1.5 Modeling with Quadratic Equations

Today your good friend Joe Bob is playing with model rockets:

a. He wants to know after how many seconds his rocket will reach a height 200ft if the initial velocity is 350ft per sec when he launches the rocket from the ground?

b. How long will it take to return to the ground?


In pairs: Compare equations with a partner. Did they come up with the same equation, why or why not? Decide on one two share.

Whole Class: Discuss different approaches to solving both parts.

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**In pairs**: Each person should individually read one of the following problems and solve it. When you finish explain your solution to your partner.

- The lengths of the sides of a right triangle are consecutive even integers. Find the lengths.

- Zachary wants to buy a rug for a room that is 12ft wide and 15ft long. He wants to leave a uniform strip of floor around the rug. He can afford to buy 108ft$^2$ of carpeting. What dimensions should the rug have?

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**In fours**: As a group, solve one of the following problems on the board:

- A square lawn has an area of 1600ft$^2$. A sprinkler placed in the center of the lawn sprays water in a circular pattern. What is the radius of the circle.

\[ s^2 = 1600 \]
\[ s = \pm 40 \]
Thus, side of square is 40 ft.
Side of square = diameter of circle = 40ft
Radius = ½ diameter = ½(40) = 20ft

- The volume of a cereal box is 157.2in$^3$. The width of the box is 4.1in less than the length of the box, and the height is 2.1in. Find the length and width.
A boat floats on a lake, 15 ft away from the dock it is attached to. The rope attaching it to the dock is tight and angles downward from the dock. It attaches to the boat at waterline. The length of the rope from the boat to the dock is 4 ft longer than twice the height of the dock above the water. What is the height of the dock?

\[
x^2 + 15^2 = (2x + 4)^2
\]
\[
x^2 + 225 = 4x^2 + 16x + 16
\]
\[
0 = 3x^2 + 16x - 209
\]
\[
x = \frac{-16 \pm \sqrt{16^2 - 4(3)(-209)}}{2(3)}
\]
\[
x = \frac{-16 \pm \sqrt{2764}}{6}
\]
\[
x = 6.1, x = -11.4
\]

Thus, the height of the dock is 6.1 ft.

Tanner and John got new walkie talkies for Christmas with a 5 mile range. If Tanner walks north at 2.5 mph and John walks east at 3.2 mph, how long will they be able to talk to each other before the walkie talkies quit working?

\[
x = \text{number of hours before walkie talkies quit working}
\]
\[
\text{Distance} = \text{rate} \cdot \text{time}
\]
\[
\text{Tanner's distance} = 2.5x \quad \text{and} \quad \text{John's distance} = 3.2x
\]
\[
(2.5x)^2 + (3.2x)^2 = 5^2
\]
\[
6.25x^2 + 10.24x^2 = 25
\]
\[
16.49x^2 = 25
\]
\[
x^2 = 1.516
\]
\[
x = \pm 1.23
\]

Thus, the walkie talkies will work for about 1.23 hours, or about 1 hour and 14 minutes.