Physics 121 – September 5, 2017

Assignments:

This week:

- Finish reading Chapter 3 of textbook
- Complete ETA Problem Set #3 by Sept 11 at 4 PM
- Chapter 3 written problems 30, 31, 38, 48, 60, 72, and 96
- Quiz in recitation this week (simple vectors problem)

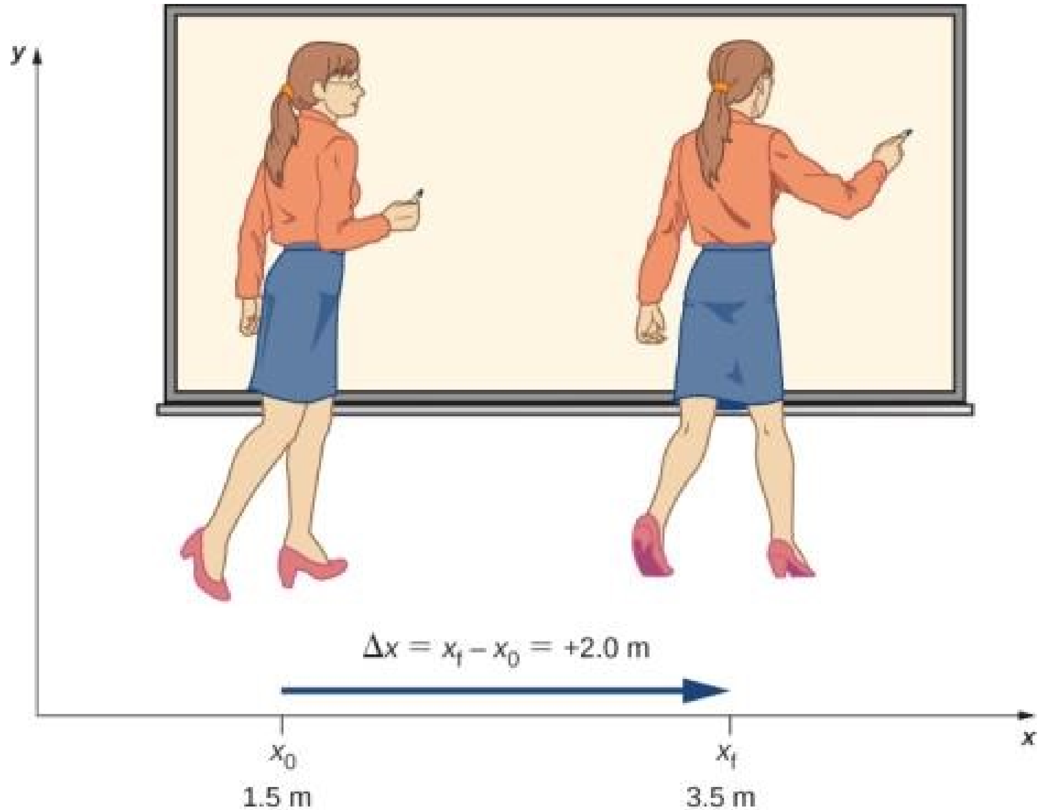
Note: Office hours on Wed and Thur, 2-3 PM

Key concepts in this chapter:

- Displacement
- Average velocity
- Instantaneous velocity
- Difference between velocity and speed
- Average acceleration
- Instantaneous acceleration

FIGURE 3.3

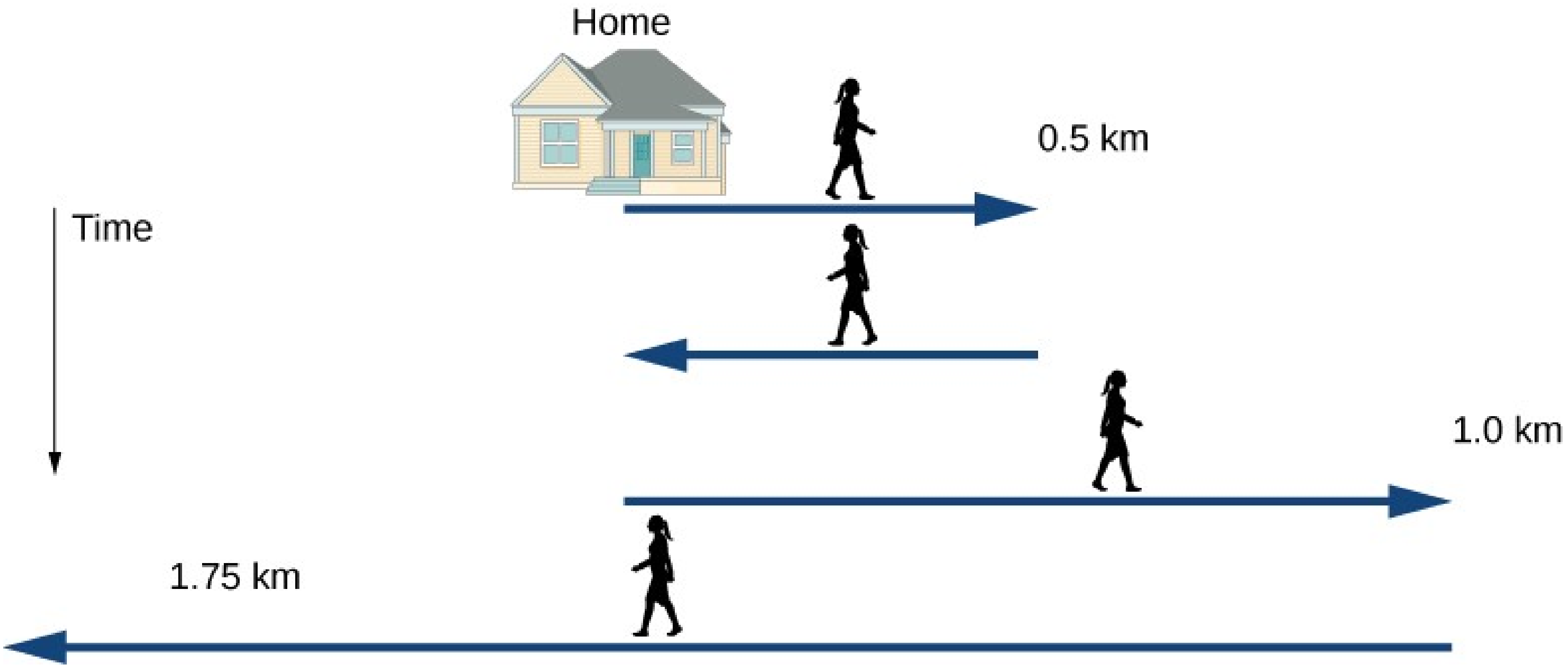
Displacement



A professor paces left and right while lecturing. Her position relative to Earth is given by *x*. The +2.0-m displacement of the professor relative to Earth is represented by an arrow pointing to the right.

FIGURE 3.4

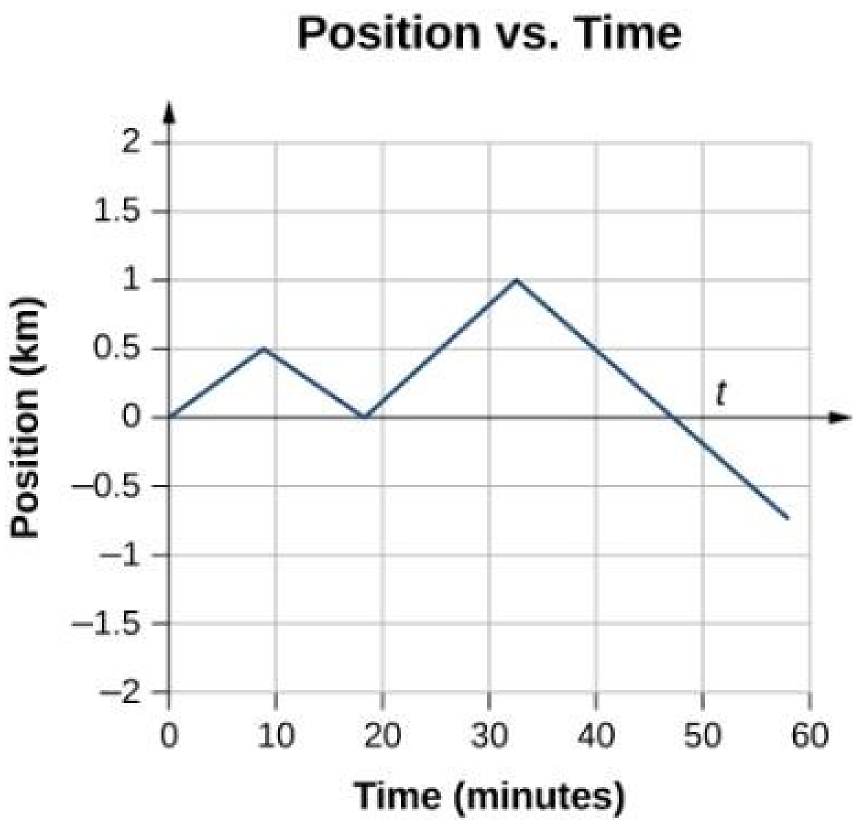
Displacement



Timeline of Jill's movements.

FIGURE 3.5

Displacement



This graph depicts Jill’s position versus time. The average velocity is the slope of a line connecting the initial and final points.

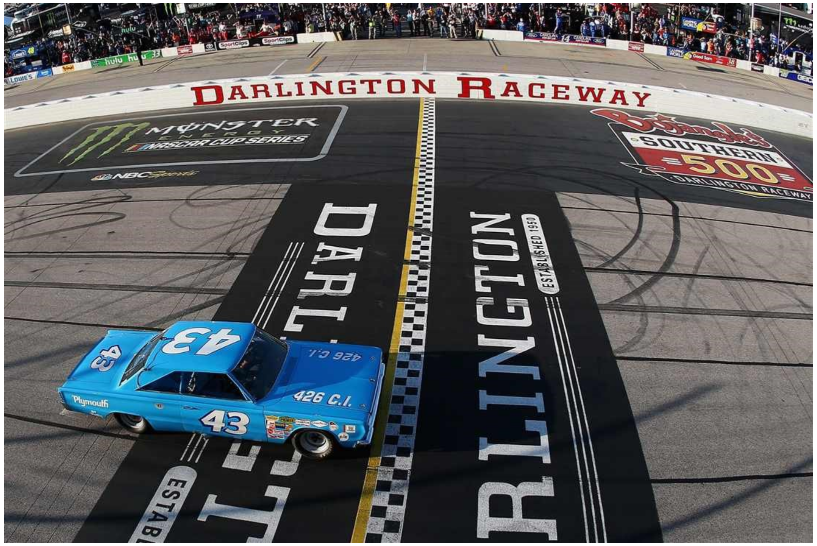
Average speed is **not** the same as average velocity.

Average velocity depends only on the endpoints x_1 and x_2

Average speed depends on the path between x_1 and x_2

Example: Hall of Famer Richard Petty took a few practice laps around Darlington on Sunday prior to the race. If the track is a mile in circumference and it took him 30 seconds to complete a lap, what was his average speed (in mph)?

What was his average velocity?



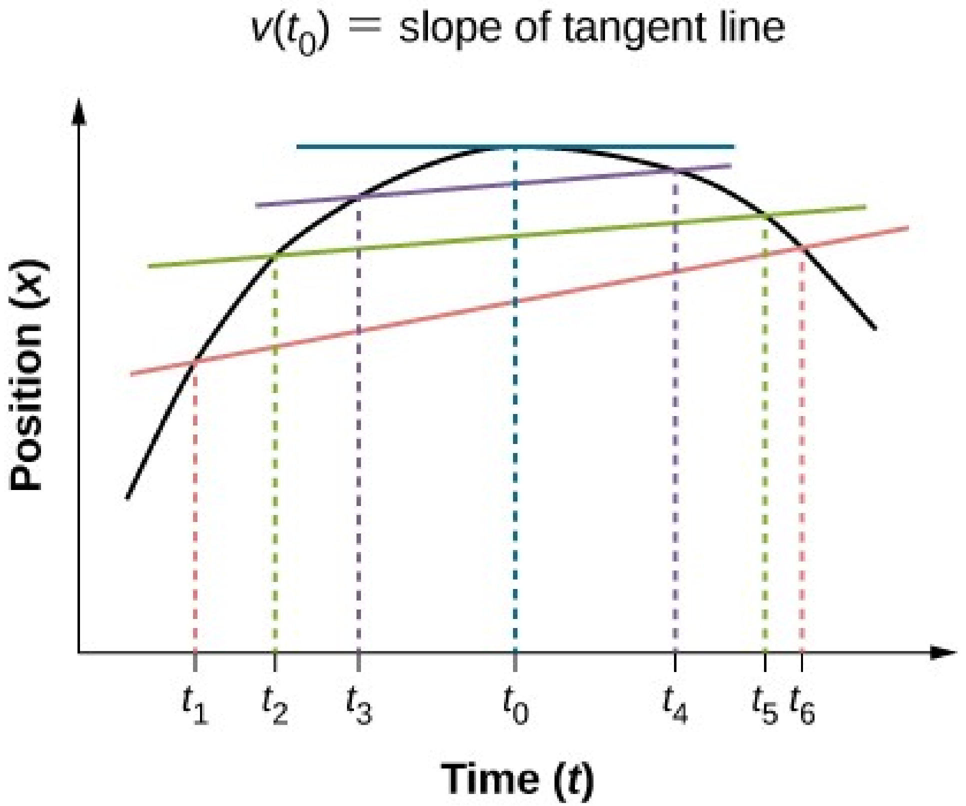
Clicker Question:

Which is always true?

A. Average speed is always less than or equal to average velocity
B. Average speed is always equal to average velocity
C. Average speed is always greater than or equal to average velocity

Average vs instantaneous velocity

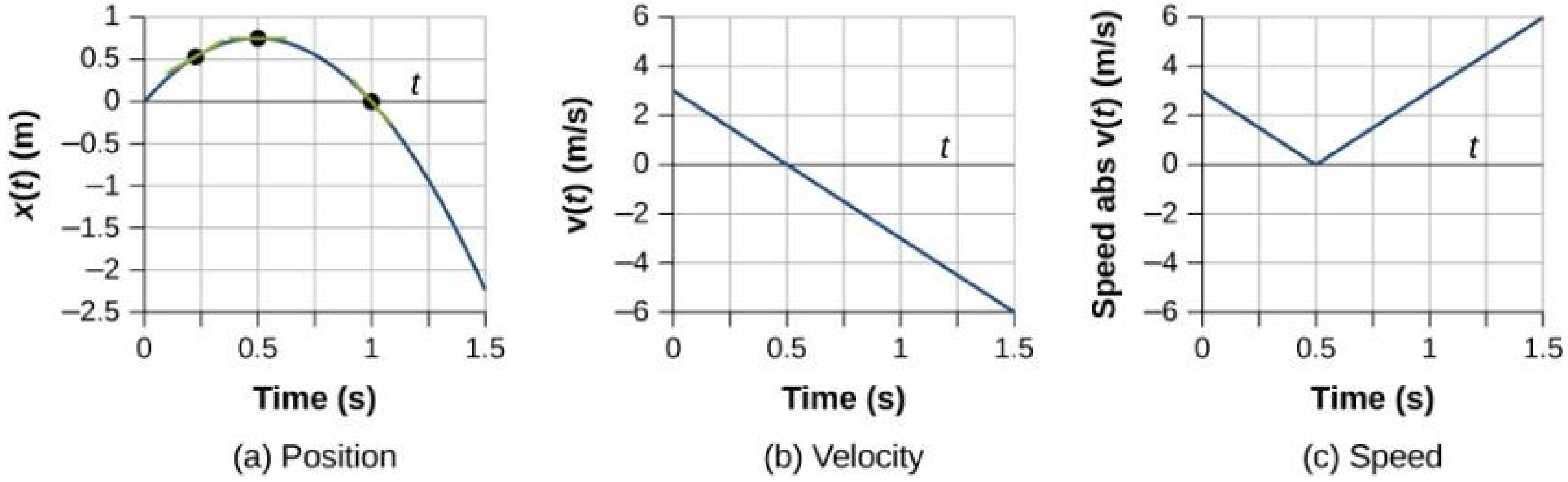
FIGURE 3.6



In a graph of position versus time, the instantaneous velocity is the slope of the tangent line at a given point. The average velocities $\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$ between times $\Delta t = t_6 - t_1$, $\Delta t = t_5 - t_2$, and $\Delta t = t_4 - t_3$ are shown. When $\Delta t \rightarrow 0$, the average velocity approaches the instantaneous velocity at $t = t_0$.

FIGURE 3.9

Displacement, velocity, and speed



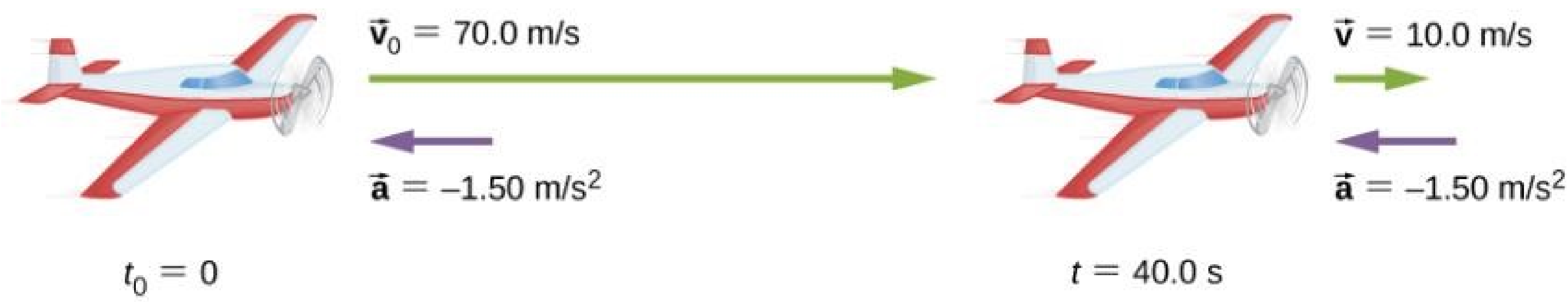
(a) Position: $x(t)$ versus time.

(b) Velocity: $v(t)$ versus time. The slope of the position graph is the velocity. A rough comparison of the slopes of the tangent lines in (a) at 0.25 s, 0.5 s, and 1.0 s with the values for velocity at the corresponding times indicates they are the same values.

(c) Speed: $|v(t)|$ versus time. Speed is always a positive number.

FIGURE 3.19

Acceleration



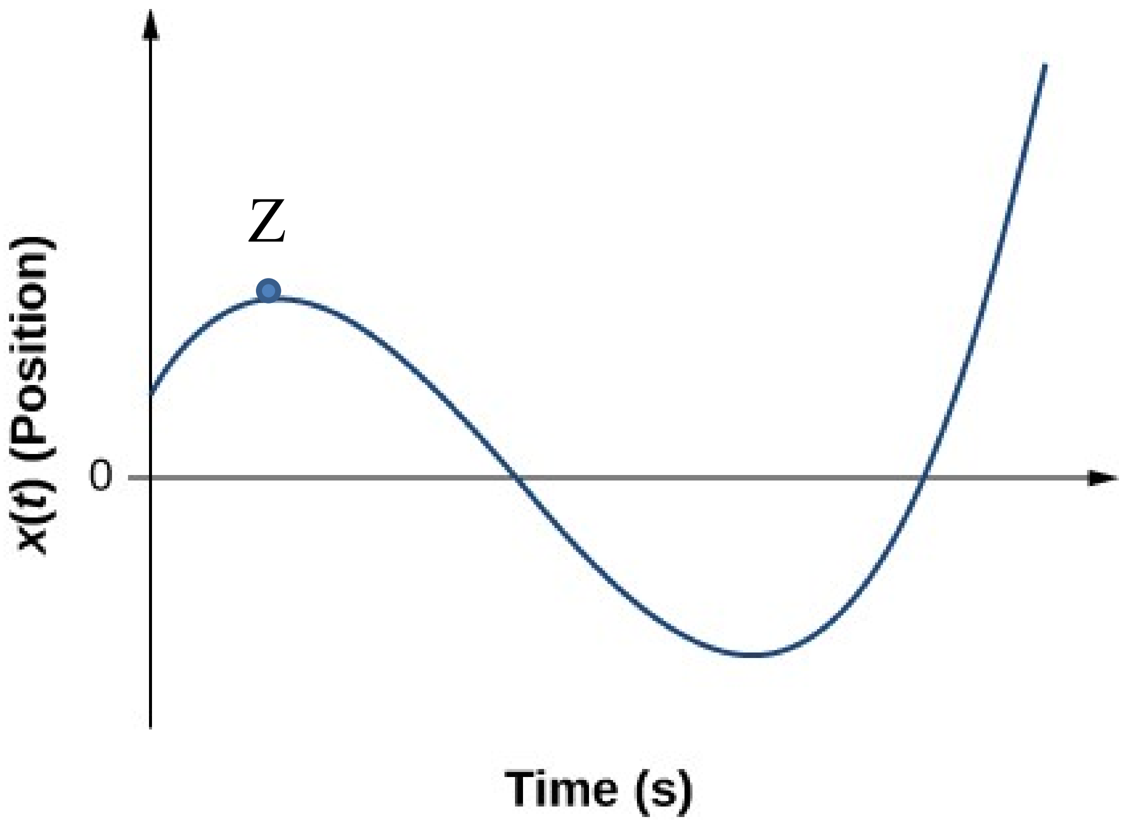
The airplane lands with an initial velocity of 70.0 m/s and slows to a final velocity of 10.0 m/s before heading for the terminal. Note the acceleration is negative because its direction is opposite to its velocity, which is positive.

FIGURE 3.20

Acceleration

U.S. Army Top Fuel pilot Tony “The Sarge” Schumacher begins a race with a controlled burnout. (credit: Lt. Col. William Thurmond. Photo Courtesy of U.S. Army.)

Clicker question

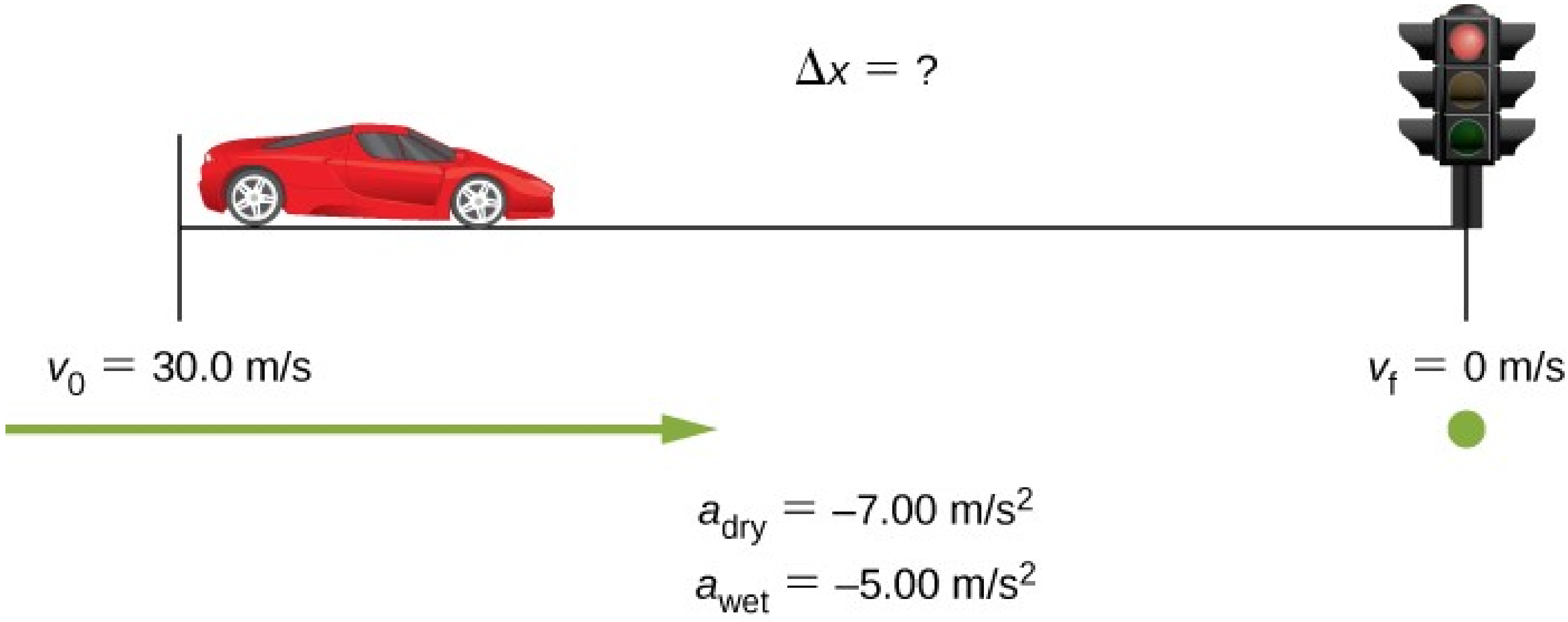


Consider the above plot of x(t), with positive x going upward. The acceleration at point “Z” is

A. positive
B. zero
C. negative

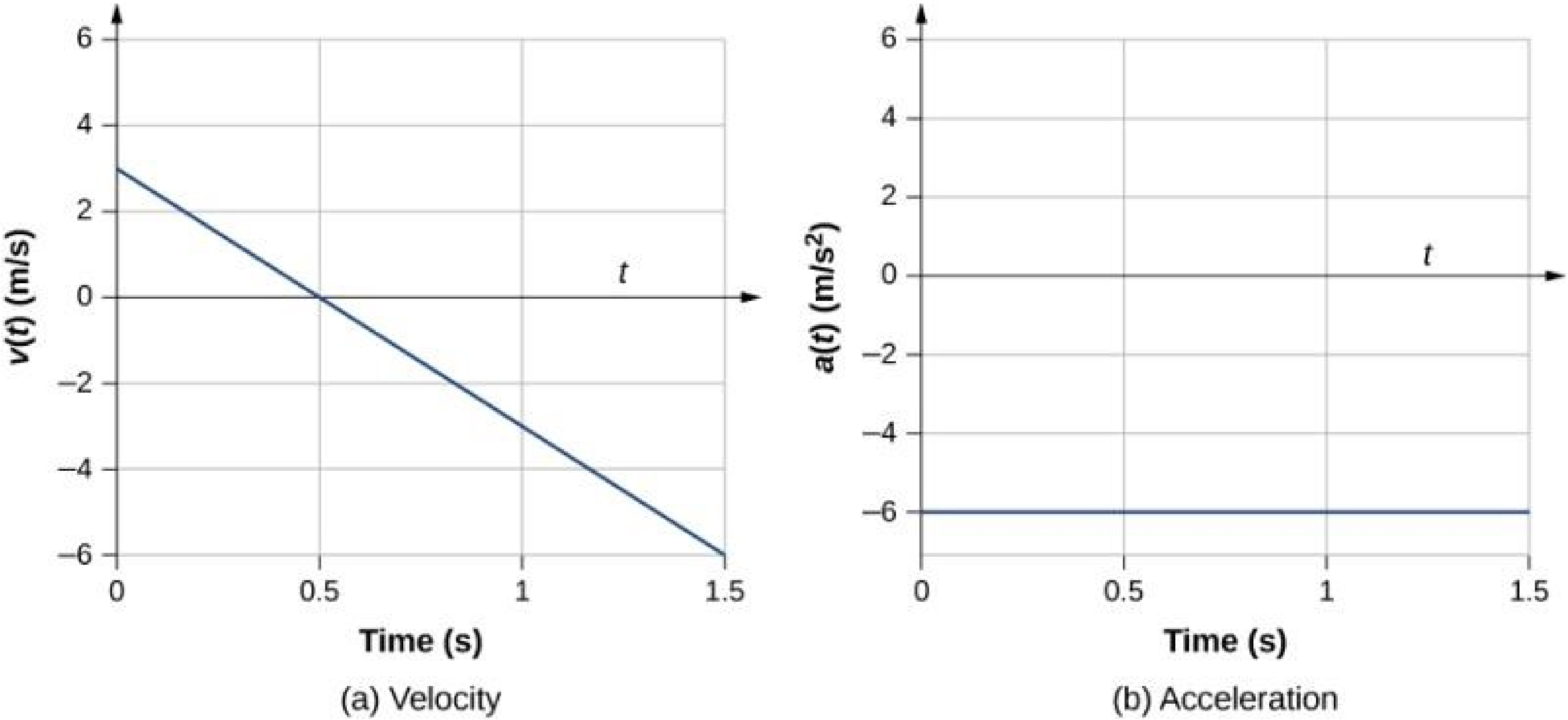
FIGURE 3.22

Acceleration



Sample sketch to visualize deceleration and stopping distance of a car.

FIGURE 3.15



(a, b) The velocity-versus-time graph is linear and has a negative constant slope (a) that is equal to acceleration, shown in (b).