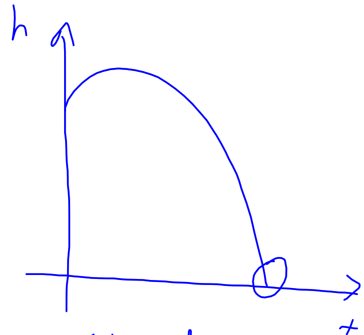
5.10 Applications of the Quadratic Equations

Ex. 1

A cliff diver in Acapulco, Mexico, dives from about 17m above the water. The diver's height above the water h, in metres, after t seconds is modelled by $h = -4.9t^2 + 1.5t + 17$. How long is the diver in the air before he hits the water?

Use Quad formula to find zeroes!



Need x-ints! "Zeroes"

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

$a = -4.9$
$b = 1.5$
$c = 17$

$$= \frac{-1.5 \pm \sqrt{(1.5)^2 - 4(-4.9)(17)}}{2(-4.9)}$$

$$= \frac{-1.5 \pm \sqrt{335.45}}{-9.8}$$

$$= \frac{-1.5 + \sqrt{335.45}}{-9.8} \qquad = \frac{-1.5 - \sqrt{335.45}}{-9.8}$$

$$\doteq -1.71 \qquad \doteq 2.02$$

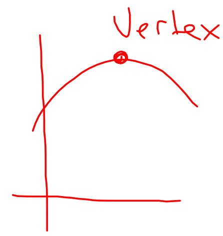
$t < 0$
$\therefore$ Inadmissable

$\therefore$ It took the diver approx 2s to hit the water

Ex. 2 The path of a basketball shot can be modelled by the equation $h = -0.09d^2 + 0.9d + 2$ where h is the height of the basketball in metres and d is the horizontal distance of the ball from the player in metres.

a. What is the maximum height reached by the ball? y of vertex

b. How far is the ball from the player when it reaches maximum height? x of the vertex



Need vertex. Complete the square to put into vertex form.

$h = -0.09d^2 + 0.9d + 2$

$= -0.09(d^2 - 10d + 25 - 25) + 2$

$= -0.09(d^2 - 10d + 25) + 2.25 + 2$

$= -0.09(d - 5)^2 + 4.25$

$V(5, 4.25)$

$\times -0.09$

$0.9d \rightarrow -10d$

d^2	$-5d$
$-5d$	25

$+2$

$-25 \rightarrow +2.25$

a) Ball reaches max of 4.25 m

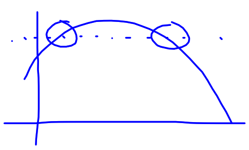
b) This occurred 5 m away.

Ex. 3 A ball is thrown up into the air. Its height h, in feet, after t seconds is $h = -4.9t^2 + 38t + 1.75$.
a) What is the height of the ball after 3 s?
b) For what length of time is the ball above 50 ft?

a) Just sub in $t = 3$

$$h = -4.9(3)^2 + 38(3) + 1.75$$
$$= 71.65$$

$\therefore$ Height at 3s is 71.65 ft.

b) 

Set $h = 50$, rearrange and solve

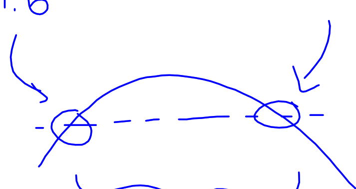
$$50 = -4.9t^2 + 38t + 1.75$$
$$0 = -4.9t^2 + 38t - 48.25$$

$a = -4.9$
$b = 38$
$c = -48.25$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{-38 \pm \sqrt{(38)^2 - 4(-4.9)(-48.25)}}{2(-4.9)}$$
$$= \frac{-38 \pm \sqrt{498.3}}{-9.8}$$

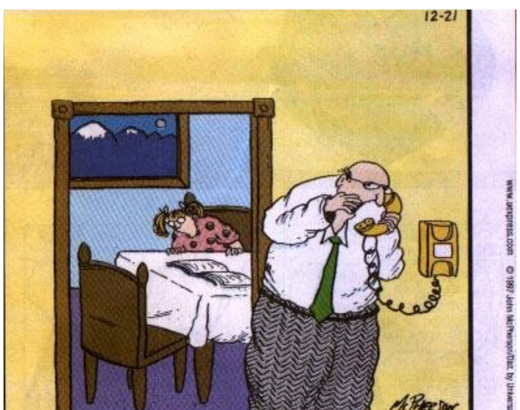
$$= \frac{-38 + \sqrt{498.3}}{-9.8} \qquad = \frac{-38 - \sqrt{498.3}}{-9.8}$$

$$\doteq 1.6 \qquad \doteq 6.2$$



$$6.2 - 1.6$$
$$= 4.6$$

$\therefore$ The ball was above 50m for 4.6s



"Uh, yeah, Homework Help Line? I need to have you explain the quadratic equation in roughly the amount of time it takes to get a cup of coffee."

Ex. 4

The path of an aerial skier from the top of the kicker (ramp) to the landing point can be modelled by the function:

$$h = -0.2d^2 + 2.5d + 8$$

where h is the height in metres above the landing point, and d is the horizontal distance from the kicker.

a) Determine the horizontal distance of the landing point.

b) Determine the maximum height of the skier.

$h = -0.2d^2 + 2.5d + 8$

a) Need zeroes!

Factor?

$h = -0.2(d^2 - 12.5d - 40)$

Nope....

Quad

$a = -0.2$

$b = 2.5$

$c = 8$

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

$= \frac{-2.5 \pm \sqrt{2.5^2 - 4(-0.2)(8)}}{2(-0.2)}$

$= \frac{-2.5 \pm \sqrt{12.65}}{-0.4}$

$x = \frac{-2.5 + \sqrt{12.65}}{-0.4}$ $\doteq -2.6$

Inadmissable

$x = \frac{-2.5 - \sqrt{12.65}}{-0.4}$ $\doteq 15.1$

∴ The skier landed approx 15m away.

b) Need vertex!

$h = -0.2d^2 + 2.5d + 8$

$= -0.2(d^2 - 12.5d + 39.0625 - 39.0625) + 8$

$= -0.2(d^2 - 12.5d + 39.0625) + 7.8125 + 8$

$= -0.2(d - 6.25)^2 + 15.8125$

Vertex $(6.25, 15.8125)$

∴ The max height is 15.8 m