Algebra RH

Essential Question: How do quadratic functions apply to real life situations?

Do Now:

Consider the quadratic function shown in the table below. Which of the following inequalities represents the range of the function?

(a) $y \geq -7$
(b) $y \leq 4$
(c) $y \geq 3$
(d) $y \leq 11$

x	−1	0	1	2	3	4
y	3	9	11	9	3	-7

↑ vertex

Parabolas in Real Life (https://www.youtube.com/watch?v=He42k1xRpbQ)

If the question asks...	Then calculate the...	How?
When does an object reach its maximum height?	vertex (input → x coordinate)	$x = \frac{-b}{2a}$
What is the maximum height?	vertex (output → y coordinate)	$x = \frac{-b}{2a}$ substitute x to find y
How long is an object in the air? When does the object hit the ground?	roots (zeros / x intercepts)	set $y = 0$ solve for x
What is the initial height?	y-intercept	set $x = 0$ solve for y } look at "c" value

(1) A baking soda rocket is fired upwards with an initial speed of 80 feet per second. Its height above the ground, h (*in feet*), can be modeled using the equation $h(t) = -16t^2 + 80t$, where t is the time since the launch (*in seconds*). At what time does the rocket hit the ground after being launched?

root

h = height (ft)
t = time (seconds)

$h(t) = -16t^2 + 80t$
$0 = -16t^2 + 80t$
$0 = -16t(t-5)$

$-16t = 0$	$t - 5 = 0$
~~$t = 0$~~ reject	$t = 5$

(after being launched) 5 seconds

(2) A player hits a baseball into the outfield. The equation $h = -0.005x^2 + x + 3$ models the path of the ball, where h is the height and x is the horizontal distance the ball travels.

(a) What is the maximum height reached by the baseball?

vertex → output value

h = height (ft)

x = horizontal distance (ft)

$x = \frac{-b}{2a}$

$x = \frac{-1}{2(-.005)}$

$x = 100$

$h = -.005(100)^2 + 100 + 3$

$h = 53$ feet

The maximum height was 53 feet.

(b) An outfielder catches the ball three feet above the ground. How far has the ball traveled horizontally when the outfielder catches it?

h = 3

x

$h = -0.005x^2 + x + 3$

$3 = -0.005x^2 + x + 3$

$0 = -0.005x^2 + x$

$0 = x(-0.005x + 1)$

$x = 0$ reject

$-0.005x + 1 = 0$

$-0.005x = -1$

$x = 200$

The ball traveled 200 feet when the outfielder catches it.

(c) Assume the outfielder misjudges the path of the ball and misses it, how far has the ball traveled horizontally when it hits the ground? *Round your answer to the nearest foot.*

x = ?

h = 0

$a = -0.005$

$b = 1$

$c = 3$

$0 = -0.005x^2 + x + 3$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-1 \pm \sqrt{(1)^2 - 4(-0.005)(3)}}{2(-0.005)}$

$x = \frac{-1 \pm \sqrt{1.06}}{-0.01}$

$x = \frac{-1 + \sqrt{1.06}}{-0.01}$

$x \approx -3$ reject

$x = \frac{-1 - \sqrt{1.06}}{-0.01}$

$x \approx 203$

The ball traveled 203 feet horizontally when it hit the ground.

3) The height of an object that is traveling through the air can be modeled by a quadratic function that opens downward. The object is fired upward and its height in feet above the ground is modeled by the equation:

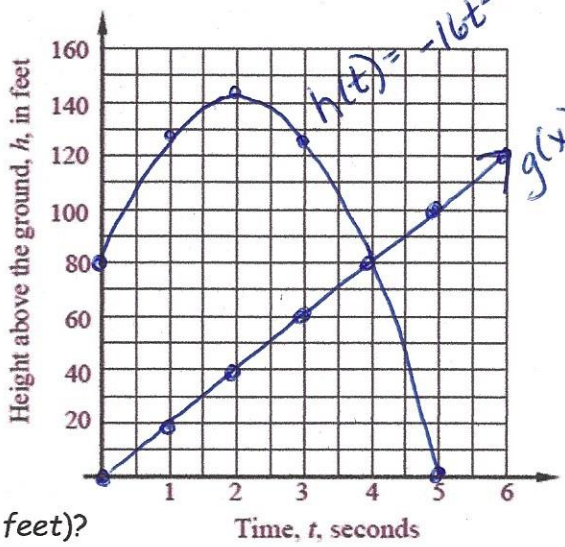
$h(t) = -16t^2 + 64t + 80$

t = time (seconds)

$h(t)$ = height (feet)

a) Using your calculator, draw a graph of the object's height for all times where the object is on or above the ground.

t	$h(t)$
0	80
1	128
2	144
3	128
4	80
5	0 ← (0 feet) on the ground



b) What is the maximum height the object reaches (*in feet*)?

output of vertex 144 feet

c) At what time does the object hit the ground?

zero / root / x intercept 5 seconds

d) Over what time interval is the object's height increasing?

input values only $0 < t < 2$

e) State the domain of the function. Explain the restrictions on the domain based on the context of the problem. $0 \le t \le 5$ $[0, 5]$

x values

It is restricted because there is no negative time and the object stops when it hits the ground.

At the same time, another object is shot through the air. It follows the path given by the equation, $g(x) = 20x$. ← linear $m = 20$ $b = 0$

f) When will the two objects meet? TOV

x	0	1	2	3	4	5	6
$g(x)$	0	20	40	60	80	100	120

point of intersection → input value 4 seconds

g) At what height do they meet?

point of intersection → output value 80 feet

TAKE AWAY

The vertex, y-intercept and roots of a quadratic function help us understand the parabolic path of an object.