Solving Quadratic Equations Using Square Roots and the Quadratic Formula

Strand: Equations and Inequalities

Topic: Solving quadratic equations using square roots and the quadratic formula

Primary SOL: A.4 The student will solve
- b) quadratic equations in one variable algebraically;
- e) practical problems involving equations and systems of equations

Related SOL: A.2c, A.3

Materials

- Applications in Solving Quadratic Equations Activity sheet
- Calculator

Vocabulary

radical, solutions, square root, standard form of an equation (earlier grades)
discriminant, quadratic equation, quadratic formula, roots, zero of a function, (A.4b, e)

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Ask students to work with a partner to identify which quadratic equations would be best solved using the quadratic formula and which would be best solved using square roots. Have students sort the following quadratic equations into two columns—one for solving using the quadratic formula and one for using square roots.

A. $x^2 + x = x + 4$	B. $8 + 3x^2 – x = 2x – 7$	C. $3x^2 – 27 – x = -x$
D. $2x^2 + 11x = 7 – x^2$	E. $x^2 – 6 = 10$	F. $1.5x^2 – 17x = 9 + 3x$

   After students have decided which equation belongs to which column, ask them to explain their reasoning. How did they decide which was the best method for finding solutions to a quadratic equation?

2. With their partner, ask students to pick one of the quadratic equations from the table above that they determined would be best solved using square roots. Instruct one person to solve the equation using square roots and the other person to find solutions using the quadratic formula. Then, have partners do the same with an equation they determined was best solved using the quadratic formula. What do they notice? Have them discuss together as partners and then share aloud with the class.
3. Distribute the Applications in Solving Quadratic Equations activity sheet. Have students complete with a partner or in groups.

Assessment

- **Questions**
  - What is the discriminant, and what information can it give you about the solutions to a quadratic equation?

  - What are possible real-world scenarios where it would not be reasonable to have two solutions even when the quadratic equation modeling that scenario has two solutions?
  - What are some real-world scenarios that would use quadratic equations?
- **Journal/writing prompts**
  - Explain how you know which is the best method to solve a quadratic equation: using the quadratic formula or using square roots.
  - Describe the similarities and differences between quadratic equations that can be solved using square roots vs. ones that would require a different strategy. Give examples of each type of equation and elaborate on strategies that can be used when square roots is not an option.
- **Other Assessments**
  - Ask students to explain how they would know when a quadratic equation will have rational or irrational solutions.

Extensions and Connections (for all students)

- Why are properties of real numbers important for solving quadratic equations?
- Quadratic equations can be used to calculate areas, find speed, find distances of objects being thrown, and determine the time a projectile object takes to land.
- Quadratic equations are used in mathematics, engineering, science, and astronomy.

Strategies for Differentiation

- Review vocabulary, as needed.
- Have students create a table to identify a, b, and c in the quadratic formula for each quadratic equation. For example, in the equation $h = -3t^2 + 45t - 10$, students can complete the table as follows:

ax^2	bx	c
a = –3	b = 45	c = –10

- Ask students to create a flow chart which shows and explains the best method to use when solving a quadratic equation.
- Allow students to use dry-erase boards with various colors to represent a, b, and c in the quadratic formula. Once they have identified a, b, and c, they can erase and replace the variables for their values in the quadratic formula.
- Allow students to highlight key information in word problems to aid in identifying values to be used in the quadratic formula.
- If students have been taught a problem-solving strategy, provide cues for applying that strategy.
- Allow for student choice in methods used to solve equations, regardless of which is preferred.

- Request that students choose a preferred method for solving each quadratic equation before starting their calculations. This gives you an opportunity to assess the student's ability to identify quadratic equations that can be solved using square roots vs. the quadratic formula before solving.

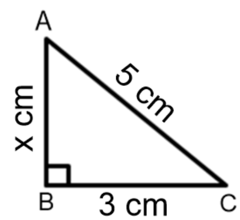
Note: The following pages are intended for classroom use for students as a visual aid to learning.

Applications in Solving Quadratic Equations

Name: ______________________________ Date:___________

Directions: For each problem, decide which method for solving quadratic equations would be best to use and then solve. Show all work.

1. In a right triangle, we can find the length of any unknown side if we know two of the three sides by using Pythagorean theorem. Pythagorean theorem states that $a^2 + b^2 = c^2$, where a and b are the legs of the right triangle and c is the hypotenuse (the longest side, directly across from the right angle). Given the following information, what is the length of side AB in triangle ABC?



2. The area of rectangle can be found by multiplying the length and width of the rectangle (A = lw). If the length of the rectangle is 4 inches less than its width and the area of the rectangle is 45 in^2, what is the width of the rectangle?

3. The area of a triangle can be found by taking half of the product of the triangle's base length times its height ($A = \frac{1}{2}bh$). If the area of a triangle is 60 cm^2 and the length of the base is 4 times the height of the triangle, what is the height of the triangle?

4. A tennis ball is placed on the top of a 32-foot ramp. The height of the ball at any given time after being dropped down the ramp can be represented by the equation $h = -16t^2 + 32$, where the height, *h,* is measured in feet from the ground and time, *t,* is measured in seconds. Determine the time that it takes the ball to reach the ground.

5. A roofer throws a shingle from the top of a roof to the ground. The distance, in feet, the shingle is above the ground is modeled by the equation $h = -16t^2 + 96t + 48$, where t represents time in seconds. How much time will it take for the shingle to hit the ground?