

## Lesson 4: Solve Quadratic Equations

**Quadratic Equation:** An equation of the form  $ax^2 + bx + c = 0$ , where  $a, b, c \in \mathbb{R}$  and  $a \neq 0$ .

The **solution** to a quadratic equation is also called the **roots** of the equation.

There are 3 methods to solve a quadratic equation.

## Method 1: Inverse Operations

Use this method when there is a single  $x$ -term (vertex form)

- Use inverse operations to isolate  $x$
- When you take the square root, recall that there should be 2 answers.

**Example:** Solve  $2(x-9)^2 = 5 + 19$

$$\begin{aligned} 2(x-9)^2 &= 5 + 19 \\ 2(x-9)^2 &= 24 \\ (x-9)^2 &= 12 \\ x-9 &= \pm\sqrt{12} \\ x-9 &= \pm\sqrt{4 \cdot 3} \\ x-9 &= \pm 2\sqrt{3} \end{aligned}$$

$$x = 9 \pm 2\sqrt{3}$$

$$x = 9 + 2\sqrt{3} \quad \& \quad x = 9 - 2\sqrt{3}$$

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## Method 2: Factoring

Try this method before resorting to method #3

- ✓ • Rearrange equation so it is in standard form  $ax^2 + bx + c = 0$
- Factor, if possible.
- Set each factor to 0 and solve each linear equation.

**Example:** Determine the roots of  $x(4x-5) = 6$

$$0 = 4x^2 - 5x - 6$$

$$0 = (x-2)(4x+3)$$

$$x-2=0$$

$$x=2$$

$$4x+3=0$$

$$4x=-3$$

$$x = -\frac{3}{4}$$

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**Method 3: Quadratic Formula**

Use this method when the equation is not factorable.

- Rearrange equation so it is in standard form  $ax^2 + bx + c = 0$
- Substitute  $a, b, c$  into the quadratic formula  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- Leave answer in simplified radical form, unless specified otherwise.

**Example:** Solve  $2x(2x+3) + 6 = 5$ 

$$4x^2 + 6x + 1 = 0$$

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

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

$$x = \frac{-6 \pm \sqrt{20}}{8} \rightarrow \begin{aligned} &= \sqrt{4}\sqrt{5} \\ &= 2\sqrt{5} \end{aligned}$$

$$x = \frac{-6 \pm 2\sqrt{5}}{8}$$

$$x = \frac{2(-3 \pm \sqrt{5})}{2(4)}$$

$$x = \frac{-3 \pm \sqrt{5}}{4}$$

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**Example:** The Profit function for a business is modelled by the equation  $P(x) = -0.5x^2 + 10x - 16$ , where  $x$  is the number of items sold in thousands, and  $P(x)$  is the profit in thousands of dollars. Determine the number of items the company must sell in order to break even. *means the zeros!*

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

$$x = \frac{-10 \pm \sqrt{10^2 - 4(-0.5)(-16)}}{2(-0.5)}$$

$$x = \frac{-10 \pm \sqrt{68}}{-1}$$

$$x = \frac{-10 \pm 2\sqrt{17}}{-1}$$

$$x = 10 \pm 2\sqrt{17}$$

$$x = 10 + 2\sqrt{17} \quad x = 10 - 2\sqrt{17}$$

$$x = 18.246 \quad x = 1.754$$

$\therefore$  The company need to sell 18246 or 1754 units to break even.

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HW U1L4:

p. 177# 1bd, 2ad, 4,5,6bd,7,8c

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