



# Solving Quadratic Equations with the Zero Product Property

Let's find solutions to equations that contain products that equal zero.

## 4.1 Math Talk: Solve These Equations

What values of the variables make each equation true?

- $6 + 2a = 0$

- $7b = 0$

- $7(c - 5) = 0$

- $g \cdot h = 0$



## 4.2 Take the Zero Product Property Out for a Spin

For each equation, find its solution or solutions. Be prepared to explain your reasoning.

1.  $x - 3 = 0$
2.  $x + 11 = 0$
3.  $2x + 11 = 0$
4.  $x(2x + 11) = 0$
5.  $(x - 3)(x + 11) = 0$
6.  $(x - 3)(2x + 11) = 0$
7.  $x(x + 3)(3x - 4) = 0$

### Are you ready for more?

1. Use factors of 48 to find as many solutions as you can to the equation  $(x - 3)(x + 5) = 48$ .
2. Once you think you have all the solutions, explain why these must be the only solutions.

## 4.3 Revisiting a Projectile

We have seen quadratic functions modeling the height of a projectile as a function of time.

Here are two ways to define the same function that approximates the height of a projectile in meters,  $t$  seconds after launch:

$$h(t) = -5t^2 + 27t + 18 \qquad h(t) = (-5t - 3)(t - 6)$$

1. Which way of defining the function allows us to use the zero product property to find out when the height of the object is 0 meters?
2. Without graphing, determine at what time the height of the object is 0 meters. Show your reasoning.

## Lesson 4 Summary

The **zero product property** says that if the product of two numbers is 0, then one of the numbers must be 0. In other words, if  $a \cdot b = 0$ , then either  $a = 0$  or  $b = 0$ . This property is handy when an equation we want to solve states that the product of two factors is 0.

Suppose we want to solve  $m(m + 9) = 0$ . This equation says that the product of  $m$  and  $(m + 9)$  is 0. For this to be true, either  $m = 0$  or  $m + 9 = 0$ , so both 0 and -9 are solutions.

Here is another equation:  $(u - 2.345)(14u + 2) = 0$ . The equation says the product of  $(u - 2.345)$  and  $(14u + 2)$  is 0, so we can use the zero product property to help us find the values of  $u$ . For the equation to be true, one of the factors must be 0.

- For  $u - 2.345 = 0$  to be true,  $u$  would have to be 2.345.
- For  $14u + 2 = 0$  or  $(14u = -2)$  to be true,  $u$  would have to be  $-\frac{2}{14}$ , or  $-\frac{1}{7}$ .

The solutions are 2.345 and  $-\frac{1}{7}$ .

In general, when a quadratic expression in factored form is on one side of an equation and 0 is on the other side, we can use the zero product property to find its solutions.

This property is unique to 0. Given an equation like  $a \cdot b = 6$ , the factors could be 2 and 3, 1 and 6, -12 and  $-\frac{1}{2}$ ,  $\pi$  and  $\frac{6}{\pi}$ , or any other of the infinite number of combinations. This type of equation does not give insight into the value of  $a$  or  $b$ .