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.

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

time

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

vertex: use $x = \frac{-b}{2a}$

* how long it takes to get to the max.

b. What was the highest point that Jason reached?

$h(1/2) = -16(1/2)^2 + 16(1/2) + 480$

$= 484$ feet

c. Jason hit the water after how many seconds?

find the x intercepts

time

$b^2 - 4ac$

$(16)^2 - 4(-16)(480)$

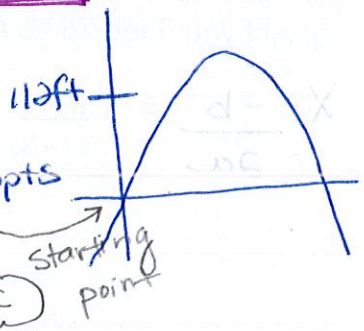
30464

$x = \frac{-16 \pm \sqrt{30464}}{2(-16)}$

$+ \rightarrow -4.95$ * time can't be negative

$- \rightarrow 5.95 \approx 6$ secs

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).



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

time

$b^2 - 4ac$

$(128)^2 - 4(-16)(0)$

16384

$x = \frac{-128 \pm \sqrt{16384}}{2(-16)}$

find x intercepts

$+ \rightarrow 0$ sec

$- \rightarrow 8$ sec

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

time → t/(x)

y

$h(t) = -16t^2 + 128t$

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

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

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

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

$t = 1$ sec → going up

$t = 7$ sec → going down

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

x time

vertex

$x = \frac{-b}{2a} = \frac{-128}{2(-16)} = \frac{-128}{-32} = 4$ sec

d. What is the maximum height?

y value of vertex

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

$= 256$ ft

EX: 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.

$h(t) = -16t^2 + vt + h_0$

101 ft cliff → original height → h_0

116 ft/s → initial velocity → v

$h(t) = -16t^2 + 116t + 100$

Use this equation to find...

$b^2 - 4ac$

$(116)^2 - 4(-16)(100)$

19856

OR

$x = \frac{-116 \pm \sqrt{19856}}{2(-16)}$

$= -.78$ or $= 8.03$ sec

this is our answer. Time is always (+)

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? yes.

vertex

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

$= \frac{32}{-32}$

$x = -1$ sec ← * for this problem only time is neg *

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

$= 21$ ft

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? NO. Vertex

$x = \frac{-b}{2a} = \frac{-12}{2(-16)} = .375$ sec

$h(.375) = -16(.375)^2 + 12(.375)$

$= 2.25$ ft

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? → solve for x intercept

x time

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

$b^2 - 4ac$

$(8)^2 - 4(-16)(24)$

1600

OR

$x = \frac{-8 \pm \sqrt{1600}}{2(-16)}$ / time can't be neg.

$\frac{3}{2}$ or 1.5 sec

7. 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

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

$b^2 - 4ac$

$(5)^2 - 4(-16)(15)$

985

DR

$x = \frac{-5 \pm \sqrt{985}}{2(-16)}$

$\nearrow -0.82$ time can't be neg.

$\searrow$ 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? Max height of the ball

$x = \frac{-b}{2a} = \frac{-39}{2(-16)} = \frac{-39}{-32} = 1.22$ sec

time @ max

$h(1.22) = -16(1.22)^2 + 39(1.22)$

$= 23.78$ ft NO.

~~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.

11. A trebuchet launches a projectile on a parabolic arc at a velocity of 35 ft/s. Using the function $h(t) = -16t + vt + h_0$, determine when the projectile will first reach a height of 80 ft., and how many seconds later will it again be 80 feet.

12. During World War I, mortars were fired from trenches 3 feet down. The mortars had a velocity of 150 ft/s. Determine how long it will take for the mortar shell to strike its target.