6.5 Solve Problems Using Quadratic Equations

Student Text Pages
304–315

Suggested Timing
140–210 min, depending on how much problem solving you have done in previous sections

Technology Tools
- graphing calculator
- computer
- spreadsheet software
- Internet access

Related Resources
- T–1 Corel® *Quattro Pro*® 8
- T–2 Corel® *Quattro Pro*® 10
- T–3 Microsoft® *Excel*
- BLM 6–10 Section 6.5 Practice Master
- A–5 Problem Solving Checklist
- A–18 My Progress as a Problem Solver

Teaching Suggestions

Examples

- **Example 1** explains the coefficients of the projectile quadratic that relates height and time. If possible, show both the paper-and-pencil method and the graphing calculator method. This encourages students to select an appropriate tool for solving problems. (15 min)
- **Examples 2**, **3**, and **4** emphasize a problem solving procedure such as the following: (45 min)
  - Draw a diagram and label it fully.
  - Consider what is known and what the question is asking for.
  - Define a set of variables. Insist that students define quantities; e.g., "Let x represent the mass of a book" rather than "Let x represent a book."
  - Define expressions that describe other quantities.
  - Set up an equation that describes the situation (have students look for clues in the wording).
  - Rewrite the equation into an appropriate form for solving.
  - Solve the equation using an appropriate tool.
  - Interpret the result.
  - Reflect on the solution to see if it could be reached in a more efficient manner.
- When data are generated through an experiment, as in **Example 5**, it is often difficult to come up with an equation modelling the data without the use of technology. Spreadsheets and graphing calculators do this job easily, allowing problems related to the data to be solved. Use **T–1 Corel® *Quattro Pro*® 8**, **T–2 Corel® *Quattro Pro*® 10**, or **T–3 Microsoft® *Excel*** to support this activity. (15 min)

Communicate Your Understanding

- Some problems may require one of the two solutions to be rejected. Ask students to justify their solution, such as: "Because x represents distance and distance must be positive, x cannot be negative."
- Encourage students to discuss their answers to the questions with a classmate before discussing as a class. Questions C1 and C2 are keys to understanding why quadratics occur frequently in real-life problems. (10 min)
- Use **A–5 Problem Solving Checklist** to assist you when assessing students. Alternatively, have students use **A–18 My Progress as a Problem Solver** as a self-assessment tool.
- Use **BLM 6–10 Section 6.5 Practice Master** for remediation or extra practice.

Common Errors

- Some students may not have trouble with the mechanics of solving a problem, but may instead have trouble setting up the model for the problem.

R_x Spend a class period setting up models, but not solving the problems. Review how to interpret the vocabulary in the problems. Stress the inclusion of a well-labelled diagram. Have students work in pairs or small groups to solve the problems.

Accommodations

Perceptual—Encourage students to work in groups to create solutions to the questions in this section, and to present their solutions as a group to their classmates.

Spatial—Provide students with diagrams for the Practise questions.

Language—Let students work in groups when completing the questions in this section.

ESL—Allow students to use translators to help them understand the new words in this section.

Communicate Your Understanding Responses (page 311)

C1. A quadratic equation occurs because the lengths of the sides are represented by the expressions x, $x + 1$, and $x + 9$. When the Pythagorean theorem is used to relate the sides, the lengths of the sides are squared. When the expression is expanded and simplified with all terms on the left side, a quadratic equation occurs.

C2. When the expression is expanded and simplified the product of x from the first factor and x from the second factor result in x^2, which will make the expression quadratic.

C3. If x represented the length of a side, disregard the root -3.8 because length must be greater than zero, and substitute to find the other required dimensions of the quadratic model.

Practise

- **Questions 1** through **7** provide a smooth entrance into the problem solving exercise.
- For **question 8**, use the formula $V = \pi r^2 h$, where $h = 12$. Then solve the quadratic.
- **Question 9** can be solved in a similar manner to **question 8**.
- Caution students when working on **question 10** not to square 365.
- For **question 11**, use the substitution method to combine the perimeter and area formulas.
- In **question 14**, students may label the height of the top of the ladder as the hypotenuse rather than the vertical height.
- For **question 17**, refer students to Section 6.2, question 17.
- Answers for **question 25** will vary depending on how the students graphed the parabola. They can use the diameter information to graph the x-intercepts and the vertex information to complete the equation.
- For **question 27**, students need to consider the direction of opening of each parabola, and the location of the vertex.
- For **question 28**, part a) is a quadratic model but part b) is linear. Students need to use critical thinking skills here.
- In **question 29**, students should consider that a diagonal launch will split the diagonal velocity into smaller vertical and horizontal velocities. When your class studies trigonometry, you can have a further discussion on this concept.
- In some schools, the Physics classes hold a trebuchet contest, as in **question 30**. If so, ask if your class can observe.

Literacy Connections

Question 25 offers an opportunity for enrichment. Students can use the Internet Link to discover information about liquid mirror telescopes. Pursue a cross-curricular connection with the Science department.

Student Success

Have students use a think aloud strategy with a partner to analyse word problems.

Have students use a four corners strategy (graphing calculator, spreadsheet, quadratic formula, factoring) to choose and complete a strategy for solving a quadratic equation.

Refer to the introduction of this Teacher's Resource for more information about how to use a think aloud and a four corners 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	30
Reasoning and Proving	2, 4–6, 9, 13, 14, 16, 17, 26, 27, 29–31
Reflecting	3, 6, 9, 11–13, 15, 17–24, 26, 28
Selecting Tools and Computational Strategies	2, 7, 11, 27
Connecting	1–3, 6, 8, 9, 11–26, 28–30
Representing	1, 3–26, 28, 30
Communicating	26–29

Ongoing Assessment

- Communicate Your Understanding questions can be used as quizzes to assess students' communication skills.