2.19 •• An antelope moving with constant acceleration covers the distance between two points 70.0 m apart in 6.00 s. Its speed as it passes the second point is 15.0 m/s. What are (a) its speed at the first point and (b) its acceleration?

Image from University Physics w/Moder Hugh Young.

First Step: Do not read the question! Rather, go from the back of the question and identify keywords.

Keywords **acceleration** and **speed**

Given	Needed	Seeking
$a_x = \text{constant}$	$\frac{dv_x}{dt} = a_x$	$\lvert v_{1x}\rvert = ?$
$\lvert v_{2x}\rvert = 15.0\ \frac{\text{m}}{\text{s}}$	$v_x = a_x t + v_{0x}$	$a_x = ?$
$\Delta x = 70.0\ \text{m}$	$\Delta x = \frac{1}{2}(v_{1x} + v_{2x})t$	
$\Delta t = 6.00\ \text{s}$		

Position at time t of a particle with **constant x-acceleration**: $x - x_0 = \frac{1}{2}(v_{0x} + v_x)t$ (2.14)

Position of the particle at time 0; Time; x-velocity of the particle at time 0; x-velocity of the particle at time t

Image from University Physics w/Moder Hugh Young.

[a]

$$\Delta x = \frac{1}{2}(v_{1x} + v_{2x})t \;\Rightarrow\; v_{1x} = \frac{2\Delta x}{t} - v_{2x}$$

$$\Rightarrow\; v_{1x} = \frac{2(70.0\ \text{m})}{6.00\ \text{s}} - \left(15.0\ \frac{\text{m}}{\text{s}}\right) = 8.33\ \frac{\text{m}}{\text{s}}.$$

[b]

$$v_x = a_x t + v_{0x} \;\Rightarrow\; a_x = \frac{\left(15.0\ \frac{\text{m}}{\text{s}}\right) - \left(\frac{2(70.0\ \text{m})}{6.00\ \text{s}} - \left(15.0\ \frac{\text{m}}{\text{s}}\right)\right)}{6.00\ \text{s}}$$

$$= \frac{\left[30.0\ \frac{\text{m}}{\text{s}} - \frac{70.0}{3.00}\right]}{6.00\ \text{s}} = \frac{\left[\frac{20.0}{3.00}\right]}{6.00}\ \frac{\text{m}}{\text{s}^2} = \frac{20.0}{18.0}\ \frac{\text{m}}{\text{s}^2} = 1.11\ \frac{\text{m}}{\text{s}^2}.$$