# 6.2 Solve Quadratic Equations

**Student Text Pages**
274–281

**Suggested Timing**
70 min

**Technology Tools**
- TI-89 calculator

**Related Resources**
- T–7 The Computer Algebra System (CAS) on the TI-89 Calculator
- BLM 6–5 Section 6.2 Practice Master
- BLM 6–6 Section 6.2 Achievement Check Rubric
- A–6 Knowledge/Understanding General Scoring Rubric

**TI-Navigator™**

Go to **www.mcgrawhill.ca/books/principles10** and follow the links to the file for this section.

## Teaching Suggestions

- Discuss the difference between a quadratic relation and a quadratic equation. The students need to understand that in order to solve an equation, the equation needs to be in terms of a single variable.

### Investigate

- Have students work through the **Investigate**. You may wish to have them work with a partner to help with their communication skills. In particular, discuss step 7 before moving on to further examples. Allow students to answer step 7 in their own words, even if they are not mathematically correct. (15 min)

### Examples

- Present **Example 1**, and solve enough examples by factoring until students understand the procedure. They need to understand that the quadratic must equal zero for the method to work. (15 min)
- Students need to see contextual examples such as **Examples 2** and **3**. Give a variety of examples where the quadratic is provided and others where the students need to build one by multiplying two factors. See Section 6.1 for additional types of examples that could be adapted to this section. (15 min)

### Communicate Your Understanding

- Review the vocabulary terms in this section (quadratic equation, root).
- Allow students to discuss their answers to the questions with a classmate before discussing the answers as a class. (10 min)
- Use **BLM 6–5 Section 6.2 Practice Master** for remediation or extra practice.

### Investigate Answers (page 274)

**1.** One or both of the numbers must be zero.

**2.** $a$ must equal zero, or $b$ must equal zero, or both $a$ and $b$ must equal zero.

**3.** Since $(x - 3)$ multiplied by $(x + 5)$ equals zero, then the expression $x - 3$ must equal zero, or the expression $x + 5$ must equal zero, or both $x - 3$ and $x + 5$ must equal zero.

**4. a)** $(x - 3)(x + 5) = 0$
Either $x - 3 = 0$ or $x + 5 = 0$
$x = 3$ $\quad$ $x = -5$

**b)** When either value is substituted into the expression $(x - 3)(x + 5)$, the result is 0.

**5. a)** $(x + 2)(x + 9) = 0$
Either $x + 2 = 0$ or $x + 9 = 0$
$x = -2$ $\quad$ $x = -9$

**b)** $(2x + 5)(3x - 4) = 0$
Either $2x + 5 = 0$ or $3x - 4 = 0$
$2x = -5$ $\quad$ $3x = 4$
$x = \frac{-5}{2}$ $\quad$ $x = \frac{4}{3}$

**6. a)** The left side of the equation $x^2 + 6x + 8 = 0$ is a quadratic expression that is not in factored form. In order to solve the equation, the trinomial on the left side of the equation, $x^2 + 6x + 8 = 0$, has to be factored.

**b)** $x^2 + 6x + 8 = 0$
$(x + 2)(x + 4) = 0$
Either $x + 2 = 0$ or $x + 4 = 0$
$x = -2$ $\quad$ $x = -4$

**7.** First, factor the quadratic expression. Next, set either factor equal to zero. Solve for the variable.

### Communicate Your Understanding Responses (page 279)

**C1.** Answers will vary. For example: When solving a quadratic equation by factoring, you are finding the $x$-intercepts of the related quadratic function. To find the $x$-intercepts of a quadratic function, let the $y$-value equal zero and solve for $x$.

**C2. a)** First, remove the common factor 3 from the trinomial. Factor the resulting trinomial on the left side of the quadratic equation, $x^2 + 4x + 3$. Solve the left side of the quadratic equation for $x$.

**b)** First, rewrite the equation so that the right side equals zero by adding 15 to both sides. Then, factor the trinomial on the left side of the quadratic equation.

**Common Errors**

- Some students may solve questions such as $(x - 2)(x + 1) = 0$ by stating $x = -2$ or $x = 1$. These same students will probably have difficulties with factors where the coefficient of $x$ is not 1.

**$R_x$** Have students think about what makes a product equal to zero, i.e., one or both of the factors must equal zero. Follow that up by substituting their incorrect answer for $x$ and then compare that result to the one obtained when the correct answer is substituted. Give students an opening sentence that they need to follow. For example:

For $(x - 7)(2x + 1) = 0$:
either $x - 7 = 0$ or $2x + 1 = 0$.

The word "either" reinforces the need for one of the factors to equal zero.

## Practise

- Students may take more time with **question 5**, as the coefficient of second-degree term is not 1. Allow students to factor using any method, including trial and error.
- **Questions 7** and **8** relate to **Examples 2** and **3**, respectively, and should be assigned.
- **Questions 10** and **11** are related to **question 9**, all of which have students work backward from given roots to a quadratic equation. **Question 10** includes a communication part, while **question 11** requires additional algebraic manipulation. Remind students that they eliminated fractions when solving linear equations in Chapter 1 Linear Systems. Use **A–6 Knowledge/Understanding General Scoring Rubric** when assessing students.
- **Question 13** may be difficult for students working at level 1 or 2. Remind students to consider how to determine if a quadratic is factorable (i.e., sum and product).
- For **question 14**, have students draw a diagram. They will need to use the equation $x^2 + (x - 1)^2 = 29^2$.

**Accommodations**

**Visual**—Encourage students to use a graphing calculator to graph the quadratic relations for the corresponding quadratic equations that they are solving. This will allow them to see the visual relationship between the $x$-intercepts of a quadratic relation and the roots of a quadratic equation.

**Perceptual**—Let students use CAS to factor quadratic expressions.

**Memory**—Provide students with index cards with each of the sequential steps for solving a quadratic equation on a separate card. Have students arrange the steps in the correct order.

**ESL**—Let students use their dictionaries when working through the questions in this section.

- **Question 18** is an Achievement Check. It is accessible to students working at all levels. Remind students how to find the volume of a rectangular prism, and to draw a labelled diagram.
- **Questions 19** and **20** are related to previous examples that students have seen. These require the use of previously learned algebraic skills that have not yet been used in the context of solving quadratic equations.

**Achievement Check Sample Solution, question 18, page 281**

Provide students with **BLM 6–6 Section 6.2 Achievement Check Rubric** to help them understand what is expected.

**18. a)** Let $x$ represent the width of the base.
Then, the length is $(x + 2)$.
Let $y$ represent the volume, width × length × height.

$$\begin{aligned} y &= 15x(x + 2) \\ &= 15x^2 + 30x \end{aligned}$$

Complete the square to express the relation $y = 15x^2 + 30x$ in the form $y = a(x - h)^2 + k$.

$$\begin{aligned} y &= 15x^2 + 30x \\ &= 15(x^2 + 2x) \\ &= 15(x^2 + 2x + 1^2 - 1^2) \\ &= 15(x + 1)^2 - 15 \end{aligned}$$

**b), c)** The volume is 2145 m$^2$.

$$\begin{aligned} 2145 &= 15(x + 1)^2 - 15 \\ 2160 &= 15(x + 1)^2 \\ \frac{2160}{15} &= \frac{15(x + 1)^2}{15} \\ 144 &= (x + 1)^2 \\ (x + 1)^2 - 144 &= 0 \\ x^2 + 2x + 1 - 144 &= 0 \\ x^2 + 2x - 143 &= 0 \\ x^2 + 13x - 11x - 143 &= 0 \\ x(x + 13) - 11(x + 13) &= 0 \\ (x + 13)(x - 11) &= 0 \end{aligned}$$

So $x = 11$ or $x = -13$. Since $x$ is a measurement, it cannot be negative. Therefore, the width is 11 m and the length is 13 m.

**d)** Questions and solutions will vary. Student solutions should be similar to the one above.

## Literacy Connections

Draw attention to the marginal item on page 274, which defines the quadratic equation. In addition, look at the Literacy Connections and the definition of "root," both on page 275. Discuss the fact that finding roots and solving equations mean the same thing with quadratic equations.

The Did You Know? feature on page 281 provides an opportunity for a cross-curricular activity with the History department.

Add "quadratic equation," "roots," and "per capita" to the Word Wall.

**Student Success**

Use the timed retell strategy to have each student make up an equation. Then, have a partner decide whether it can be solved, by what method, and why.

Refer to the introduction of this Teacher's Resource for more information about how to use a timed retell strategy.

## Mathematical Processes Integration

The table shows questions that provide good opportunities for students to use the mathematical processes.

| Process Expectations | Selected Questions |
|---|---|
| Problem Solving | 18 |
| Reasoning and Proving | 9–13, 15, 17, 21 |
| Reflecting | 2, 15, 17 |
| Selecting Tools and Computational Strategies | 18, 20 |
| Connecting | 7, 8, 14, 16–20 |
| Representing | 8–14, 17–19 |
| Communicating | 10, 13, 15, 18, 21 |

## Ongoing Assessment

- Use Achievement Check question 9 to monitor student success. See Achievement Check Answers and **BLM 6–6 Section 6.2 Achievement Check Rubric**.
- Communicate Your Understanding questions can be used as quizzes to assess students' communication skills.