

INTERMEDIATE  
*Algebra*

*Richelle M. Blair*

# Intermediate Algebra

**Richelle M. (Rikki) Blair**

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*To my husband  
for his love and support.*

# Preface

## From the Author

Students in intermediate algebra arrive with a wide range of skills and problem-solving strategies learned in beginning algebra. The goal of this textbook is to build upon those skills and abilities, engage each student, and develop his/her algebraic thinking and confidence in learning mathematics. Standards-based and traditional content in intermediate algebra have been blended to involve students actively in real-world problem solving and reasoning, while including the use of a graphing calculator as a learning tool. The instructional strategies in this textbook are supported by research in the science of learning and teaching mathematics with the goal of addressing the multiple learning styles of students and different teaching styles of faculty. Content and instructional strategies have been chosen to build upon each student's previous knowledge in beginning algebra and open the door to understanding algebra.

## Focus on Student Learning

The science of learning mathematics emphasizes the importance of students being involved and taking control of their own learning. Active student learning activities have been shown to increase the degree to which students transfer learning to new concepts.<sup>1</sup> Learning new concepts involves connecting previously learned information to new information, reflecting, and transferring that knowledge to new problem situations. Each section of this textbook presents student activities to create an active learning environment and build cognitive connections. Each feature below occurs in almost every section of every chapter. One example of each feature can be found on the page listed. Students are expected to:

- Apply quantitative literacy and algebraic skills in other courses and disciplines, p. 127
- Employ problem-solving skills with real-world problems, p. 185
- Build confidence in solving mathematics problem situations, p. 21
- Read, write, explore, discuss, reflect, and do mathematics as active learners, p. 13
- Complete true/false, matching, and reasoning questions, p. 520
- Analyze data and solve real-world problems, pp. 190–192
- Use technology as a problem-solving tool to discover and enhance understanding, p. 45
- Create 3 × 5-inch study cards of important definitions, formulas, and examples
- Complete a mathematics dictionary

## Focus on Standards-Based Teaching

An instructor using this textbook is seen not only as an expert mathematician and problem solver, but also as a facilitator and manager of student learning in an active classroom, employing a variety of instructional activities. This textbook embraces the standards

<sup>1</sup> Bransford, Brown, and Cocking (Eds.). (2000). *How People Learn—Brain, Mind, Experience and School*. Washington, DC. National Academy Press.

of the American Mathematical Association of Two-Year Colleges,<sup>2</sup> the National Council of Teachers of Mathematics,<sup>3</sup> and the Mathematical Association of America<sup>4</sup> by employing a variety of standards-based strategies. Each feature below occurs in almost every section of every chapter. One example of each feature can be found on the page listed.

- Activities for students to work (learn) together, pp. 161–63
- Activities for interactive lecturing, pp. 145–47
- Step-by-step examples, p. 149
- Organizing, analyzing, and graphing real-world data, pp. 199–200
- Connecting mathematics to other disciplines, p. 138
- Problems using a graphing calculator to explore, visualize, observe patterns, and generalize and confirm solutions, p. 53

## Organization and Features of the Textbook

Each section of each chapter is organized into three subsections: Getting Started, Discussing Mathematics, and Doing Mathematics. The innovative keystone feature of the textbook is the student activities in the Getting Started section. These activities and problems are designed to help the student review previously learned concepts and connect that knowledge to new concepts in the section. The Getting Started section can be used in a variety of ways, depending on the desired approach chosen by the instructor. Getting Started is followed by Discussing Mathematics, an explanation of concepts and examples, and Doing Mathematics, a selection of practice problems. The entire textbook is written in a comfortable and welcoming tone and style that students can read on their own.

Using the textbook is as easy as 1-2-3:



*Getting Started* presents student activities to be used as classroom group work or lecture discussions, or assigned as homework for the next day.



*Discussing Mathematics* presents definitions, examples of key concepts, and helpful hints.



*Doing Mathematics* presents practice problems.

### CALCULATOR CLIPS

The graphing calculator, as a learning tool, is an integral component of this text. Students are encouraged to discover patterns, generalize observations, and model and solve problems using real-world data. The calculator clips provide step-by-step instruction on key strokes and operations for using a graphing calculator to solve specific problems. See page 37 for an example.

<sup>2</sup>AMATYC. (1995). *Crossroads in Mathematics: Standards for Introductory College Mathematics Before Calculus*. Memphis, TN: AMATYC. A revision of these standards, *Beyond Crossroads*, will be released in November 2006.

<sup>3</sup>NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

<sup>4</sup>MAA. (2004). *Undergraduate Programs and Courses in the Mathematical Sciences: CUPM Curriculum Guide 2004*. A report of the Committee on the Undergraduate Program (CUPM). Washington, DC: Mathematical Association of America.

## STUDENT PROJECTS

Each chapter includes one project that focuses on key concepts from the chapter. The project may be assigned for students to complete individually or in groups. See page 73 for an example. An additional project for each chapter is available as part of the Printed Test Bank/Instructor's Resource Guide.

Additional material on conic sections, matrices and determinants, and synthetic division is available online at [www.aw-bc.com/blair](http://www.aw-bc.com/blair).

## Supplements for the Instructor

### INSTRUCTOR'S SOLUTIONS MANUAL

(ISBN 0-321-27953-0) This supplement contains complete, worked-out solutions to all of the exercises in the text.

### PRINTED TEST BANK/INSTRUCTOR'S RESOURCE GUIDE

(ISBN 0-321-27954-9) This supplement contains several tests per chapter, teaching notes correlated to each chapter, and a variety of other helpful resources for this text.

### TESTGEN®

TestGen enables instructors to build, edit, print, and administer tests using a computerized bank of questions developed to cover all the objectives of the text. TestGen is algorithmically based, allowing instructors to create multiple but equivalent versions of the same question or test with the click of a button. Instructors can also modify test bank questions or add new questions. Tests can be printed or administered online. The software is available on a dual-platform Windows/Macintosh CD-ROM.

### MYMATHLAB

MyMathLab is a series of text-specific, easily customizable online courses for Addison-Wesley textbooks in mathematics and statistics. Powered by CourseCompass™ (Pearson Education's online teaching and learning environment) and MathXL® (our online homework, tutorial, and assessment system), MyMathLab gives you the tools you need to deliver all or a portion of your course online, whether your students are in a lab setting or working from home. MyMathLab provides a rich and flexible set of course materials, featuring free-response exercises that are algorithmically generated for unlimited practice and mastery. Students can also use online tools, such as animations and an online version of the textbook, to independently improve their understanding and performance. Instructors can use MyMathLab's homework and test managers to select and assign online exercises correlated directly to the textbook, and they can also create and assign their own online exercises and import TestGen tests for added flexibility. MyMathLab's online gradebook—designed specifically for mathematics and statistics—automatically tracks students' homework and test results and gives the instructor control over how to calculate final grades. Instructors can also add offline (paper-and-pencil) grades to the gradebook. MyMathLab is available to qualified adopters. For more information, visit our website at [www.mymathlab.com](http://www.mymathlab.com) or contact your Addison-Wesley sales representative.

**MATHXL®**

MathXL® is a powerful online homework, tutorial, and assessment system that accompanies Addison-Wesley textbooks in mathematics or statistics. With MathXL, instructors can create, edit, and assign online homework and tests using algorithmically generated exercises correlated at the objective level to the textbook. They can also create and assign their own online exercises and import TestGen tests for added flexibility. All student work is tracked in MathXL's online gradebook. Students can take chapter tests in MathXL and receive personalized study plans based on their test results. The study plan diagnoses weaknesses and links students directly to tutorial exercises for the objectives they need to study and retest. Students can also access supplemental animations directly from selected exercises. MathXL is available to qualified adopters. For more information, visit our website at [www.mathxl.com](http://www.mathxl.com), or contact your Addison-Wesley sales representative.

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**(ISBN 0-321-42632-0)** This supplement contains complete, worked-out solutions to the odd-numbered exercises in the text.

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**(ISBN 0-321-42749-1)** This interactive tutorial CD-ROM provides algorithmically generated practice exercises that are correlated at the objective level to the exercises in the textbook. Every practice exercise is accompanied by an example and a guided solution designed to involve students in the solution process. The software provides helpful feedback for incorrect answers and can generate printed summaries of students' progress.

**INTERACT MATH TUTORIAL WEBSITE: [www.interactmath.com](http://www.interactmath.com)**

Get practice and tutorial help online! This interactive tutorial website provides algorithmically generated practice exercises that correlate directly to the exercises in the textbook. Students can retry an exercise as many times as they like with new values each time for unlimited practice and mastery. Every exercise is accompanied by an interactive guided solution that provides helpful feedback for incorrect answers, and students can also view a worked-out sample problem that steps them through an exercise similar to the one they're working on.

**ADDISON-WESLEY MATH TUTOR CENTER**

The Addison-Wesley Math Tutor Center is staffed by qualified mathematics instructors who provide students with tutoring on examples and odd-numbered exercises from the textbook. Tutoring is available via toll-free telephone, toll-free fax, e-mail, or the Internet. White Board technology allows tutors and students to actually see problems worked while they "talk" in real time over the Internet during tutoring sessions. For more information, go to [www.aw-bc.com/tutorcenter](http://www.aw-bc.com/tutorcenter).



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# Arithmetic and Algebra Review Skills Test

This test is intended to assess skills at the beginning of the course.  
*Do not use a calculator on this test.*

Multiply or divide the fractions and reduce to lowest terms.

1.  $\frac{28}{3} \cdot \frac{15}{7}$       a)  $\frac{43}{10}$       b)  $\frac{420}{21}$       c) 22      d) 20

2.  $1\frac{4}{7} \div 5\frac{2}{3}$       a)  $\frac{33}{24}$       b)  $\frac{33}{119}$       c)  $\frac{187}{21}$       d)  $\frac{33}{68}$

Add or subtract the fractions and reduce to lowest terms. Write answers that are improper fractions as mixed numbers.

3.  $\frac{7}{5} + \frac{3}{5}$       a)  $2\frac{1}{3}$       b) 1      c)  $\frac{21}{25}$       d) 2

4.  $\frac{11}{8} - \frac{2}{5}$       a)  $1\frac{1}{40}$       b)  $\frac{39}{40}$       c)  $3\frac{1}{40}$       d)  $\frac{9}{3} = 3$

Perform the operations and reduce to lowest terms. Follow the Order of Operations.  
Write answers that are improper fractions as mixed numbers.

5.  $\frac{17}{2} - \frac{7}{2} \cdot \frac{4}{3}$       a)  $3\frac{5}{6}$       b)  $-2\frac{3}{4}$       c)  $13\frac{1}{3}$       d)  $6\frac{2}{3}$

6.  $\left(\frac{11}{2} - \frac{7}{2}\right) \cdot \frac{4}{3}$       a)  $2\frac{2}{3}$       b)  $6\frac{2}{3}$       c)  $5\frac{1}{3}$       d)  $1\frac{1}{3}$

Perform the operations.

7.  $142.56 + 35.47$       a) 1780.3      b) 17.803      c) 1.7803      d) 178.03

8.  $142.56 - 35.47$       a) 107.09      b) 10,709      c) 1070.9      d) 0.10709

9.  $4.08 \div 2.0 \times 1.3$       a) 0.2652      b) 265.2      c) 2.652      d) 26.52

10. Convert  $1.02 \times 10^{-2}$  from scientific notation to standard form.

a) 0.00102      b) 0.00102      c) 0.0102      d) 0.102

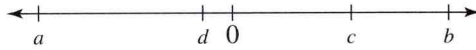
11. Convert 2,530,000 from standard form to scientific notation.

a)  $25.3 \times 10^5$       b)  $2.53 \times 10^5$       c)  $25.3 \times 10^6$       d)  $2.53 \times 10^6$

12. Solve the proportion  $\frac{3}{5} = \frac{x}{20}$ .

a)  $x = 60$       b)  $x = 6$       c)  $x = 4$       d)  $x = 12$

13. The variables  $a$ ,  $b$ ,  $c$ , and  $d$  represent real numbers in the respective locations on the number line. Is the sum of  $a$  and  $d$  a negative or positive number?



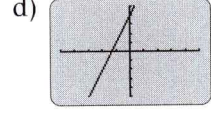
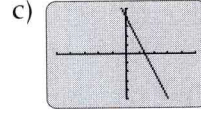
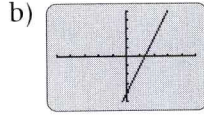
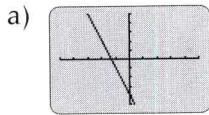
a) Negative

b) Positive

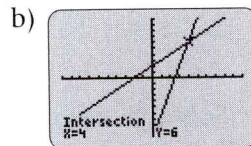
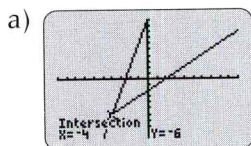
Use the Order of Operations to perform the indicated operations.

14.  $-2^2 + 3(2 - 6)$       a)  $-28$       b)  $-8$       c)  $-16$       d)  $5$
15.  $-2 \times 6 \div 3 + (-6)$       a)  $-10$       b)  $10$       c)  $2$       d)  $-2$
16. Evaluate  $a^2 + b^2$ , given that  $a = -3$  and  $b = -2$ .  
 a)  $-25$       b)  $-13$       c)  $13$       d)  $25$
17. Perform the operations  $-5(2x - 1) - (4x + 7)$  Remove parentheses and combine LIKE terms.  
 a)  $-6x + 12$       b)  $-14x - 2$       c)  $-14x + 2$       d)  $-14x + 12$
18. Solve the equation  $4x - 2(x - 3) = x + 1$ .  
 a)  $x = -5$       b)  $x = \frac{4}{5}$       c)  $x = 7$       d)  $x = 5$
19. Find the solution of the inequality  $-2x - 9 > 5$  written in interval notation.  
 a)  $(-\infty, -7)$       b)  $(-7, \infty)$       c)  $(-\infty, -7]$       d)  $[-7, \infty)$

20. Choose the graph of the equation  $y = -3x + 4$ .  
 Window  $[-5, 5]$  Xscl 1  $[-5, 5]$  Yscl 1.

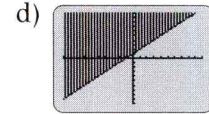
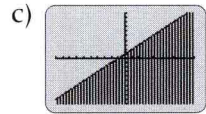
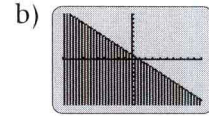
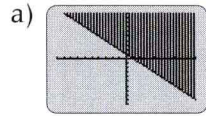


21. Find the equation of the line with slope 5 and  $y$ -intercept  $-1$ .  
 a)  $y = -x + 5$       b)  $y = 5x - 1$       c)  $y = x - 5$       d)  $y = 5x + 1$
22. Find a line parallel to  $y = 5x + 7$ .  
 a)  $y = 5x - 3$       b)  $y = \frac{1}{5}x + 2$       c)  $y = -5x + 3$       d)  $y = -\frac{1}{5}x - 4$
23. Which graph illustrates the graphical solution using the Intersection-of-Graphs method of  $x - 2 = 4x + 10$ ? Window  $[-10, 10]$  Xscl 1  $[-10, 10]$  Yscl 1.



24. Find the solution of the system  $3x + y = 8$   
 $3x - y = -2$ .
- a)  $x = -1, y = 5$    b)  $x = 1, y = -5$    c)  $x = -1, y = -5$    d)  $x = 1, y = 5$

25. The graphical solution of the inequality  $x + y \geq 1$ .  
 Window  $[-10, 10]$  Xscl 1  $[-10, 10]$  Yscl 1.



Simplify.

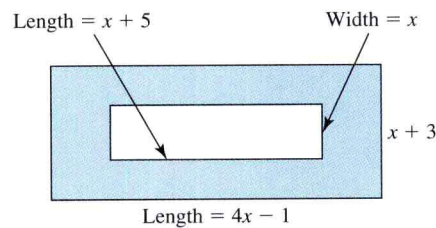
26.  $(-3xy^2)^3$
- a)  $-27x^3y^5$    b)  $-27x^3y^6$    c)  $27x^3y^6$    d)  $-9x^3y^6$

27.  $5x^{-6}$ .
- a)  $-5x^6$    b)  $\frac{1}{-5x^6}$    c)  $\frac{1}{5x^6}$    d)  $\frac{5}{x^6}$

28.  $-2x^2(x - 5)(x + 6)$
- a)  $-2x^3 - 2x^2 + 60x$    b)  $2x^3 + 2x^2 - 60x$   
 c)  $-2x^4 - 2x^3 + 60x^2$    d)  $-2x^4 + 2x^3 - 60x^2$

29.  $\frac{-24a^2b^2}{8a^2b}$
- a)  $-3b$    b)  $3b$    c)  $3ab$    d)  $-3a^4b^3$

30. Express the area of the shaded region as a polynomial.



- a)  $3x^2 + 6x - 3$    b)  $5x^2 + 6x - 3$   
 c)  $3x^2 + 16x - 3$    d)  $3x^2 - 6x + 3$

Factor completely.

31.  $-2x^3y + 50xy$

a)  $-2xy(x^2 + 25)$

c)  $-2xy(x - 5)(x + 5)$

b)  $-2xy(x + 4)(x + 1)$

d)  $-2xy(x - 4)(x - 1)$

32.  $6x^2 + 5xy - 4y^2$

a)  $(2x - 4y)(3x + y)$

c)  $(2x + 4y)(3x + y)$

b)  $(2x - y)(3x + 4y)$

d)  $(2x + y)(3x - 4y)$

33. Reduce to lowest terms  $\frac{x^2 - 9}{x^2 + 2x - 15}$ .

a)  $\frac{x - 3}{x - 5}$

c)  $\frac{x - 3}{x + 5}$

b)  $\frac{x + 3}{x - 5}$

d)  $\frac{x + 3}{x + 5}$

34. Solve  $4x^2 + x = 3$  using the Zero-Product Property.

a)  $x = -\frac{3}{4}, x = 1$

c)  $x = \frac{3}{4}, x = -1$

b)  $x = -\frac{3}{4}, x = -1$

d)  $x = \frac{3}{4}, x = 1$

Perform the operations and reduce the answers to lowest terms.

35.  $\frac{-2x}{15y^2} \cdot \frac{3x^2y^2}{8}$

a)  $\frac{x^3}{20}$

c)  $-\frac{x^2}{20}$

b)  $\frac{x}{5}$

d)  $-\frac{x^3}{20}$

36.  $\frac{x^2 - 4}{2x + 2y} \div \frac{x + 2}{x^2 - y^2} \cdot \frac{-14}{x - 2}$

a)  $-14(x - y)$

c)  $7(x - y)$

b)  $-7(x - y)$

d)  $-7(x - y)(x + 2)$

37.  $\frac{10}{x + 1} - \frac{2}{x + 1}$

a)  $\frac{12}{x + 2}$

c)  $\frac{8}{2x + 2}$

b) 8

d)  $\frac{8}{x + 1}$

38.  $\frac{20}{x} + \frac{6}{5x}$

a)  $\frac{106}{5x}$

c)  $\frac{26}{6x}$

b)  $\frac{106}{10x}$

d)  $\frac{26}{5x}$

39.  $\frac{1}{y^2 - y} + \frac{3y}{y^2 - 1}$

a)  $\frac{3y + 1}{2y^2 - y - 1}$

c)  $\frac{3y^2 + y + 1}{y(y - 1)(y + 1)}$

b)  $\frac{3y + 1}{y^2 - y - 1}$

d)  $\frac{4y + 1}{2(y - 1)(y + 1)}$

Simplify. Assume  $x > 0$  and  $y > 0$ .

40.  $\sqrt{75x^5y^2}$

a)  $15xy\sqrt{xy}$

c)  $25x^2y\sqrt{3x}$

b)  $5x^2y\sqrt{3x}$

d)  $3xy\sqrt{5xy}$

41.  $\sqrt[3]{-40z^3}$

a)  $-2z\sqrt[3]{5}$

c)  $8z$

b)  $-2z$

d)  $2z$

Perform the operations. Write each answer in simplified form. Assume  $x > 0$  and  $z > 0$ .

42.  $2x\sqrt{9z} + 5x\sqrt{9z}$

a)  $7x^2\sqrt{9z}$

c)  $21x\sqrt{z}$

b)  $7x\sqrt{9z}$

d)  $21\sqrt{z}$

43.  $4\sqrt{x}(\sqrt{x} - \sqrt{z})$

a)  $4x - 4z$

c)  $4x - 4\sqrt{xz}$

b)  $4x^2 - 4xz$

d)  $4x - 4xz$

44. Reflection: Which 4 problems on this SKILLS Test did you find the most difficult? Ask your instructor for practice problems related to those difficult problems.

# Contents

	Preface	ix
	Arithmetic and Algebra Review Skills Test	xv
<b>Chapter 1</b>	<b>Real Numbers, Review of Introductory Algebra, and the Cartesian Plane</b>	<b>1</b>
1.1	The Real Numbers and Order of Operations	1
1.2	Graphing on the Number Line, Set-Builder Notation, and Interval Notation	14
1.3	Translating Word Phrases into Mathematical Statements, Problem-Solving Strategies, and Study Skills	21
1.4	Properties of Exponents and Scientific Notation	32
1.5	Simplifying Algebraic Expressions	41
1.6	Plotting Points and Graphing Linear Equations on the Cartesian Plane	47
	<b>CHAPTER 1 SUMMARY</b>	59
	<b>CHAPTER 1 REVIEW</b>	64
	<b>PRACTICE TEST—CHAPTER 1</b>	70
	<b>STUDENT PROJECT FOR CHAPTER 1</b>	72
	<b>ANSWERS TO GETTING STARTED—CHAPTER 1</b>	73
<b>Chapter 2</b>	<b>Linear Equations, Inequalities, and Absolute Value</b>	<b>75</b>
2.1	Solving Linear Equations	75
2.2	Solving Linear Equations Graphically	83
2.3	Solving Linear Inequalities	93
2.4	Solving Linear Equations and Inequalities Using Graphical Methods on the Cartesian Plane	104
2.5	Solving Linear Equations and Inequalities Involving Absolute Value	113
	<b>CHAPTER 2 SUMMARY</b>	128
	<b>CHAPTER 2 REVIEW</b>	132
	<b>PRACTICE TEST—CHAPTER 2</b>	138
	<b>STUDENT PROJECT FOR CHAPTER 2</b>	141
	<b>ANSWERS TO GETTING STARTED—CHAPTER 2</b>	142
<b>Chapter 3</b>	<b>Relations and Functions</b>	<b>145</b>
3.1	Relations, Functions, and Function Notation	145
3.2	Linear Relations and Functions, Slope, and Slope-Intercept Form	161
3.3	Point-Slope Formula, and Parallel and Perpendicular Lines	178
3.4	Algebra of Functions	193



	<b>CHAPTER 3 SUMMARY</b>	201
	<b>CHAPTER 3 REVIEW</b>	204
	<b>PRACTICE TEST—CHAPTER 3</b>	210
	<b>STUDENT PROJECT FOR CHAPTER 3</b>	212
	<b>ANSWERS TO GETTING STARTED—CHAPTER 3</b>	214
	<b>CUMULATIVE TEST CHAPTERS 1–3</b>	216
<b>Chapter 4</b>	<b>Systems of Equations</b>	<b>221</b>
4.1	Solving Linear Systems in Two Variables, Analytically and Graphically	221
4.2	Solving Linear Systems in Three Variables	234
4.3	Real-World Problems Involving Linear Systems	242
4.4	Solving Linear Systems Using Matrices and Determinants	257
4.5	Solving Linear Inequalities in Two Variables and Systems of Linear Inequalities in Two Variables	274
	<b>CHAPTER 4 SUMMARY</b>	288
	<b>CHAPTER 4 REVIEW</b>	294
	<b>PRACTICE TEST—CHAPTER 4</b>	301
	<b>STUDENT PROJECT FOR CHAPTER 4</b>	304
	<b>ANSWERS TO GETTING STARTED—CHAPTER 4</b>	305
<b>Chapter 5</b>	<b>Polynomials and Polynomial Functions</b>	<b>308</b>
5.1	Introduction to Polynomials and Polynomial Functions	308
5.2	Multiplication of Polynomials	320
5.3	Division of Polynomials	331
5.4	Common Factors and Factoring by Grouping	339
5.5	Factoring Trinomials of the Form $ax^2 + bx + c$	347
5.6	Factoring Special Products and Multistep Factoring	358
5.7	Solving Polynomial Equations	370
	<b>CHAPTER 5 SUMMARY</b>	381
	<b>CHAPTER 5 REVIEW</b>	386
	<b>PRACTICE TEST—CHAPTER 5</b>	395
	<b>STUDENT PROJECT FOR CHAPTER 5</b>	398
	<b>ANSWERS TO GETTING STARTED—CHAPTER 5</b>	399
<b>Chapter 6</b>	<b>Rational Expressions, Equations, and Functions</b>	<b>402</b>
6.1	Rational Expressions and Functions, Multiplication and Division	402
6.2	Addition and Subtraction of Rational Expressions and Functions	413
6.3	Graphs of Rational Functions	428
6.4	Solving Rational Equations	445
6.5	Complex Rational Expressions	454
6.6	Formulas and Variation	465