

The Quadratic Formula

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

Some problems cannot be solved by factoring. The quadratic formula can be used in this situation to find the quadratic roots.

Example: Solve $x^2 - 6x + 4 = 0$ by the quadratic formula.

$$a = 1 \quad b = -6 \quad c = 4$$

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(1)(4)}}{2(1)}$$

$$x = \frac{6 \pm \sqrt{36 - 16}}{2}$$

$$x = \frac{6 \pm \sqrt{20}}{2}$$

$$x = \frac{6 \pm \sqrt{20}}{2} \quad \text{and} \quad x = \frac{6 - \sqrt{20}}{2}$$

$$x = \{0.8, 5.2\}$$

More Practice!

1. $x^2 + 10x - 2 = 0$ $a = 1$ $b = 10$ $c = -2$

$$x = \frac{-10 \pm \sqrt{10^2 - 4(1)(-2)}}{2(1)}$$

$$x = \frac{-10 \pm \sqrt{100 + 8}}{2}$$

$$x = \frac{-10 \pm \sqrt{108}}{2}$$

$$x = \frac{-10 + \sqrt{108}}{2} \quad \text{and} \quad x = \frac{-10 - \sqrt{108}}{2}$$

$$x = \{-10.2, 0.2\}$$

2. $x^2 - 11 = 4x$ $a = 1$ $b = -4$ $c = -11$

$$\frac{-4x}{-4x} \quad x^2 - 4x - 11 = 0$$

$$x = \frac{4 \pm \sqrt{(-4)^2 - 4(1)(-11)}}{2(1)}$$

$$x = \frac{4 \pm \sqrt{16 + 44}}{2}$$

$$x = \frac{4 \pm \sqrt{60}}{2}$$

$$x = \frac{4 + \sqrt{60}}{2} \quad x = \frac{4 - \sqrt{60}}{2}$$

$$x = \{-1.9, 5.9\}$$

3. $x^2 - 8x = 20$ $a = 1$ $b = -8$ $c = -20$

$$\frac{-20}{-20} \quad x^2 - 8x - 20 = 0$$

$$\frac{8 \pm \sqrt{64 - 4(1)(-20)}}{2}$$

$$\frac{8 \pm \sqrt{64 + 80}}{2}$$

$$\frac{8 \pm 12}{2} \quad \frac{20}{2} \quad \frac{-4}{2} \quad x = \{-2, 10\}$$

4. $x^2 - 5x - 36 = 0$ $a = 1$ $b = -5$ $c = -36$

$$\frac{5 \pm \sqrt{25 - 4(1)(-36)}}{2}$$

$$\frac{5 \pm \sqrt{25 + 144}}{2}$$

$$\frac{5 \pm 13}{2} \quad \frac{13}{2} \quad \frac{-8}{2} \quad x = \{-4, 9\}$$

5. $x^2 + 6x + 10 = 0$ $a = 1$ $b = 6$ $c = 10$

$$\frac{-6 \pm \sqrt{36 - 4(1)(10)}}{2}$$

$$\frac{-6 \pm \sqrt{-4}}{2}$$

No Solutions

6. $x^2 - 12x - 18 = 0$ $a = 1$ $b = -12$ $c = -18$

$$\frac{12 \pm \sqrt{144 - 4(1)(-18)}}{2}$$

$$\frac{12 \pm \sqrt{144 + 72}}{2}$$

$$\frac{12 \pm \sqrt{216}}{2}$$

$$\frac{12 + \sqrt{216}}{2} \quad \frac{12 - \sqrt{216}}{2}$$

$$x = \{-10.2, -1.8\}$$

<p>7. $-x^2 + 7x - 3 = 0$ $a = -1$ $b = 7$ $c = -3$</p> $\frac{-7 \pm \sqrt{49 - 4(-1)(-3)}}{-2}$ <p>0.5</p> $\frac{-7 \pm \sqrt{49 - 12}}{-2}$ $\frac{-7 \pm \sqrt{37}}{-2}$ $\frac{-7 + \sqrt{37}}{-2} \quad \frac{-7 - \sqrt{37}}{-2}$ <p>$X = \{0.5, 6.5\}$</p>	<p>8. $x^2 + 4x + 1 = 0$ $a = 1$ $b = 4$ $c = 1$</p> $\frac{-4 \pm \sqrt{16 - 4(1)(1)}}{2}$ $\frac{-4 \pm \sqrt{16 - 4}}{2}$ $\frac{-4 \pm \sqrt{12}}{2}$ $\frac{-4 + \sqrt{12}}{2} \quad \frac{-4 - \sqrt{12}}{2}$ <p>$X = \{-3.7, -0.3\}$</p>
<p>9. $2x = 7 - x^2$ $a = 1$ $b = 2$ $c = -7$</p> $x^2 + 2x - 7 = 0$ $\frac{-2 \pm \sqrt{4 - 4(1)(-7)}}{2}$ $\frac{-2 \pm \sqrt{4 + 28}}{2} = \frac{-2 \pm \sqrt{32}}{2}$ <p>$X = \{-3.8, 1.8\}$</p>	<p>10. $x^2 + 11x = 0$ $a = 1$ $b = 11$ $c = 0$</p> $\frac{-11 \pm \sqrt{121 - 4(1)(0)}}{2}$ $\frac{-11 \pm 11}{2}$ $\frac{-11 + 11}{2} \quad \frac{-11 - 11}{2}$ <p>$X = \{-11, 0\}$</p>
<p>11. $2x^2 + 5x + 4 = 0$ $a = 2$ $b = 5$ $c = 4$</p> $\frac{-5 \pm \sqrt{25 - 4(2)(4)}}{4}$ $\frac{-5 \pm \sqrt{25 - 32}}{4}$ $\frac{-5 \pm \sqrt{-7}}{4}$ <p>No Solution</p>	<p>12. $2x^2 + 7x - 9 = 0$ $a = 2$ $b = 7$ $c = -9$</p> $\frac{-7 \pm \sqrt{49 - 4(2)(-9)}}{4}$ $\frac{-7 \pm \sqrt{49 + 72}}{4}$ $\frac{-7 \pm \sqrt{121}}{4}$ $\frac{-7 + 11}{4} \quad \frac{-7 - 11}{4}$ <p>$X = \{1, -\frac{9}{2}\}$</p>
<p>13. $2x^2 - 8 = 0$ $a = 2$ $b = 0$ $c = -8$</p> $\frac{0 \pm \sqrt{6^2 - 4(2)(-8)}}{4}$ $\frac{\pm \sqrt{64}}{4} = \pm \frac{8}{4} = \pm 2$ <p>$X = \{\pm 2\}$</p>	<p>14. $4x^2 + 9 = 12x$ $a = 4$ $b = -12$ $c = 9$</p> $4x^2 - 12x + 9 = 0$ $\frac{12 \pm \sqrt{144 - 4(4)(9)}}{8}$ $\frac{12 \pm \sqrt{144 - 144}}{8} = \frac{12}{8} = \frac{3}{2}$ <p>$X = \{1.5\}$</p>
<p>15. $3x^2 - 1 = -8x$ $a = 3$ $b = 8$ $c = -1$</p> $3x^2 + 8x - 1 = 0$ $\frac{-8 \pm \sqrt{64 - 4(3)(-1)}}{6}$ $\frac{-8 \pm \sqrt{64 + 12}}{6}$ $\frac{-8 \pm \sqrt{76}}{6}$ <p>$X = \{-2.8, 0.9\}$</p>	<p>16. $3x^2 + 7x = x^2 - 2x + 15$ $a = 2$ $b = 9$ $c = -15$</p> $2x^2 + 9x - 15 = 0$ $\frac{-9 \pm \sqrt{81 - 4(2)(-15)}}{4}$ $\frac{-9 \pm \sqrt{81 + 120}}{4}$ $\frac{-9 \pm \sqrt{201}}{4}$ <p>$X = \{-5.8, 1.3\}$</p>
$\frac{-8 + \sqrt{76}}{6}$ $\frac{-8 - \sqrt{76}}{6}$ <p>0.9 -2.8</p>	$\frac{-9 + \sqrt{201}}{4}$ $\frac{-9 - \sqrt{201}}{4}$ <p>1.3 -5.8</p>