# Topic 8.4 – Modeling with Quadratics

EXAMPLE 1 – A company offers rectangular pool sizes with dimensions as shown. Each pool includes a deck around it. If Carolina wants a 15-ft wide pool with a deck, how many square feet will she need to have available in her yard?

a) Write a quadratic function to represent the area of the pool and deck.

$A = (2x+8)(x+8)$

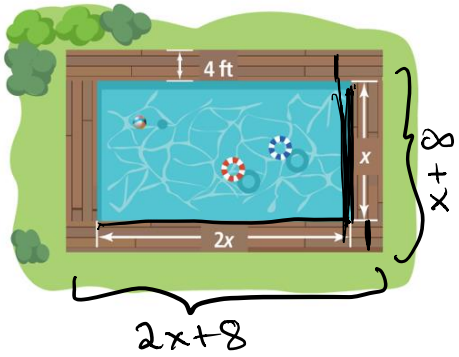
$A = 2x^2 + 16x + 8x + 64$

b) Find the area of the pool and deck.

$A = 2x^2 + 24x + 64$

$A = 2(15)^2 + 24(15) + 64$

$A = 874\ ft^2$




**Vertical Motion Model:**

The equation $h(t) = -16t^2 + v_0t + h_0$ is the **~~vertical motion~~ model.** The variable *h* represents the heights of an object, in feet, *t* seconds after it is launched into the air. The term $v_0$ is the object's initial vertical velocity and $h_0$ is its initial height.

EXAMPLE 2 – A diver jumps off a high platform at an initial vertical velocity of 16ft/s.

a) What quadratic function represents the height, *h,* of the diver after *t* seconds of the dive?

$h(t) = -16t^2 + 16t + 30$

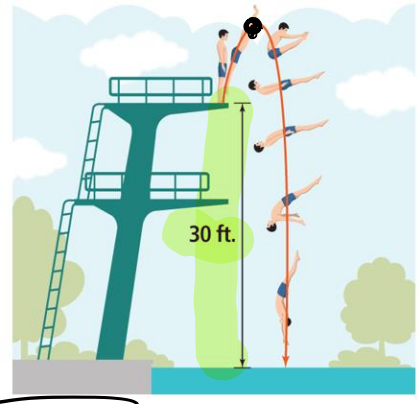
b) How long will it take the diver to reach its highest point?

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

c) How many feet above the water will the diver be at their highest point?

$h(t) = -16\left(\frac{1}{2}\right)^2 + 16\left(\frac{1}{2}\right) + 30$

$h(t) = -16\left(\frac{1}{4}\right) + 8 + 30 = -4 + 8 + 30 = 34\ ft$




EXAMPLE 3 – With social distancing in mind, Bryan throws a ball from the roof of his house to Nate's backyard. (Don't worry he was wearing gloves.) The ball is thrown from an initial height of 20 feet with an initial velocity of 32 ft/sec.

a) Write a quadratic function that represents the height, *h,* of the ball *t* second after being thrown.

$h(t) = -16t^2 + 32t + 20$

b) How many seconds after being thrown does the ball reach it's maximum height?

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

c) What is the maximum height the ball gets above the ground?

$h(t) = -16(1)^2 + 32(1) + 20$

$h(t) = 36\ ft$

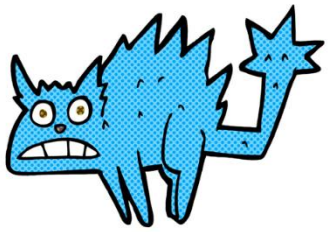
**You Try!**

1) A frightened cat jumps from the ground straight into the air with an initial velocity of 14 feet per second.

$h_0 = 0$ ft

a) Write a quadratic function that represents the height, *h*, of the cat *t* seconds after jumping.

$h(t) = -16t^2 + 14t$



b) How long does it take the cat to reach its maximum height?

$x = \frac{-14}{2(-16)} = \frac{-14}{-32} = \frac{7}{16} = 0.4375$ sec

c) How high does the cat jump?

$h(t) = -16(0.4375)^2 + 14(0.4375) =$

3.0625 ft above the ground