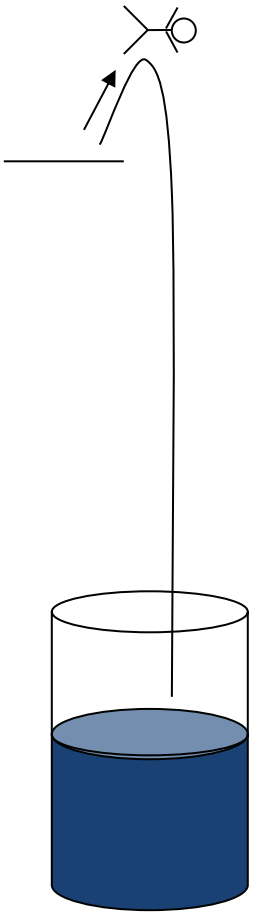
PreCalculus **Name** Solutions

Average & Instantaneous Velocity

Kelli and Kate build a nice springy diving board for Mr. Murphy's next dive into the tank. Because of this, instead of just going straight down off the diving board, Mr. Murphy is able to get some upward motion and therefore some extra height before falling into the water (see diagram below). Gus and Marco attentively study and time Mr. Murphy's path to the water and find the equation for his height to be
$h(t) = 192 + 16t - 16t^2$



1) How long was Mr. Murphy in the air? In other words, when did he land?

$h(t) = 192 + 16t - 16t^2 = 0$

$= -16(t^2 - t - 12) = -16(t-4)(t+3) = 0$ $t = -3, 4$

$t = 4$ seconds

2) Use your calculator to find Mr. Murphy's maximum height and at what time and at what time he reached it.

Window
x-min 0
x-max 4

$t = 0.5$ sec
$Y_1 = 196$ ft

3) Use the derivative to find Mr. Murphy's maximum height and at what time he reached it.

$v(t) = 16 - 32t = 0$
$16 = 32t$
$t = \frac{1}{2}$ seconds

$h(\frac{1}{2}) = 192 + 16(\frac{1}{2}) - 16(\frac{1}{4})$
$= 192 + 8 - 4 = 196$ ft

4) What was Mr. Murphy's average velocity over the period of time that he was in the air?

$\text{Avg velocity} = \frac{h(4) - h(0)}{4 - 0} = \frac{0 - 192}{4} = -48$ ft/sec

slope of a secant line. See 5-1 and 5-2 units on secant line slopes and average velocity

5) What was Mr. Murphy's average velocity from the time he started falling to the time he hit the water?

$$\text{Avg velocity} = \frac{h(4) - h\left(\frac{1}{2}\right)}{4 - \frac{1}{2}} = \frac{0 - 196}{3.5} = -56 \text{ ft/sec}$$

$\frac{1}{2}$ second is when Mr Murphy started falling

6) Find Mr. Murphy's instantaneous velocity at 1, 2, and 3 seconds.

$v(1) = 16 - 32(1) = 16 - 32 = -16$ ft/sec

$v(2) = 16 - 32(2) = 16 - 64 = -48$ ft/sec

$v(3) = 16 - 32(3) = 16 - 96 = -80$ ft/sec

7) Find Mr. Murphy's instantaneous velocity when he hit the water.

$v(4) = 16 - 32(4) = 16 - 128 = -112$ ft/sec