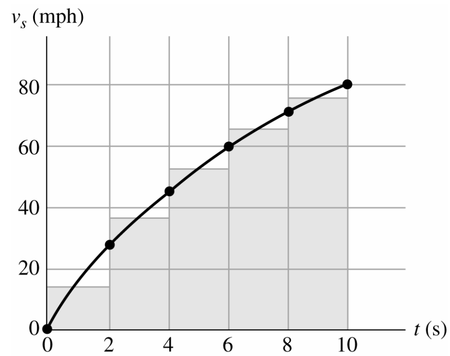
2.42. Model: The automobile is a particle.
Solve: (a)



The acceleration is not constant because the velocity-versus-time graph is not a straight line.
(b) Acceleration is the slope of the velocity graph. You can use a straightedge to estimate the slope of the graph at $t = 2$ s and at $t = 8$ s. Alternatively, we can estimate the slope using the two data points on either side of 2 s and 8 s. Either way, you need the conversion factor 1 mph = 0.447 m/s from Table 1.4.

$$a_x(\text{at 2 s}) \approx \frac{v_x(\text{at 4 s}) - v_x(\text{at 0 s})}{4\text{ s} - 0\text{ s}} = 11.5\frac{\text{mph}}{\text{s}} \times \frac{0.447\text{ m/s}}{1\text{ mph}} = 5.1\text{ m/s}^2$$

$$a_x(\text{at 8 s}) \approx \frac{v_x(\text{at 10 s}) - v_x(\text{at 6 s})}{10\text{ s} - 6\text{ s}} = 4.5\frac{\text{mph}}{\text{s}} \times \frac{0.447\text{ m/s}}{1\text{ mph}} = 2.0\text{ m/s}^2$$

(c) The displacement, or distance traveled, is

$$\Delta x = x(\text{at 10 s}) - x(\text{at 0 s}) = \int_{0\text{ s}}^{10\text{ s}} v_x dx = \text{area under the velocity curve from 0 s to 10 s}$$

We can approximate the area under the curve as the area of five rectangular steps, each with width $\Delta t = 2$ s and height equal to the average of the velocities at the beginning and end of each step.

0 s to 2 s	$v_{avg} = 14$ mph $= 6.26$ m/s	area $= 12.5$ m
2 s to 4 s	$v_{avg} = 37$ mph $= 16.5$ m/s	area $= 33.0$ m
4 s to 6 s	$v_{avg} = 53$ mph $= 23.7$ m/s	area $= 47.4$ m
6 s to 8 s	$v_{avg} = 65$ mph $= 29.1$ m/s	area $= 58.2$ m
8 s to 10 s	$v_{avg} = 74$ mph $= 33.1$ m/s	area $= 66.2$ m

The total area under the curve is ≈ 217 m, so the distance traveled in 10 s is ≈ 217 m.