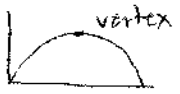
Name: KEY
Date: 3/5-6 Period: 6/7

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)

Find vertex $x = \frac{-b}{2a} = \frac{-(16)}{2(-16)} = \frac{-16}{-32} =$ $\frac{1}{2}$ second

b. What was the highest point that Jason reached?

Find vertex y by substituting answer to part a into the function.

$h(\frac{1}{2}) = -16(\frac{1}{2})^2 + 16(\frac{1}{2}) + 480$
$= -16(\frac{1}{4}) + 8 + 480$
$= -4 + 8 + 480$
$h(\frac{1}{2}) =$ 484 feet

c. Jason hit the water after how many seconds?

↳ height = 0

$-16t^2 + 16t + 480 = 0$
$-16(t^2 - t - 30) = 0$
$-16(t-6)(t+5) = 0$

$t - 6 = 0$ or $t + 5 = 0$ (can't have negative time)
$t = 6$ sec. $t = -5$ sec.

After 6 seconds.

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? (height = 0)

$h(t) = -16t^2 + 128t$
$-16t^2 + 128t = 0$
$-16t(t-8) = 0$

$-16t = 0$ or $t - 8 = 0$
$t = 0$ sec. $t = 8$ sec.
↳ starts out on the ground at 0 seconds — returns to the ground

After 8 seconds.

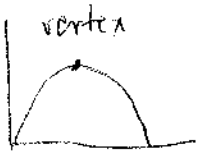
b. After how many seconds will the rocket be 112 feet above the ground?

$112 = -16t^2 + 128t$
$16t^2 - 128t + 112 = 0$
$16(t^2 - 8t + 7) = 0$

$16(t-7)(t-1) = 0$
$t - 7 = 0$ or $t - 1 = 0$
$t = 7$ sec. $t = 1$ sec

After 1 sec and 7 sec.

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



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

d. What is the maximum height?

$h(4) = -16(4)^2 + 128(4)$
$= -16(16) + 512$
$= -256 + 512$
$h(4) =$ 256 feet

3. A rocket is launched from atop a 101 (h_0) – foot cliff with an initial velocity of 116 ft/s. (v)

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) $0 = -16t^2 + 116t + 101$

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

$t = -0.7856$ or $t = 8.0356$

$t = 8.0$ sec.

$t = -0.8$ sec can't have negative time

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?

① Find vertex y-value

vertex $x = \dfrac{-b}{2a} = \dfrac{-32}{2(-16)} = \dfrac{-32}{-32} = 1$ sec

vertex $y \Rightarrow h(1) = -16(1)^2 + 32(1) + 5$

$= -16 + 32 + 5$

$= 21$ feet

This is long enough to reach the 20 ft ledge.

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?

① Find vertex y-value

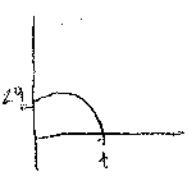
vertex $x = \dfrac{-b}{2a} = \dfrac{-12}{2(-16)} = \dfrac{-12}{-32} = \dfrac{3}{8}$ sec

vertex $y \Rightarrow h\left(\frac{3}{8}\right) = -16\left(\frac{3}{8}\right)^2 + 12\left(\frac{3}{8}\right)$

$h\left(\frac{3}{8}\right) = \frac{9}{4}$ feet $= 2.25$ feet

This player will not be able to dunk the basketball because 2.25 feet < 2.5 feet.

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?



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

$0 = -16t^2 + 8t + 24$

$16t^2 - 8t - 24 = 0$

$t = \dfrac{-(-8) \pm \sqrt{(-8)^2 - 4(16)(-24)}}{2(16)}$

$t = \frac{3}{2}$ sec or $t = -1$ sec can't have negative time