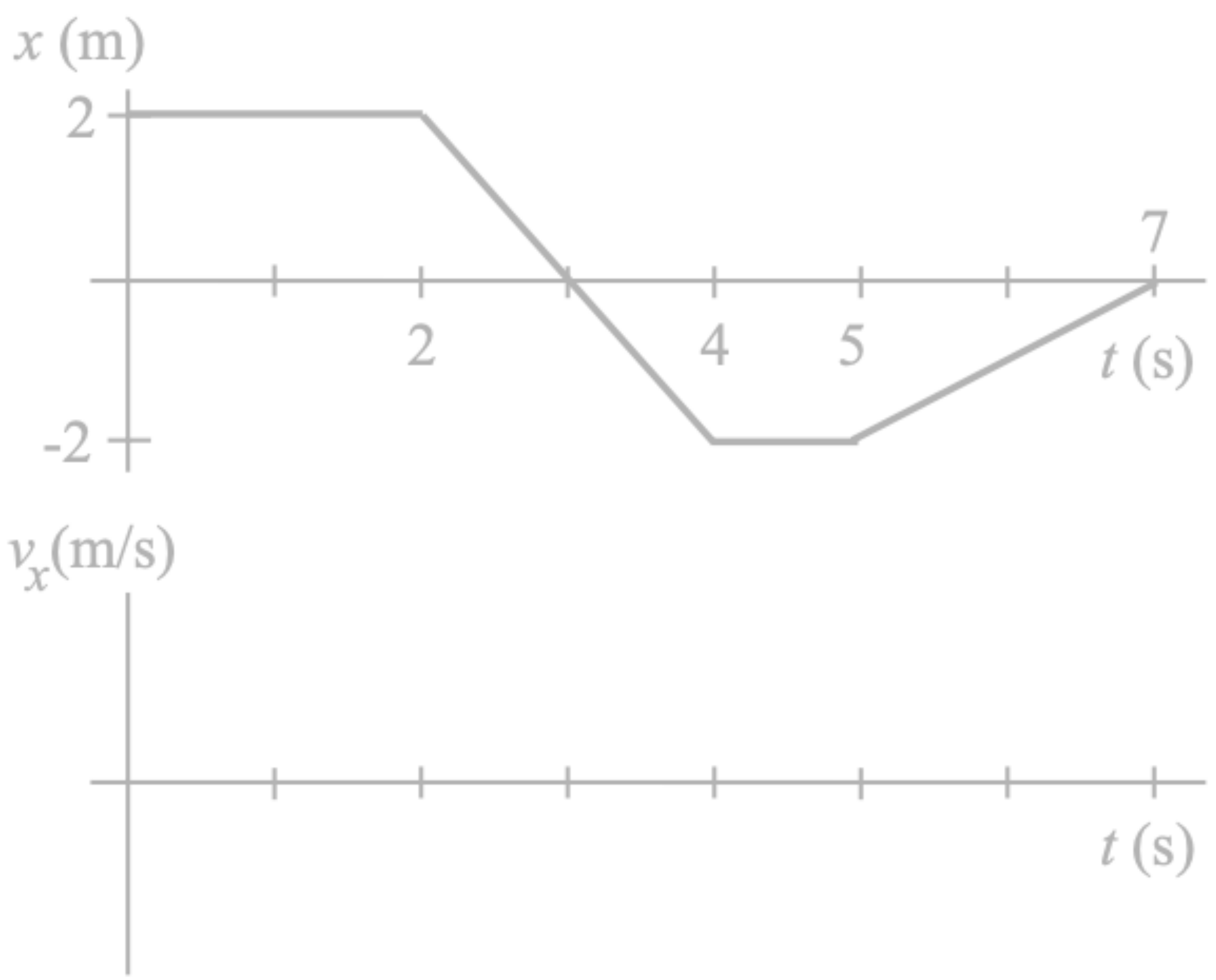


FIG. 1:

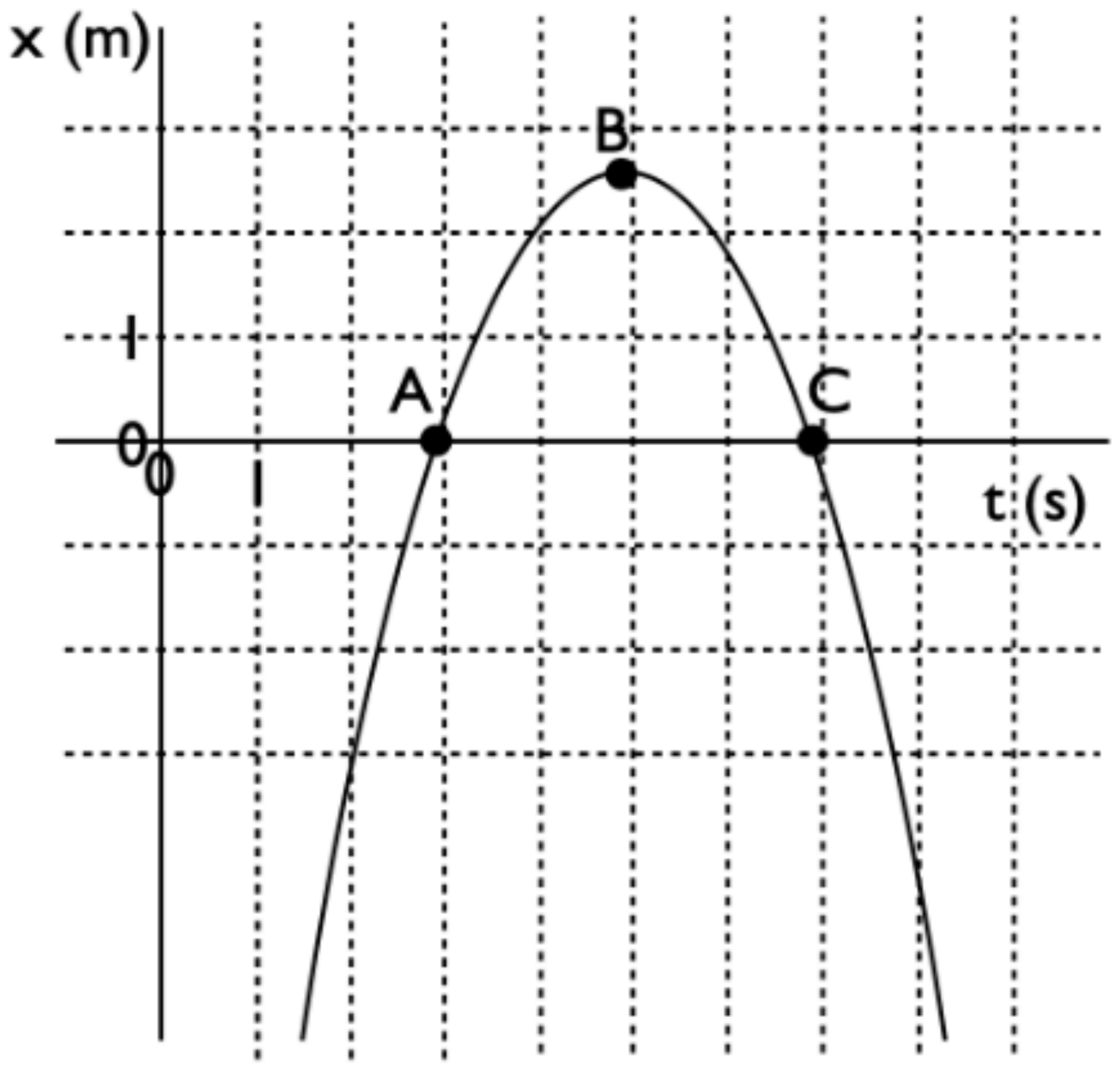


FIG. 1:

3. (a) At each of A, B and C on Fig. 1, estimate the x-component of the velocity vector, v_x from the position vs. time graph (/3) . Draw a tangent line to the graph at each location (/3) and show the calculation of its slope (/3).

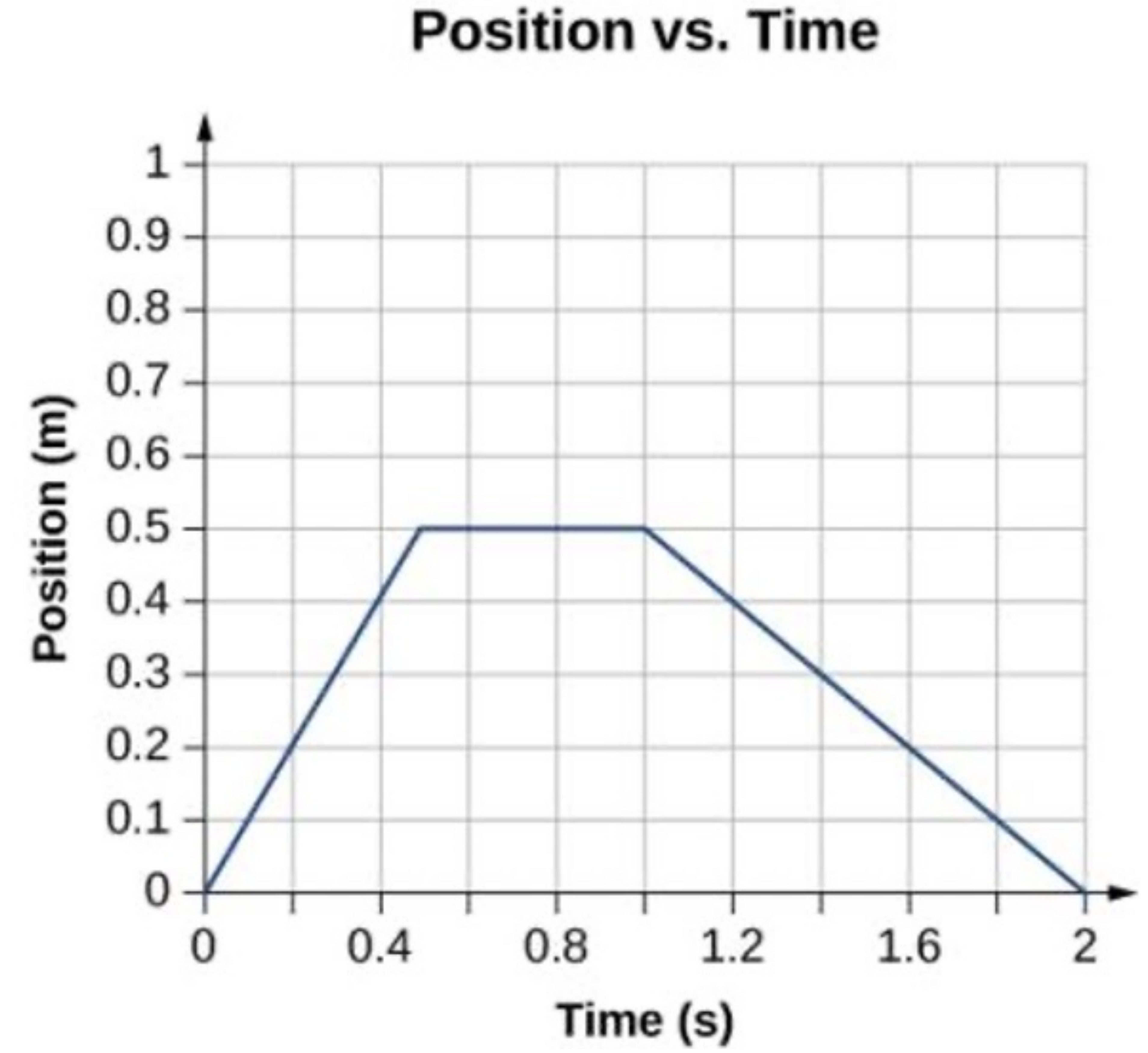
(b) What sign, if any, does the x-component of the acceleration vector, a_x, have at point B (/2)?

Figure 3.1 A JR Central L0 series five-car maglev (magnetic levitation) train undergoing a test run on the Yamanashi Test Track. The maglev train's motion can be described using kinematics, the subject of this chapter. (credit: modification of work by "Maryland GovPics"/Flickr)

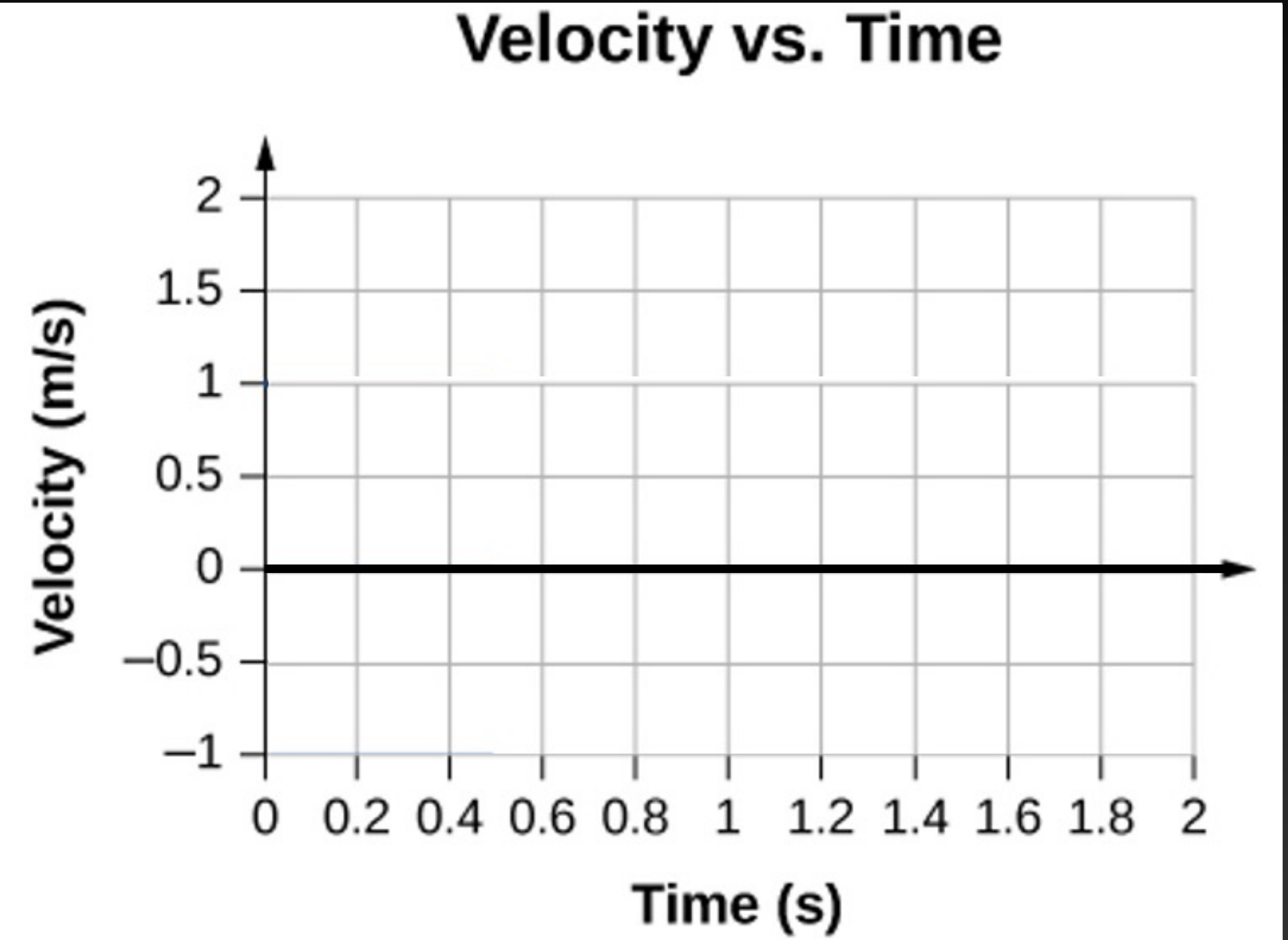
Chapter Outline

Our universe is full of objects in motion. From the stars, planets, and galaxies; to the motion of people and animals; down to the microscopic scale of atoms and molecules—everything in our universe is in motion. We can describe motion using the two disciplines of kinematics and dynamics. We study dynamics, which is concerned with the causes of motion, in Newton's Laws of Motion; but, there is much to be learned about motion without referring to what causes it, and this is the study of kinematics. Kinematics involves describing motion through properties such

Position Graph to Velocity Graph



The object starts out in the positive direction, stops for a short time, and then reverses direction, heading back toward the origin. Notice that the object comes to rest instantaneously, which would require an infinite force. Thus, the graph is an approximation of motion in the real world. (The concept of force is discussed in Newton's Laws of Motion.)



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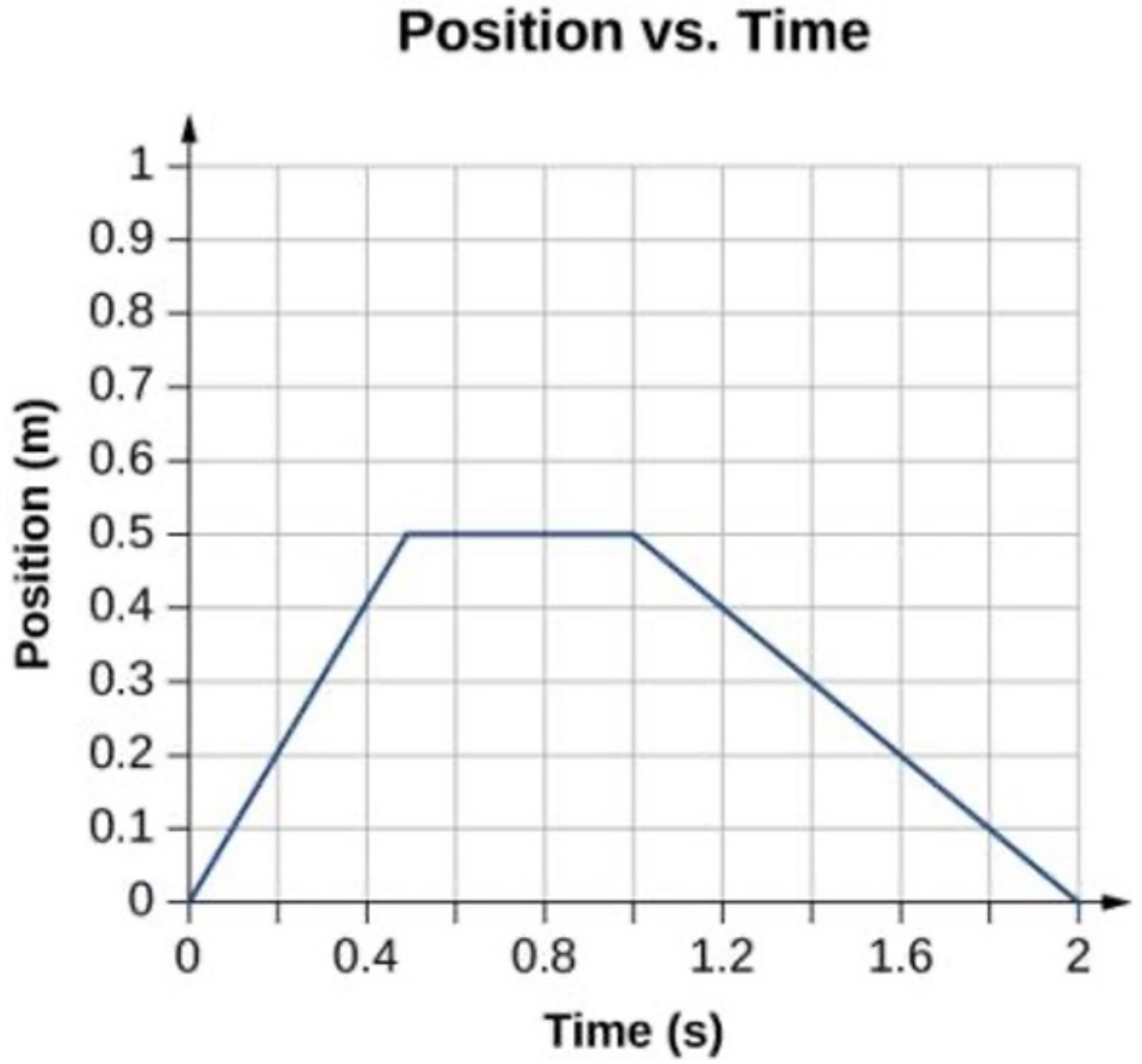

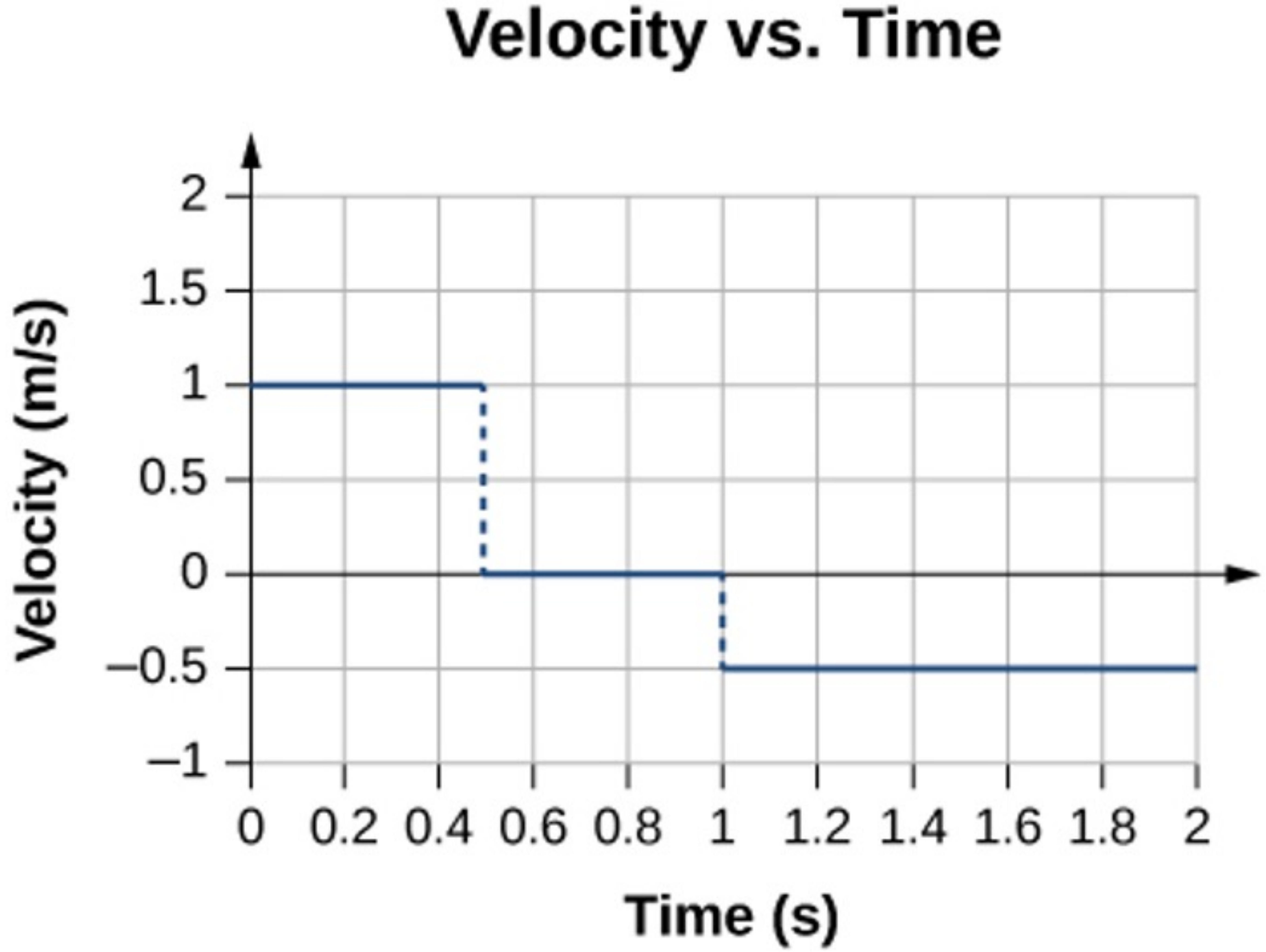

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Key Equations

Displacement	$\Delta x = x_{\mathrm{f}} - x_{\mathrm{i}}$
Total displacement	$\Delta x_{\mathrm{Total}} = \sum \Delta x_{\mathrm{i}}$
Average velocity (for constant acceleration)	$\overline{v} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$
Instantaneous velocity	$v(t) = \frac{dx(t)}{dt}$
Average speed	$\text{Average speed} = \overline{s} = \frac{\text{Total distance}}{\text{Elapsed time}}$
Instantaneous speed	$\text{Instantaneous speed} = \lvert v(t) \rvert$
Average acceleration	$\overline{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_0}{t_f - t_0}$
Instantaneous acceleration	$a(t) = \frac{dv(t)}{dt}$
Position from average velocity	$x = x_0 + \overline{v}t$

Key Equations

Average velocity	$\bar{v} = \frac{v_0+v}{2}$
Velocity from acceleration	$v = v_0 + at \quad (\text{constant } a)$
Position from velocity and acceleration	$x = x_0 + v_0 t + \frac{1}{2}at^2 \quad (\text{constant } a)$
Velocity from distance	$v^2 = v_0^2 + 2a(x - x_0) \quad (\text{constant } a)$
Velocity of free fall	$v = v_0 - gt$ (positive upward)
Height of free fall	$y = y_0 + v_0 t - \frac{1}{2}gt^2$
Velocity of free fall from height	$v^2 = v_0^2 - 2g(y - y_0)$
Velocity from acceleration	$v(t) = \int a(t)dt + C_1$
Position from velocity	$x(t) = \int v(t)dt + C_2$

Clicker Questions

CQ.3.3

Daniel set a timer before he started on a walk. He walked 1.2 km north and then turned and walked 1.6 km east. He then turned and walked straight back to his starting point. The timer showed that the trip took him 56.5 minutes. What was his average speed (in km/h) for the entire trip?

a) 5.1 km/hr

b) –5.1 km/hr

c) 0 km/hr

d) 3.0 km/hr

A B C D E

CQ.3.3

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b) $-5.1\ \text{km/hr}$

c) $0\ \text{km/hr}$

d) $3.0\ \text{km/hr}$

Detailed solution: $d_3 = \sqrt{{d_1}^2 + {d_2}^2} = \sqrt{(1.2\,\text{km})^2 + (1.6\,\text{km})^2} = 2.0\,\text{km}$

$$v_{avg} = \frac{\Delta d}{\Delta t} = \frac{(1.2\ \text{km}+1.6\ \text{km}+2.0\ \text{km})}{56.5\ \ \text{min}} \times \left(\frac{60\ \text{min}}{1\ \text{h}}\right) = 5.1\ \text{km/h}$$

A B C D E

CQ.3.4

A car is moving on a straight road at a constant speed in a single direction. Which of the following statements is true?

a) Average velocity is zero.

b) The magnitude of average velocity is equal to the average speed.

c) The magnitude of average velocity is greater than the average speed.

d) The magnitude of average velocity is less than the average speed.

A

B

C

D

E

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c) The magnitude of average velocity is greater than the average speed.

d) The magnitude of average velocity is less than the average speed.

Detailed solution: The magnitude of its velocity will be equal to the speed if the direction of motion is not changing.

A

B

C

D

E

HW 3 Tips

HW3.2. Throwing Stones

Mateo simultaneously throws two stones from the top edge of a building with a speed 28.4 m/s. They throw one straight down and the other straight up.

The first one hits the street in a time t_1. How much later is it before the second stone hits?

$\Delta t =$ number (3 significant figures) s

Save & Grade *Single attempt* Save only *Additional attempts available with new variants*

HW 3 Tips

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HW 3 Tips

HW3.9. The Magnitude of a Particle's Vector

A particle has a trajectory given as $\vec{r} = $ (4t^2 - 3t)$\hat{\imath} +$ (-4t^2 - 4t)$\hat{\jmath}\, m$ for t given in seconds. What is the magnitude of the velocity vector for this particle at $t =$ 14 s?

Magnitude = number (3 significant figures) m/s ?

Save & Grade *Single attempt* Save only

Additional attempts available with new variants ?

HW 3 Tips

HW3.9. The Magnitude of a Particle's Vector

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Magnitude =	number (3 significant figures)	m/s	?

HW 3 Tips

HW3.10. A Coyote and a Rat

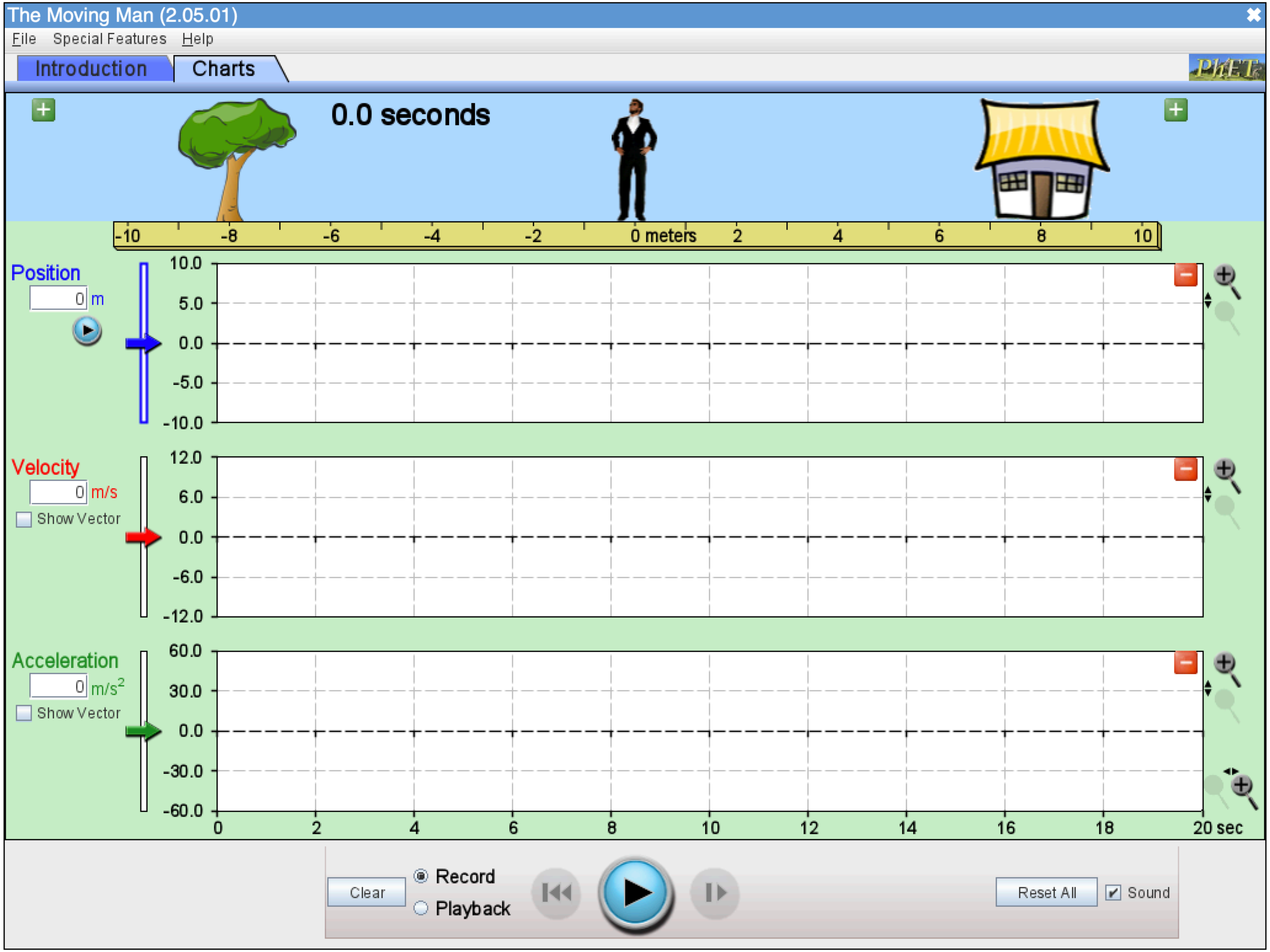
A 15 kg coyote notices a 4 kg rat running past it, but the rat has a possible route to safety. At the end of the field (41 m to the right from where the rat starts) there is a thorny bush. If the rat can reach the bush before the coyote catches it, the coyote will not be able to pursue it any farther. At $t = 0\ s$, the rat is running towards the bush at a constant velocity of 4 m/s, and the coyote is at rest, 30 m to the left of the rat. However, the coyote begins running to the right with an acceleration of $a =$ 4 m/s^2.

Set your reference frame to be located with the origin at the original location of the coyote, and the rightward direction corresponding to x-increasing.

Part 1

Parts 9 and 10 are optional!

Simulation



The Moving Man (2.05.01)
File Special Features Help
Introduction
Charts
0.0 seconds
-10 -8 -6 -4 -2 0 meters 2 4 6 8 10
Position
0 m
Velocity
0 m/s
Show Vector
Acceleration
0 m/s2
Show Vector
0 2 4 6 8 10 12 14 16 18 20 sec
Clear
Record
Playback
Reset All
Sound

See you next class!

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