Name: _____

Date: _____ Period: ___

Quadratic Formula Word Problems

1. Jason jumped off of a cliff into the ocean in Acapulco while vacationing with some friends. His height as a function of time could be modeled by the function $h(t) = -16t^2 + 16t + 480$, where t is the time in seconds and h is the height in feet. (time, height)

a. How long did it take for Jason to reach his maximum height? (time)

$x = \frac{-(16)}{2(-16)} = \frac{-16}{-32} = \frac{1}{2}$

It took $\frac{1}{2}$ second to get to the Max height.

b. What was the highest point that Jason reached?

$y = -16\left(\frac{1}{2}\right)^2 + 16\left(\frac{1}{2}\right) + 480$

$= 484$

The maximum height is 484 ft.

c. Jason hit the water after how many seconds? (x-intercept)

10 seconds

$x = \frac{-(16) \pm \sqrt{(16)^2 - 4(-16)(480)}}{2(-16)} = \frac{-16 \pm \sqrt{30,976}}{-32} = \frac{-16 \pm 176}{-32}$

$\frac{-16+176}{-32} = -5$ ↓ $\frac{-16-176}{-32} = 6$

2. If a toy rocket is launched vertically upward from ground level with an initial velocity of 128 feet per second, then its height *h* after *t* seconds is given by the equation $h(t) = -16t^2 + 128t$ (if air resistance is neglected). (time, height)

a. How long will it take for the rocket to return to the ground? x-intercept

$-16t^2 + 128t = 0$

$-16t(t - 8) = 0$

$\frac{-16t}{-16} = \frac{0}{-16}$

$t = 0$

$t - 8 = 0$

$+8 \quad +8$

$t = 8$

8 seconds to return to the ground

b. After how many seconds will the rocket be 112 feet above the ground?

$-16t^2 + 128t = 112$

$-16t^2 + 128t - 112 = 0$

$-16(t^2 - 8 + 7) = 0$

$-16(t-7)(t-1) = 0$

$t = 7 \quad t = 1$

c. How long will it take the rocket to hit its maximum height? (Vertex)

$x = \frac{-(128)}{2(-16)} = 4$

4 seconds to get to the Max. height.

d. What is the maximum height?

$y = -16(4)^2 + 128(4)$

$= 256$

Max height is 256 ft!

3. A rocket is launched from atop a 101 – foot cliff with an initial velocity of 116 ft/s.

a. Substitute the values into the vertical motion formula $h(t) = -16t^2 + vt + h_0$. Let h(t) = 0

b. Use the quadratic formula to find out how long the rocket will take to hit the ground after it is launched. Round to the nearest tenth of a second.

(a) $-16t^2 + 116t + 101$

(b) $x = \dfrac{-(116) \pm \sqrt{(116)^2 - 4(-16)(101)}}{2(-16)}$

$x = \dfrac{-116 \pm \sqrt{19920}}{-32}$

Throw away the neg answer!

$\dfrac{-116 + \sqrt{19920}}{-32}$ $\quad$ $\dfrac{-116 - \sqrt{19920}}{-32}$

$x = +0.7$ $\quad$ $x = 8.04$ Sec

4. You and a friend are hiking in the mountains. You want to climb to a ledge that is 20 ft. above you. The height of the grappling hook you throw is given by the function $h(t) = -16t^2 - 32t + 5$. What is the maximum height of the grappling hook? Can you throw it high enough to reach the ledge?

Maximum Height - Vertex

$-16t^2 - 32t + 5 = 0$ $\quad$ $(-1, 21)$

$x = \dfrac{-(-32)}{2(-16)} = \dfrac{+32}{-32} = -1$

$y = -16(-1)^2 - 32(-1) + 5$

$= 21$

∴ You need to throw the hook 20ft - the Maximum height of the Vertex is 21. Yes - you have enough reach.

5. You are trying to dunk a basketball. You need to jump 2.5 ft. in the air to dunk the ball. The height that your feet are above the ground is given by the function $h(t) = -16t^2 + 12t$. What is the maximum height your feet will be above the ground? Will you be able to dunk the basketball?

$h(t) = -16t^2 + 12t$

$x = \dfrac{-(12)}{2(-16)} = \dfrac{-12}{-32} = 0.375$

$(0.375, 2.25)$

$y = -16(0.375)^2 + 12(0.375)$

$y = 2.25$

He needs a vertical jump of 2.5, therefore he will not dunk with a vertical of 2.25.

6. A diver is standing on a platform 24 ft. above the pool. He jumps form the platform with an initi8al upward velocity of 8 ft/s. Use the formula $h(t) = -16t^2 + vt + s$, where h is his height above the water, t is the time, v is his starting upward velocity, and s is his starting height. How long will it take for him to hit the water? (x-intercept)

$h(t) = -16t^2 + 8t + 24$

$-8(2t^2 - t - 3) = 0$

Bottom's Up

$t^2 - t - 6 = 0$

$(t - \frac{3}{2})(t + \frac{2}{2}) = 0$

$t = 3/2$ $\quad$ ~~$t = -1$~~

* It will take him 1.5 sec. to hit the water.

. A ball is thrown upward from a height of 15 ft. with an initial upward velocity of 5 ft/s. Use the formula $h(t) = -16t^2 + vt + s$ to find how long it will take for the ball to hit the ground. (x-intercept)

$h(t) = -16t^2 + 5t + 15$

$a = -16$

$b = 5$

$c = 15$

$x = \frac{-(5) \pm \sqrt{(5)^2 - 4(-16)(15)}}{2(-16)}$

$= \frac{-5 \pm \sqrt{985}}{-32}$

~~$x = -0.8$~~

$x = 1.14$ sec

8. One of the games at a carnival involves trying to ring a bell with a ball by hitting a lever that propels the ball into the air. The height of the ball is modeled by the equation $h(t) = -16t^2 + 39t$. If the bell is 25 ft. above the ground, will it be hit by the ball?

$h(t) = -16t^2 + 39t$

Vertex = (1.2, 23.75)

$x = \frac{-(39)}{2(-16)} = \frac{-39}{-32} = 1.2$

$y = -16(1.2)^2 + 39(1.2) = 23.75$

∴ No, the bell will not hit the bell.

9. A ship drops anchor in a harbor. The anchor is 49 ft. above the surface of the water when it is released. Use the vertical motion formula $h = -16t^2 + vt + s$ to answer the following questions.

a. What is the value of x, the starting height?

b. What is the value of h when the anchor hits the water?

c. The starting velocity is zero. After how many seconds will the anchor hit the water?

10. An amateur rocketry club is holding a competition. There is cloud cover at 1000 ft. If a rocket is launched with a velocity of 315 ft/s, use the function $h(t) = -16t + vt + h_0$ to determine how long the rocket is out of sight.