# 5.5 Solving Problems Involving Polynomial Functions

**Study Guide and Exercise Book Pages**
98 to 100

**Tools**
- grid paper
- graphing calculator
- computer with dynamic geometry software

**Related Resources**
- G–1 Grid Paper
- T–2 *The Geometer's Sketchpad*® 4
- A–5 Connecting

## Teaching Suggestions

### Key Concepts

- Remind students that they studied linear functions in grade 9 and quadratic functions in grade 10. These are two types of polynomial functions. Ask them to name real-world examples of straight line functions and parabolas.
- Ask students to give an example of a real-world application of a quadratic function in which restrictions must be imposed on the domain. Discuss why there are restrictions on a domain. How might a restriction on the domain affect the range?

### Example

- Have students recognize that they must understand the context of a word problem before they can determine a logical domain for it. You may wish to give students some helpful hints:
  – Read the problem more than once.
  – Highlight the important words.
  – Look up the meaning of terms with which you are unfamiliar.
  – Know what each variable in the equation represents.

  Students may wish to write the equation in terms of $y$ on the left-hand side and $x$ on the right-hand side.
- Help students recall how to use the **ZERO** operation and **MAXIMUM** operation on their graphing calculator.
- Students may need help adjusting the window on their graphing calculator. Help them recognize that a leading coefficient for this question is $\frac{1}{1800}$, which is a very small number, resulting in very small $y$-values. If they use large $y$-values in their window, they may not be able to see the graph on their screen.
- It may be helpful for students to create a visual representation using a graphing calculator for the **Example** and all questions in this section. Before using technology, encourage students to sketch their own graph on grid paper. Have them create and complete a checklist before drawing their sketch:
  – What type of function is this?
  – What is its degree?
  – What is the leading coefficient and how does this affect the end behaviours?
  – Is there a constant term?
  – What is the $y$-intercept?
  – How many maximum and minimum points could a function of this degree have?
  – How many $x$-intercepts could a function of this degree have?
  – Will the function have any symmetry?
  – What would the sketch of this function look like? What parts of the completed sketch could be erased due to a restriction in the domain?

  Having an idea of what the graph should look like will enable students to understand the question and recognize if they have made an error.
- You may wish to show students an alternative method for writing domain and range: $0 \leq x \leq 8.3$ can be written as $[0, 8.3]$, and $0 < x \leq 8.3$ can be written as $(0, 8.3]$. Make sure students do not mistake a domain, such as $x \in (0, 8)$, for an ordered pair.

**Common Errors**
- Students sometimes forget to use units in their answers for application problems.

$R_x$ Remind students that real-world problems have meaning, and that the answers to these problems have specific meaning. The units give meaning to the answer.

**Differentiated Instruction**
- Before attempting application problems involving cubic and quartic functions, use a **Frayer model** to summarize important characteristics of these functions.

### Questions

- The questions in this section are designed to show students how features of polynomial functions can be described with real-life terminology.
- Consider having students work in groups to complete these questions. You could assign each group two or three questions, and have them present their solutions to the class. You could assess group presentations with a rubric.
- Remind students to use the tables of values on their graphing calculator to help determine the window that they should use to graph the polynomial function.
- When evaluating the functions using pencil and paper, encourage students to show all steps and proper form. They can then use technology to check their answers.
- Relate **question 1c**) to the $y$-intercept and the constant term.
- For **question 2**, it may be necessary to review the order of operations, BEDMAS.
- Review with students how best to solve the quadratic equation in **question 2c**).
- For **question 4**, you may want to discuss with students that $t = 0$ means the tank is full. Then, discuss what value of $t$ would make the function equal 0 (the value that makes $28 - t$ equal to 0). Ask, "What is the significance of this value?" (it is the time when the tank is empty).
- For **question 6**, challenge students to learn more about patients' reaction times to different types of medicines.
- For **question 7**, consider having students visit Statistics Canada's website to gather real-life data about population growth in different areas.
- As an extension to **question 8**, have students calculate the leading coefficient using finite differences.
- For **question 13c**), tell students that average speed is measured in metres per second, and that they can use the slope formula.

## Technology Suggestions

- **Question 3** is a good candidate for using *The Geometer's Sketchpad*®. Dragging a point along the function while watching the coordinates change provides a good model for students, especially for visual learners.
- **Question 8** presents a good application for the finite differences template that students created using a spreadsheet in section 5.2 (see **T5–3 How to Do Section 5.2 #11 Using a Graphing Calculator or a Spreadsheet**).
- **Question 13** is a good candidate for using *The Geometer's Sketchpad*®. Part **c**) can be made dynamic so students can see the change in the average speed of the ball as it continues its flight.

## Mathematical Process Expectations

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

| Process Expectation | Selected Questions |
|---|---|
| Problem Solving | 1–13 |
| Reasoning and Proving | 2 |
| Reflecting | 3, 4, 13 |
| Selecting Tools and Computational Strategies | 2–9 |
| Connecting | 2, 13 |
| Representing | n/a |
| Communicating | 2, 3, 5 |

**Ongoing Assessment**

- Use **A–5 Connecting** to remind students what they should take into consideration when solving application problems, and how you may be assessing the "**look fors**."