# Applications of Quadratics - Day 1

key

1. If an M-16 is fired straight upward, then the height h(t) of the bullet in feet at time t in seconds is given by $h(t) = -16t^2 + 325t + 4$.

a) What is the starting height of the bullet?

(time, height)

y-int

4 ft

b) How long does it take for the bullet to return to the earth?

x-int

$x = \frac{-325 \pm \sqrt{(325)^2 - 4(-16)(4)}}{2(-16)} = -.012$ & 20.32 sec

c) What is the maximum height?

(h, k)

$h = \frac{-(325)}{2(-16)} = 10.16$ $\quad k = -16(10.16)^2 + 325(10.16) + 4 =$ 1,654.39 ft

d) What is a realistic domain and range?

D: [0, 20.32] seconds $\quad$ R: [0, 1,654.39] feet

y=500, find x

e) At a height of 500 feet how much time has passed?

$500 = -16t^2 + 325t + 4$

$0 = -16t^2 + 325t - 496$

$t = \frac{-325 \pm \sqrt{(325)^2 - 4(-16)(-496)}}{2(-16)} =$ 1.66 sec & 18.65 sec

2. A contestant tosses a horseshoe from one pit to another with an initial vertical velocity of 50 feet per second. The horseshoe is released 3 feet above the ground. Use the model $h = -16t^2 + 50t + 3$, where *h* is the height (in feet) and *t* is the time (in seconds) to tell how long the horseshoe was in the air.

x-int

$x = \frac{-50 \pm \sqrt{(50)^2 - 4(-16)(3)}}{2(-16)} = -.06$ and 3.18 sec

3. The number of mosquitoes $M(x)$, in millions, in a certain area depends on the June rainfall x, in inches, according to the equation $M(x) = 10x - 2x^2$. What rainfall produces the maximum number of mosquitoes?

vertex, h

(rainfall, mosquitos)

$M(x) = -2x^2 + 10x$ ($a$, $b$)

$\frac{-10}{2(-2)}$ $\quad \frac{10}{4} =$ 2.5 inches

4. The polynomial function $I(t) = -0.1t^2 + 1.9t$ represents the yearly income (or loss) from a real estate investment, where t is time in years after 1970. During what year does the maximum income occur?

vertex, h

(time(yr), $)

$h = \frac{-(1.9)}{2(-0.1)} = 9.5$

1970 + 9.5 = year 1979

5. Your company uses the quadratic model $y = -7x^2 + 350x$ to represent how many units y of a new product will be sold x weeks after its release. How many units can you expect to sell in week 27?

x=27, find y

$y = -7(27)^2 + 350(27) =$ 4,347 units

6. Your company uses the quadratic model $y = -4.5x^2 + 150x$ to represent the average number of new customers who will be signed on x weeks after the release of your new service. How many new customers can you expect to gain in week 8?

x=8, find y

$y = -4.5(8)^2 + 150(x) =$ 912 new customers

7. The profit for a company is given by $P(x) = -0.0002x^2 + 140x - 250000$, where x is the number of units produced. What production level will yield a maximum profit?

(# units, profit)

Vertex h

$\frac{-140}{2(-.0002)} =$ 350,000 units

8. A boy tosses a ball upward at 32 feet per second from a window that is 48 feet above the ground. The height of the ball above ground (in feet) at time t (in seconds) is given by $h(t) = -16t^2 + 32t + 48$.

x-int

a) Find the time at which the ball strikes the ground.

$-16t^2 + 32t + 48 = 0$ $(t-3)(t+1) = 0$

$t^2 - 2t - 3 = 0$ $t = 3, -1$

3 seconds

b) At a height of 60 feet how much time as passed?

y=60, find x

$-16t^2 + 32t + 48 = 60$

$-16t^2 + 32t - 12 = 0$

$x = \frac{-32 \pm \sqrt{(32)^2 - 4(-16)(-12)}}{2(-16)} = \frac{1}{2}$ & $\frac{3}{2}$

0.5 & 1.5 seconds

9. A rock is thrown upward so that its distance, in feet, above the ground after t seconds is $h(t) = -14t^2 + 336t$

x-int

a. Find the zeros of the function and explain the meaning in the context of the problem. (sec, height)

$-14t(t-24) = 0$

$t = 0$ $t = 24$

Rock is on ground at start & again after 24 seconds

b. Find the vertex of the function and explain the meaning in the ~~context of the problem.~~

$\frac{-336}{2(-14)} = 12$

(12, 2016) At 12 seconds, it's 2,016 ft high

c. What is a realistic Domain and Range?

D: [0, 24] R: [0, 2,016]

10. John owns a hotdog stand. He has found that his profit is represented by the equation $P(x) = -x^2 + 68x + 77$, with P being the profit in dollars, and x the number of hotdogs sold. How many hotdogs must he sell to earn the most profit?

(hotdogs, $)

Vertex h

$\frac{-68}{2(-1)} =$ 34 hot dogs!

11. The manufacturer of a CD player has found that the revenue R (in dollars) is $R(p) = -4p^2 + 1280p$, when the unit price is p dollars. If the manufacturer sets the price p to maximize revenue, what is the maximum revenue to the nearest whole dollar?

(price, revenue)

Vertex, k

$\frac{-1280}{2(-4)} = 160$ (160, 102,400) $102,400

$-4(160)^2 + 1280(160) = 102,400$