Vertical Motion **In Exercises 97 and 98, use the position function $s(t) = -16t^2 + v_0 t + s_0$ for free-falling objects.**

97. A silver dollar is dropped from the top of a building that is 1362 feet tall.

(a) Determine the position and velocity functions for the coin.

(b) Determine the average velocity on the interval $[1, 2]$.

(c) Find the instantaneous velocities when $t = 1$ and $t = 2$.

(d) Find the time required for the coin to reach ground level.

(e) Find the velocity of the coin at impact.

Vertical Motion **In Exercises 97 and 98, use the position function $s(t) = -16t^2 + v_0 t + s_0$ for free-falling objects.**

98. A ball is thrown straight down from the top of a 220-foot building with an initial velocity of -22 feet per second. What is its velocity after 3 seconds? What is its velocity after falling 108 feet?

Vertical Motion **In Exercises 99 and 100, use the position function $s(t) = -4.9t^2 + v_0t + s_0$ for free-falling objects.**

99. A projectile is shot upward from the surface of Earth with an initial velocity of 120 meters per second. What is its velocity after 5 seconds? After 10 seconds?

Vertical Motion **In Exercises 99 and 100, use the position function $s(t) = -4.9t^2 + v_0t + s_0$ for free-falling objects.**

100. To estimate the height of a building, a stone is dropped from the top of the building into a pool of water at ground level. The splash is seen 5.6 seconds after the stone is dropped. What is the height of the building?

 Solution Key

Vertical Motion In Exercises 97 and 98, use the position function $s(t) = -16t^2 + v_0 t + s_0$ for free-falling objects.

97. A silver dollar is dropped from the top of a building that is 1362 feet tall. $V_0 = 0$ $S_0 = 1362$

(a) Determine the position and velocity functions for the coin.

a) $s(t) = -16t^2 + 0t + 1362$ $v(t) = -32t$

(b) Determine the average velocity on the interval [1, 2].

(c) Find the instantaneous velocities when $t = 1$ and $t = 2$.

(d) Find the time required for the coin to reach ground level. * set $s(t) = 0$

(e) Find the velocity of the coin at impact.

b) avg. velocity $= \frac{s(2)-s(1)}{2-1} = \frac{1298-1346}{2-1} =$ **-48 ft/s**

$s(1) = 1346$

$s(2) = 1298$

e) $v(9.226) \approx$ **-295.242 ft/s**

c) $v(1) = -32$ ft/s

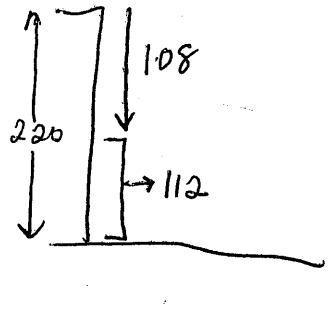
$v(2) = -64$ ft/s

d) $0 = -16t^2 + 1362$ $16t^2 = 1362$ $t^2 = \frac{1362}{16}$ $t = \sqrt{\frac{1362}{16}}$ **$t \approx 9.226$ secs.**

Vertical Motion In Exercises 97 and 98, use the position function $s(t) = -16t^2 + v_0 t + s_0$ for free-falling objects.

$V_0 = -22$ ft/s $S_0 = 220$

98. A ball is thrown straight down from the top of a 220-foot building with an initial velocity of -22 feet per second. What is its velocity after 3 seconds? What is its velocity after falling 108 feet?



height/position $= 220 - 108 = 112$ ft.

* height is measured from the ground up.

$s(t) = -16t^2 - 22t + 220$

$v(t) = -32t - 22$

$v(3) = -32(3) - 22 = -118$ ft/s

* Find t when $h(t) = 112$, then find $v(t)$

$112 = -16t^2 - 22t + 220$

$0 = -16t^2 - 22t + 108$

$0 = -2(8t^2 + 11t - 54)$

$-2(t-2)(8t+27) = 0$

$t = 2$ $t = -\frac{27}{8}$

$v(2) = -32(2) - 22$

$=$ **-86 ft/s**

Vertical Motion **In Exercises 99 and 100, use the position function $s(t) = -4.9t^2 + v_0t + s_0$ for free-falling objects.**

$V_0 = 120$ m/s

$S_0 = 0$

99. A projectile is shot upward from the surface of Earth with an initial velocity of 120 meters per second. What is its velocity after 5 seconds? After 10 seconds?

$s(t) = -4.9t^2 + 120t + 0$

$s'(t) = -9.8t + 120$

$s'(5) = -9.8(5) + 120 = \boxed{71 \text{ m/s}}$

$s'(10) = -9.8(10) + 120 = \boxed{22 \text{ m/s}}$

Vertical Motion **In Exercises 99 and 100, use the position function $s(t) = -4.9t^2 + v_0t + s_0$ for free-falling objects.**

$V_0 = 0$

$S_0 = S_0$

100. To estimate the height of a building, a stone is dropped from the top of the building into a pool of water at ground level. The splash is seen 5.6 seconds after the stone is dropped. What is the height of the building?

$s(t) = -4.9t^2 + 0t + S_0$ * $s(t) = 0$ when $t = 5.6$ sec.

$0 = -4.9(5.6)^2 + S_0$

$S_0 = 4.9(5.6)^2$

$\boxed{S_0 \approx 153.7 \text{ m}}$