

Solving Quadratic Equations

A **quadratic equation** is a nonlinear equation that can be written in the standard form $ax^2 + bx + c = 0$, where $a \neq 0$. You can solve quadratic equations by factoring, graphing, using square roots, completing the square, or using the Quadratic Formula.

Example 1 Solve $x^2 - 2x - 3 = 0$ by factoring.

$$\begin{aligned} x^2 - 2x - 3 &= 0 \\ (x + 1)(x - 3) &= 0 \\ x + 1 &= 0 \quad \text{or} \quad x - 3 = 0 \\ x &= -1 \quad \text{or} \quad x = 3 \end{aligned}$$

► The solutions are $x = -1$ and $x = 3$.

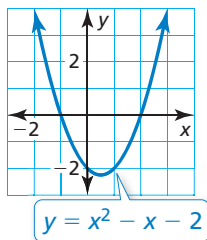
Example 2 Solve $5x^2 = 45$ using square roots.

$$\begin{aligned} 5x^2 &= 45 \\ x^2 &= 9 \\ x &= \pm\sqrt{9} \\ x &= \pm 3 \end{aligned}$$

► The solutions are $x = 3$ and $x = -3$.

Example 3 Solve $x^2 - x - 2 = 0$ by graphing.

Graph the related function $y = x^2 - x - 2$.



The x -intercepts are -1 and 2 .

► So, the solutions are $x = -1$ and $x = 2$.

Example 4 Solve $2x^2 + 12x - 4 = 0$ by completing the square.

$$\begin{aligned} 2x^2 + 12x - 4 &= 0 \\ 2x^2 + 12x &= 4 \\ x^2 + 6x &= 2 \\ x^2 + 6x + 3^2 &= 2 + 3^2 \\ (x + 3)^2 &= 11 \\ x + 3 &= \pm\sqrt{11} \\ x &= -3 \pm \sqrt{11} \end{aligned}$$

► The solutions are $x = -3 + \sqrt{11} \approx 0.32$ and $x = -3 - \sqrt{11} \approx -6.32$.

Example 5 Solve $2x^2 - 6x + 4 = 0$ using the Quadratic Formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(2)(4)}}{2(2)} = \frac{6 \pm \sqrt{4}}{4} = \frac{6 \pm 2}{4}$$

► So, the solutions are $x = \frac{6+2}{4} = 2$ and $x = \frac{6-2}{4} = 1$.

Practice

Check your answers at BigIdeasMath.com.

Solve the equation using any method. Explain your choice of method.

- $x^2 + x - 12 = 0$ $x = -4, x = 3$
- $3x^2 = 48$ $x = -4, x = -4$
- $x^2 - 10x + 20 = 0$ $x \approx 7.24,$
 $x \approx 2.76$
- $2x^2 + 8x - 2 = 0$ $x \approx 0.24, x \approx -4.24$
- $3x^2 - 7x + 4 = 0$ $x = 1, x = \frac{4}{3}$
- $2x^2 + 3x - 5 = 0$ $x = -\frac{5}{2}, x = 1$
- PHYSICS** You launch a model rocket. The equation $h = -16t^2 + 40t + 2$ models the rocket's height h (in feet) after t seconds. How much time does it take for the rocket to reach the ground?
about 2.5 seconds