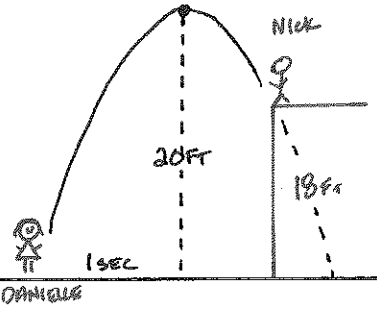
Honors Algebra 2
Solving Quadratic Application Problems

Name: KEY
Date: _____ Period: _____

1.) Danielle is throwing an orange to her friend Nick, who is standing on a balcony. The height, h (in feet), of the orange above the ground (t) seconds after it is thrown is given by $h(t) = -16t^2 + 32t + 4$. If Nick's outstretched arms are 18 feet above the ground, will the orange ever be high enough so that he can catch it?



FIND VERTEX

$t = \frac{-b}{2a} = \frac{-32}{2(-16)} = \frac{-32}{-32} = 1$

$t = 1$

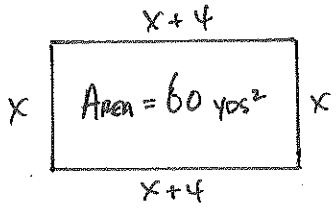
$h(1) = -16(1)^2 + 32(1) + 4$

$h(1) = 20$

TIME, HEIGHT
VERTEX = (1, 20)

* NICK WILL CATCH ORANGE.

2.) The length of a rectangular garden is 4 more yards than its width. The area of the garden is 60 square yards. Find the dimensions of the garden



AREA = LENGTH · WIDTH

$60 = (x+4) \cdot x$

$60 = x^2 + 4x$

$0 = x^2 + 4x - 60$

$0 = (x+10)(x-6)$

$x = \cancel{-10}$ AND $x = 6$

LENGTH = 10
WIDTH = 6

3.) Imagine you have a large, ground based catapult, and no feelings for the well-being of animals. You take a cow, put it in the catapult, and let Betsy fly. Betsy will follow a parabolic path! Let's say her altitude, or height, above the earth is modeled by this equation: $h(t) = -16t^2 + 224t$ where h is measured in feet, and t is measured in seconds. Now, just because you have a strong disdain for animals, that doesn't mean you aren't curious about parabolas; let's ask some questions.

a) When will Betsy reach her highest point, or her *maximum height*? 7 SECONDS

$t = \frac{-b}{2a} = \frac{-224}{2(-16)} = \frac{-224}{-32} =$ 7 SECONDS

b) What will Betsy's *maximum height* be? 784 FEET

$h(7) = -16(7)^2 + 224(7)$

$h(7) = -16(49) + 1568$

$h(7) = -784 + 1568$

$h(7) =$ 784 FEET

c) When will Betsy land? 14 SECONDS

BETSY WILL LAND WHEN $h = 0$.

$0 = -16t^2 + 224t$

$0 = -16t(t - 14)$

$-16t = 0$ or $t - 14 = 0$

$\cancel{t = 0}$ $t = 14$

4.) Now that we have an idea of what catapults, I mean parabolas, are good for, let's mix it up a bit. Imagine one of your great ancestors, let's call him Bob, riding on a flying dragon in a great prehistoric battle. Bob's enemies have a cannon, perched atop a 200 foot tower, that can shoot a pretty mean, parabolic-path following ball of dragon killing iron. Suppose the height of the cannon ball is modeled by $h(t) = -16t^2 + 192t + 200$, again where h is measured in feet and t is measured in seconds.

a) When will the cannon ball reach its highest point? 6 SECONDS

$t = \frac{-b}{2a} = \frac{-192}{2(-16)} = \frac{-192}{-32} = \boxed{6}$

b) How far above the *ground* will it be at this time? 776 FEET

$h(6) = -16(6)^2 + 192(6) + 200$
$h(6) = -16(36) + 1152 + 200$
$h(6) = -576 + 1352$
$\boxed{h(6) = 776}$

c) When will the cannon ball land? 10.85 SECONDS

CANNON BALL WILL LAND WHEN $h=0$.

$0 = -16t^2 + 192t + 200$
$0 = -8(2t^2 - 24t + 25)$
$x = \frac{24 \pm \sqrt{(-24)^2 - 4(2)(25)}}{2(2)}$
$x = \frac{24 \pm \sqrt{576 - 200}}{4}$
$x = \frac{24 \pm \sqrt{376}}{4}$

$x = \frac{24 + \sqrt{376}}{4}$ AND $x = \frac{24 - \sqrt{376}}{4}$

$\boxed{x = 10.85}$ AND ~~$x = 1.15$~~

5.) Taylor Swift decided to jump off of a cliff into the ocean in Acapulco because her NEW single "Why Don't All the Boys ever-ever-ever-ever Like Me ever" tanked. Her 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 Taylor to reach her maximum height? 0.5 SECONDS

$t = \frac{-b}{2a} = \frac{-16}{2(-16)} = \frac{-16}{-32} = \boxed{0.5}$

b.) What was the highest point that Taylor reached? 484 FEET

$h(0.5) = -16(0.5)^2 + 16(0.5) + 480$
$h(0.5) = -16(.25) + 8 + 480$
$h(0.5) = -4 + 488$
$\boxed{h(0.5) = 484}$

c.) Taylor hit the water after how many seconds? 6 SECONDS

TAYLOR SWIFT WILL HIT THE WATER WHEN $h=0$.

$0 = -16t^2 + 16t + 480$
$0 = -16(t^2 - t - 30)$
$0 = (t-6)(t+5)$
$\boxed{t=6}$ AND ~~$t=-5$~~

6.) 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 $h(t) = 128t - 16t^2$ (if air resistance is neglected).

a.) How long will it take the rocket to hit its maximum height? 4 SECONDS

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

b.) What is the maximum height? 256 FEET

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

c.) How long will it take for the rocket to return to the ground? (Show Work)

$h = 0$: $0 = 128t - 16t^2$

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

$16t = 0$ → $t = 0$ ✗

$8 - t^2 = 0$
$-t^2 = -8$
$t^2 = 8$
$t = 2.83$
$t = -2.83$ ✗

2.83 SECONDS

d.) After how many seconds will the rocket be 112 feet above the ground? (Show Work)

$h = 112$: $112 = 128t - 16t^2$

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

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

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

$t = 1$ $t = 7$

7.) After not making the CUT to play in the US Open because he struggled hitting out of the sand, Tiger Woods decided to take out his frustration by hitting golf balls into the ocean from the top level of his super expensive home in Hawaii. Tiger Woods noticed that there was a flock of seagulls flying overhead at a height of 202 feet. He thought to himself...if I could hit the seagull from here, not only would this help me in my golf game but it would give the reporters something else to talk about than my poor performance. The path of TW's golf ball can be modeled by the equation $f(x) = -16t^2 + 96t + 48$.

a.) At what height is TW striking the golf ball from? 48 FEET

b.) When will the golf ball reach its maximum height? 3 SECONDS

$x = \frac{-b}{2a} = \frac{-96}{2(-16)} = \frac{-96}{-32} = 3$

c.) What is the maximum height of the golf ball? 192 FEET

$f(3) = -16(3)^2 + 96(3) + 48$
$h(3) = 192$

d.) When will the golf ball hit the water?

HEIGHT = 0

$0 = -16t^2 + 96t + 48$
$0 = -16(t^2 - 6t - 3)$
QUADRATIC FORMULA

$x = \frac{6 \pm \sqrt{(-6)^2 - 4(1)(-3)}}{2(1)}$

$x = \frac{6 \pm \sqrt{36 + 12}}{2}$

$x = \frac{6 \pm \sqrt{48}}{2}$

$x = \frac{6 + \sqrt{48}}{2}$ $x = \frac{6 - \sqrt{48}}{2}$

$x = 6.46$ $x = -0.46$ ✗

6.46 SECONDS

e.) Will Tiger Woods hit the Seagull? Explain. NO

8.) You and your friend, R. Kelly, became stranded on a boat in the middle of Lake Algonquin and where deserted for what seemed like hours. R. Kelly's parents became very worried and hired a private search plane to fly over the Lake. The pilot of the plane decided that flying 400 feet above the Lake would be an adequate height to spot the boat. As darkness began to set and the plane approaching your position, the responsible individual yo are began to search the boat because you couldn't stand the idea of being "Locked in the Boat" with R. Kelly. You came across a flare gun and decided it was time to launch the flare from the boat. The height, h, in feet, of the flare above the water is approximately modeled by the function $h(t) = -15t^2 + 150t$, where t is the number of seconds after the flare is launched.

a.) When will the flare reach its maximum height?

$t = \frac{-b}{2a} = \frac{-150}{2(15)} = \frac{-150}{-30} = 5$

5 SECONDS

b.) What will be the flare's maximum height?

$h(5) = -15(5)^2 + 150(5)$

$h(5) = -15(25) + 750$

$h(5) = -375 + 750$

$h(5) = 375$

375 FEET

c.) When will flare hit the water?

$h=0$: $0 = -15t^2 + 150t$

$0 = -15t(t - 10)$

$-15t = 0$ $\quad t - 10 = 0$

~~$t = 0$~~ $\quad t = 10$

10 SECONDS

d.) Will the pilot be able to see the flare and save you from being "Locked in the Boat" with R. Kelly? Explain.

NO BECAUSE $375 < 400$.