



**Learning Goals:**

To find solutions (roots or zeros) using the quadratic formula.

To determine the number of solutions for a quadratic equation using the discriminant.

**The Quadratic Formula**

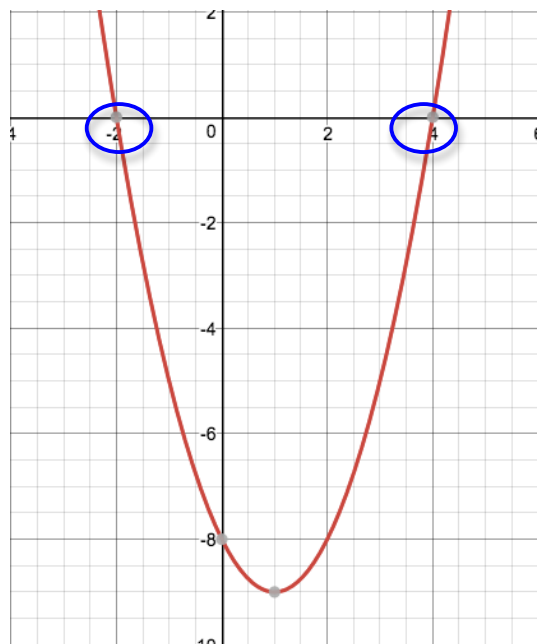
Use the Quadratic Formula to find solutions when the quadratic equation is difficult to factor.

♦ If  $ax^2 + bx + c = 0$  and  $a \neq 0$ , then  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ .

**Solve Using the Quadratic Formula**

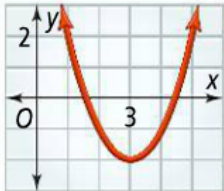
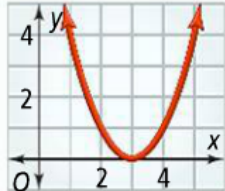
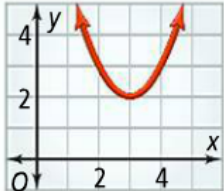
<p><b>Steps:</b></p> <ul style="list-style-type: none"> <li>Write the quadratic equation in standard form.</li> <li>Substitute numeric values for a, b, and c.</li> <li>Use the quadratic formula to solve for the roots or zeros.</li> <li>Simplify.</li> </ul>	<p><b>What are the solutions for <math>x^2 - 8 = 2x</math>? Use the quadratic formula to solve.</b></p> <p><math>x^2 - 2x - 8 = 0</math>  <math>a = 1, b = -2, c = -8</math></p> $x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-8)}}{2(1)}$ $x = \frac{2 \pm \sqrt{4 + 32}}{2}$ $x = \frac{2 \pm \sqrt{36}}{2}$ $x = \frac{2 \pm 6}{2}$ $x = \frac{2+6}{2} = \frac{8}{2} = 4 \text{ or } x = \frac{2-6}{2} = \frac{-4}{2} = -2$
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The graph of  $y = x^2 - 2x - 8$ .  
The solutions  $x = 4$  and  $x = -2$  are the x-intercepts.



## The Discriminant

- Quadratic equations can have **two, one, or no** solutions. You can determine the number of solutions a quadratic equation has using the **discriminant**.
- The discriminant is the expression under the radical sign in the quadratic formula:  **$b^2 - 4ac$** .
- The discriminant can be **positive, negative, or zero**.

Discriminant	$b^2 - 4ac > 0$	$b^2 - 4ac = 0$	$b^2 - 4ac < 0$
Example	$x^2 - 6x + 7 = 0$ The discriminant is $(-6)^2 - 4(1)(7) = 8$ , which is positive.	$x^2 - 6x + 9 = 0$ The discriminant is $(-6)^2 - 4(1)(9) = 0$ .	$x^2 - 6x + 11 = 0$ The discriminant is $(-6)^2 - 4(1)(11) = -8$ , which is negative.
			
Number of Solutions	There are two real-number solutions.	There is one real-number solution.	There are no real-number solutions.

## Using the Discriminant

### Steps:

- Write the quadratic equation in standard form.
- Substitute numeric values for  $a$ ,  $b$ , and  $c$ .
- Simplify.
- Determine the number of solutions.
- $b^2 - 4ac$ :
  - $> 0 \rightarrow 2$  solutions
  - $= 0 \rightarrow 1$  solution
  - $< 0 \rightarrow$  no solution

How many real number solutions does  $2x^2 - 3x = -5$  have?

$$2x^2 - 3x + 5 = 0$$

$$a = 2, b = -3, c = 5$$

$$b^2 - 4ac = (-3)^2 - 4(2)(5) = 9 - 40 = -31$$

The discriminant is negative so there are no solutions for the quadratic equation.