Chapter 1

Functions

Curriculum Expectations

Characteristics of Functions

Representing Functions

A1.1 explain the meaning of the term *function*, and distinguish a function from a relation that is not a function, through investigation of linear and quadratic relations using a variety of representations (i.e., tables of values, mapping diagrams, graphs, function machines, equations) and strategies (e.g., identifying a one-to-one or many-to-one mapping; using the vertical-line test)

Sample problem: Investigate, using numeric and graphical representations, whether the relation $x = y^2$ is a function, and justify your reasoning.

Technology Notes

The technology used in this chapter includes graphing calculators, specifically the TI-83 Plus/TI-84 Plus series and the TI-Nspire™ CAS graphing calculator.

A1.2 represent linear and quadratic functions using function notation, given their equations, tables of values, or graphs, and substitute into and evaluate functions [e.g., evaluate $f\left(\frac{1}{2}\right)$, given $f(x) = 2x^2 + 3x - 1$]

A1.3 explain the meanings of the terms *domain* and *range*, through investigation using numeric, graphical, and algebraic representations of the functions $f(x) = x$, $f(x) = x^2$, $f(x) = \sqrt{x}$, and $f(x) = \frac{1}{x}$; describe the domain and range of a function appropriately (e.g., for $y = x^2 + 1$, the domain is the set of real numbers, and the range is $y \geq 1$); and explain any restrictions on the domain and range in contexts arising from real-world applications

Sample problem: A quadratic function represents the relationship between the height of a ball and the time elapsed since the ball was thrown. What physical factors will restrict the domain and range of the quadratic function?

Solving Problems Involving Quadratic Functions

A2.1 determine the number of zeros (i.e., x-intercepts) of a quadratic function, using a variety of strategies (e.g., inspecting graphs; factoring; calculating the discriminant)

Sample problem: Investigate, using graphing technology and algebraic techniques, the transformations that affect the number of zeros for a given quadratic function.

A2.2 determine the maximum or minimum value of a quadratic function whose equation is given in the form $f(x) = ax^2 + bx + c$, using an algebraic method (e.g., completing the square; factoring to determine the zeros and averaging the zeros)

Sample problem: Explain how partially factoring $f(x) = 3x^2 - 6x + 5$ into the form $f(x) = 3x(x - 2) + 5$ helps you determine the minimum of the function.

A2.3 solve problems involving quadratic functions arising from real-world applications and represented using function notation

Sample problem: The profit, $P(x)$, of a video company, in thousands of dollars, is given by $P(x) = -5x^2 + 550x - 5000$, where x is the amount spent on advertising, in thousands of dollars. Determine the maximum profit that the company can make, and the amounts spent on advertising that will result in a profit and that will result in a profit of at least \$4 000 000.

A2.4 determine, through investigation, the transformational relationship among the family of quadratic functions that have the same zeros, and determine the algebraic representation of a quadratic function, given the real roots of the corresponding quadratic equation and a point on the function

Sample problem: Determine the equation of the quadratic function that passes through (2, 5) if the roots of the corresponding quadratic equation are $1 + \sqrt{5}$ and $1 - \sqrt{5}$.

A2.5 solve problems involving the intersection of a linear function and a quadratic function graphically and algebraically (e.g., determine the time when two identical cylindrical water tanks contain equal volumes of water, if one tank is being filled at a constant rate and the other is being emptied through a hole in the bottom)

Sample problem: Determine, through investigation, the equations of the lines that have a slope of 2 and that intersect the quadratic function $f(x) = x(6 - x)$ once; twice; never.

Determining Equivalent Algebraic Expressions

A3.2 verify, through investigation with and without technology, that $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$, $a \geq 0$, $b \geq 0$, and use this relationship to simplify radicals (e.g., $\sqrt{24}$) and radical expressions obtained by adding, subtracting, and multiplying [e.g., $(2 + \sqrt{6})(3 - \sqrt{12})$]

Chapter 1 Planning Chart

Section Suggested Timing	Student Text Page(s)	Teacher's Resource Blackline Masters	Assessment	Tools
Chapter 1 Opener • 10–15 min	1			
Prerequisite Skills • 45–60 min	2–3	• G–3 Four Quadrant Grids • BLM 1–1 Prerequisite Skills		• grid paper • graphing calculator
1.1 Functions, Domain, and Range • 75 min	4–15	• G–1 Grid Paper • BLM 1–2 Section 1.1 Practice		• grid paper • graphing calculator
1.2 Functions and Function Notation • 75 min	16–24	• G–1 Grid Paper • BLM 1–3 Section 1.2 Practice		• grid paper • graphing calculator • computer with graphing software (optional)
1.3 Maximum or Minimum of a Quadratic Function • 75–90 min	25–32	• G–1 Grid Paper • BLM 1–4 Section 1.3 Practice		• grid paper • graphing calculator • computer with graphing software (optional)
Use Technology: Use a TI-Nspire™ CAS Graphing Calculator to Find the Maximum or Minimum and the Zeros of a Quadratic Function • 15–20 min	33			• TI-Nspire™ CAS graphing calculator
1.4 Skills You Need: Working With Radicals • 75–90 min	34–40	• BLM 1–5 Section 1.4 Practice		• scientific calculator (optional)
Use Technology: Use a TI-Nspire™ CAS Graphing Calculator to Explore Operations With Radicals • 20–40 min	41–42			• TI-Nspire™ CAS graphing calculator
1.5 Solve Quadratic Equations • 75 min	43–51	• G–1 Grid Paper • BLM 1–6 Section 1.5 Practice		• grid paper • graphing calculator
1.6 Determine a Quadratic Equation Given Its Roots • 75 min	52–59	• G–1 Grid Paper • BLM 1–7 Section 1.6 Practice	• BLM 1–8 Section 1.6 Achievement Check Rubric	• grid paper • graphing calculator • computer with graphing software (optional)
1.7 Solve Linear-Quadratic Systems • 75 min	60–69	• G–1 Grid Paper • BLM 1–9 Section 1.7 Practice		• grid paper • graphing calculator • TI-Nspire™ CAS graphing calculator (optional)
Chapter 1 Review • 60–75 min	70–71	• G–1 Grid Paper • BLM 1–10 Chapter 1 Review		• grid paper • graphing calculator • computer with graphing software (optional)
Chapter 1 Problem Wrap-Up • 15–30 min	71	• G–1 Grid Paper	• BLM 1–11 Chapter 1 Problem Wrap-Up Rubric	• grid paper • graphing calculator • computer with Internet access
Chapter 1 Practice Test • 45–60 min	72–73	• G–1 Grid Paper	• BLM 1–12 Chapter 1 Practice Test	• grid paper • graphing calculator
Chapter 1 Task: Laser Beams • 75 min	74	• G–1 Grid Paper • BLM 1–14 BLM Answers	• BLM 1–13 Task: Laser Beams Rubric	• grid paper • graphing calculator

Chapter 1 Blackline Masters Checklist

	BLM	Title	Purpose
Prerequisite Skills			
	G–3	Four Quadrant Grids	Student Support
	BLM 1–1	Prerequisite Skills	Practice
1.1 Functions, Domain, and Range			
	G–1	Grid Paper	Student Support
	BLM 1–2	Section 1.1 Practice	Practice
1.2 Functions and Function Notation			
	G–1	Grid Paper	Student Support
	BLM 1–3	Section 1.2 Practice	Practice
1.3 Maximum or Minimum of a Quadratic Function			
	G–1	Grid Paper	Student Support
	BLM 1–4	Section 1.3 Practice	Practice
Use Technology: Use a TI-Nspire™ CAS Graphing Calculator to Find the Maximum or Minimum and the Zeros of a Quadratic Function			
1.4 Skills You Need: Working With Radicals			
	BLM 1–5	Section 1.4 Practice	Practice
Use Technology: Use a TI-Nspire™ CAS Graphing Calculator to Explore Operations with Radicals			
1.5 Solving Quadratic Equations			
	G–1	Grid Paper	Student Support
	BLM 1–6	Section 1.5 Practice	Practice
1.6 Determine a Quadratic Equation Given Its Roots			
	G–1	Grid Paper	Student Support
	BLM 1–7	Section 1.6 Practice	Practice
	BLM 1–8	Section 1.6 Achievement Check Rubric	Assessment
1.7 Solve Linear-Quadratic Systems			
	G–1	Grid Paper	Student Support
	BLM 1–9	Section 1.7 Practice	Practice
Chapter 1 Review			
	G–1	Grid Paper	Student Support
	BLM 1–10	Chapter 1 Review	Practice
Chapter 1 Problem Wrap-Up			
	G–1	Grid Paper	Student Support
	BLM 1–11	Chapter 1 Problem Wrap-Up Rubric	Assessment
Chapter 1 Practice Test			
	G–1	Grid Paper	Student Support
	BLM 1–12	Chapter 1 Practice Test	Summative Assessment
Chapter 1 Task: Laser Beams			
	G–1	Grid Paper	Student Support
	BLM 1–13	Task: Laser Beams Rubric	Assessment
	BLM 1–14	BLM Answers	Answers

Prerequisite Skills

Student Text Pages
2 to 3

Suggested Timing
45–60 min

Tools
- grid paper
- graphing calculator

Related Resources
- G–3 Four Quadrant Grids
- BLM 1–1 Prerequisite Skills

Assessment
You may wish to use **BLM 1–1 Prerequisite Skills** as a diagnostic assessment. Refer students to the Skills Appendix for examples and further practice of the topics.

Teaching Suggestions

- You may wish to have students complete some questions in class and others as homework. Students may show different abilities to recall the concepts. Pairing weaker students with stronger ones would be helpful if all questions are assigned.
- In **question 5**, remind students of the two important algebraic techniques: substitution and elimination. Have students work in pairs on this question. Or, have small student groups present their solutions or post the solutions on the classroom wall.
- In **question 7**, remind students to first look for common factors. They should see that the factored trinomials are still factorable.

Chapter Problem

The Chapter Problem is introduced on page 3. Have students discuss their understanding of this branch of mathematics. The Chapter Problem is revisited in Section 1.2 (question 19), Section 1.5 (question 19), Section 1.6 (question 14), and Section 1.7 (question 14). These questions are designed to help students move toward the Chapter Problem Wrap-Up on page 71. The Chapter Problem questions may be assigned in each section where they appear. Alternatively, you may wish to assign them all with the Chapter Problem Wrap-Up when students have completed the chapter, as part of a summative assessment.

1.1 Functions, Domain, and Range

Student Text Pages
4 to 15

Suggested Timing
75 min

Tools
- grid paper
- graphing calculator

Related Resources
- G–1 Grid Paper
- BLM 1–2 Section 1.1 Practice

Teaching Suggestions

- Allow 20 to 25 min to complete **Investigate A** and **Investigate B**. Ensure students develop a graphical understanding of the essential difference between a relation and a function.
- In **Investigate B**, when students draw graphs in step 2, ask them, "How do the graphs differ? How are they the same?" Step 3 is designed so students construct the idea of the vertical line test in **Example 1**.
- In **Example 1**, use an acetate overlay with a vertical line drawn on it and move the line left and right on each graph to illustrate when a graph fails the vertical line test.
- **Example 2** may require a discussion of discrete versus continuous values in data. In part b), ask, "Can any value be used for the age or the number of children?" This should spark the idea that there is no such thing as 1.4, or π, or the square root of 5 children at the sports camp. Discuss the margin note and have students give examples of different sets of numbers.