Honors Algebra 1
9.7 Vertical Velocity

Name:
Period: key

Warm Up! Solve the equations by factoring. Remember to Factor out a GCF First (if possible).

1) $4x^2 - 9 = 0$ $x = \pm\frac{3}{2}$
$(2x-3)(2x+3)=0$
$2x-3=0$ $2x+3=0$

2) $18x^2 - 8 = 0$ $x = \pm 2/3$
$2(9x^2-4)=0$
$2(3x+2)(3x-2)=0$
$3x+2=0$ $3x-2=0$

3) $x^2 + 2x - 15 = 0$ $x = 3, -5$
$(x+5)(x-3)=0$
$x+5=0$ $x-3=0$

4) $5x^2 + 34x - 7 = 0$ $x = \frac{1}{5}, -7$
$(5x-1)(x+7)=0$
$5x-1=0$ $x+7=0$
$x=\frac{1}{5}$ $x=-7$

5) $3x^2 - 48 = 0$ $x = \pm 4$
$3(x^2-16)=0$
$3(x+4)(x-4)=0$
$x+4=0$ $x-4=0$

6) $3x^2 + 24x = 0$ $x = 0, -8$
$3x(x+8)=0$
$3x=0$ $x+8=0$
$x=0$ $x=-8$

Vertical Motion

The height of an object above the ground, in feet, is given by:

height $h(t) = -16t^2 + v_0 \cdot t + h_0$ *

- v_0 is the initial vertical velocity measured in $\frac{ft}{s}$
- t is time measured in seconds
- h_0 is the initial height, measured in feet

velocity: directional speed

1. An athlete throws a discus from an initial height of 6 feet with an initial vertical velocity of 46 $\frac{ft}{s}$.

$h_0 = 6ft$ $V_0 = 46\ ft/s$

a. Write an equation that gives the height (in feet) of the discus as a function of time (in seconds) since it left the athlete's hand.

$h(t) = -16t^2 + 46t + 6$

b. After how many seconds does the discus hit the ground? $h(t)=0$

$0 = -16t^2 + 46t + 6$
$0 = -2(8t^2 - 23t - 3)$
$0 = -2(8t+1)(t-3)$
$0=8t+1$ $0=t-3$
$-1 \quad -1$
$t=-1/8$ $t=3$ sec.

2. An athlete hits a tennis ball at an initial height of 8 feet with an initial vertical velocity of 62 $\frac{ft}{s}$.

a. Write the vertical motion equation that models this situation. $h_0 = 8ft$ $V_0 = 62\ ft/s$

$h(t) = -16t^2 + 62t + 8$

b. After how many seconds does the ball hit the ground? $h(t)=0$

$0 = -16t^2 + 62t + 8$
$0 = -2(8t^2 - 31t - 4)$
$0 = -2(8t+1)(t-4)$
$8t+1=0$ $t-4=0$
$t=-\frac{1}{8}$ $t=4$ seconds

3. A football is kicked from the ground with an initial vertical velocity of 48 ft/s. How long will it be before it hits the ground? $V_0 = 48$ ft/s $h_0 = 0$ ft $h(t) = 0$

$0 = -16t^2 + 48t + 0$
$0 = -16t(t - 3)$
$0 = -16t$ $0 = t$ $0 = t - 3$ $3 = t$
3 seconds

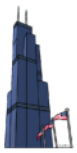
4. A cat leaps from the ground into the air with an initial vertical velocity of 11 ft/s. After how many seconds does the cat land on the ground?

$h_0 = 0$ ft
$V_0 = 11$ ft/s
$h(t) = 0$ ft
$0 = -16t^2 + 11t + 0$
$0 = -t(16t - 11)$
$0 = -t$ $0 = 16t - 11$
$0 = t$
$t = \frac{11}{16}$ sec

5. You drop a rock from a tall cliff. How long does it take for the rock to hit the bottom, 144 ft below the cliff?

$h_0 = 144$ ft
$V_0 = 0$ ft/s
$h(t) = 0$ ft
$0 = -16t^2 + 0t + 144$
$0 = -16(t^2 - 9)$
$0 = -16(t + 3)(t - 3)$
$0 = t + 3$ $0 = t - 3$
~~$-3 = t$~~ $3 = t$
$t = 3$ seconds

6. A ball is dropped from the top of a 50 ft building. How long does it take before it hits the ground? (You will need to use the $\sqrt{\ }$ on the calculator to solve this one)



$h_0 = 50$ ft
$V_0 = 0$ ft/s
$h(t) = 0$ ft
$0 = -16t^2 + 0t + 50$
$0 = -16t^2 + 50$
-50 -50
$\frac{-50}{-16} = \frac{-16t^2}{-16}$ → $\sqrt{3.125} = \sqrt{t^2}$
$1.77 \text{ sec} = t$

7. In a shot put event, an athlete throws the shot put with an initial vertical velocity of 38 ft/s and releases it from a height of 5 ft. How high above the ground is it after 2 sec?

$V_0 = 38$ ft/s
$h_0 = 5$ ft
$t = 2$ sec
$h(t) = -16(2)^2 + 38(2) + 5$
$h(t) = 17$ ft

8. A hickory nut falls from a branch that is 100 ft above the ground. After how many seconds does the hickory nut land on the ground?

$h_0 = 100$ ft
$V_0 = 0$ ft/s
$h(t) = 0$ ft
$0 = -16t^2 + 0t + 100$
$0 = -4(4t^2 - 25)$
$0 = -4(2t - 5)(2t + 5)$
$0 = 2t - 5$ $0 = 2t + 5$
$+5$ $+5$ -5 -5
$5 = 2t$ $-5 = 2t$
$t = \frac{5}{2}$ sec $t = -\frac{5}{2}$

Factor:

9. $-3x^3 + 75x = 0$
$-3x(x^2 - 25) = 0$
$-3x(x + 5)(x - 5) = 0$
$-3x = 0$ $x + 5 = 0$ $x - 5 = 0$
$x = 0$ $x = -5$ $x = 5$

10. $x^2 - 2x - 15 = 0$
$(x - 5)(x + 3) = 0$
$x - 5 = 0$ $x + 3 = 0$
$x = 5$ $x = -3$

11. $48x^2 = 16x$
$48x^2 - 16x = 0$
$16x(3x - 1) = 0$
$16x = 0$ $3x - 1 = 0$
$x = 0$ $x = 1/3$

1. $5x^2 + 33x - 14 = 0$
$(5x - 2)(x + 7) = 0$
$5x - 2 = 0$ $x + 7 = 0$
$+2$ $+2$
$5x = 2$
$x = 2/5$ $x = -7$