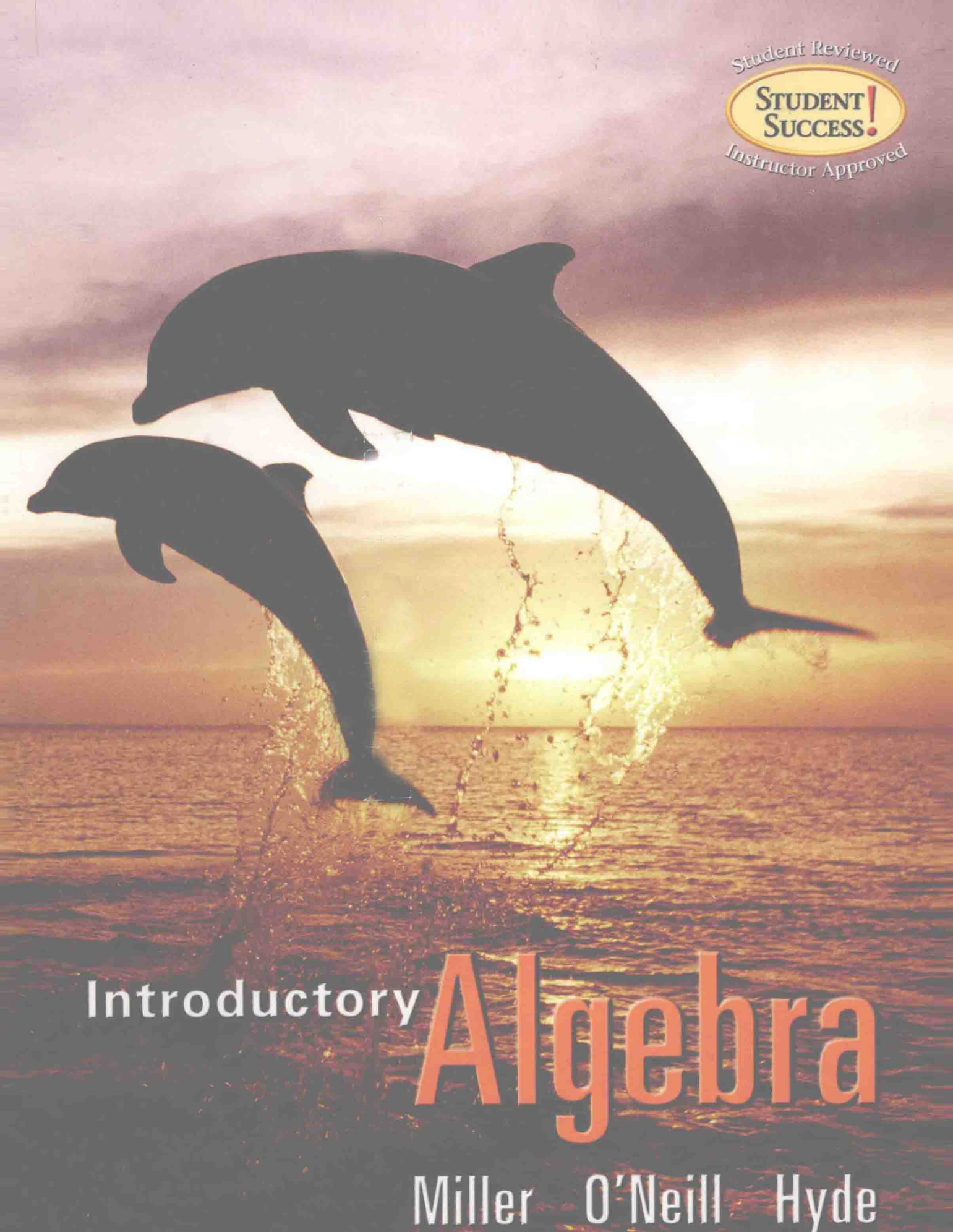

Student Reviewed
STUDENT! SUCCESS!
Instructor Approved
Introductory Algebra
Miller O'Neill Hyde

Introductory Algebra

Julie Miller
Molly O'Neill
Nancy Hyde

WITH CONTRIBUTIONS BY MITCHEL LEVY

Higher Education

Boston Burr Ridge, IL Dubuque, IA Madison, WI New York San Francisco St. Louis
Bangkok Bogotá Caracas Kuala Lumpur Lisbon London Madrid Mexico City
Milan Montreal New Delhi Santiago Seoul Singapore Sydney Taipei Toronto

The McGraw-Hill Companies

Mc Graw Hill **Higher Education**

INTRODUCTORY ALGEBRA

This book is printed on acid-free paper.

3 4 5 6 7 8 9 0 VNH/VNH 0 9 8 7

ISBN-13 978-0-07-302310-6—soft cover
ISBN-10 0-07-302310-8
ISBN-13 978-0-07-327414-0—hard cover
ISBN-10 0-07-327414-3
ISBN-13 978-0-07-302311-3 (Annotated Instructor's Edition)—soft cover
ISBN-10 0-07-302311-6
ISBN-13 978-0-07-327414-0 (Annotated Instructor's Edition)—hard cover
ISBN-10 0-07-327414-3

Publisher: *Elizabeth J. Haefele*
Sponsoring Editor: *David Millage*
Senior Developmental Editor: *Erin Brown*
Marketing Manager: *Barbara Owca*
Project Manager: *Jodi Rhomberg*
Senior Production Supervisor: *Sherry L. Kane*
Lead Media Project Manager: *Stacy A. Patch*
Media Producer: *Amber M. Huebner*
Designer: *Laurie B. Janssen*
Interior Designer: *Rokusek Design*
(USE) Cover Image: © *ImageState /Alamy*
Lead Photo Research Coordinator: *Carrie K. Burger*
Photo Research: *Pam Carley/Sound Reach*
Supplement Producer: *Melissa M. Leick*
Compositor: *Techbooks/GTS, York, PA*
Typeface: *10/12 TimesTen Roman*
Printer: *Von Hoffmann Corporation*

Photo Credits

Page 1: © Vol. 75/Corbis; p. 3: © PhotoDisc/Getty website; p. 26: © Corbis website; Chapter 1 Opener: © Elena Rooraid/PhotoEdit; p. 89: © Vol. 44/Corbis CD; p. 101: © Corbis website; Chapter 2 Opener: © Vol. 14/PhotoDisc/Getty; p. 166: © Vol. 44/Corbis CD; p. 174: © Judy Griesdieck/Corbis; p. 184: Corbis website; p. 227: © Tony Freeman/PhotoEdit; p. 262: © Vol. 107/Corbis CD; p. 300: © Susan Van Etten/PhotoEdit; p. 316: © PhotoDisc website; Chapter 4 Opener: © Vol. 1/PhotoDisc/Getty; p. 380: Jeff Greenberg/PhotoEdit; p. 403: © Linda Waymire; Chapter 5 Opener: Vol. 34/PhotoDisc/Getty; p. 441: Vol. 26/Corbis; p. 483: Corbis website; Chapter 6 Opener: © Richard Hamilton Smith/Corbis; Chapter 7 Opener: © Dennis MacDonald/PhotoEdit; p. 568: Paul Morris/Corbis; p. 605: EyeWire/Getty; p. 632: NOAA; p. 648: © PhotoDisc/Getty Website; p. 648: © Vol. 59/Corbis; Chapter 8 Opener: © Gabe Palmer/Corbis; p. 685: © Dennis O'Clair; p. 707: © Vol. 101/Corbis; Chapter 9 Opener: © Michelle D. Bridwell/PhotoEdit; p. 763: © Vol. 527/Corbis; p. 767: © Frank Whitney/Brand X/Pictures Quest.

Library of Congress Cataloging-in-Publication Data

Miller, Julie, 1962–
Introductory algebra / Julie Miller, Molly O'Neill, Nancy Hyde. — 1st ed.
p. cm.
Includes index.
ISBN 978-0-07-302310-6 — 0-07-302310-8 (acid-free paper)
1. Algebra—Textbooks. I. O'Neill, Molly, 1953–. II. Hyde, Nancy. III. Title.

QA152.3.M576 2007
512—dc22 2005054382

www.mhhe.com

Dedication

To my mother, Joanne T. Miller, for teaching me to love reading and language

—Julie Miller

To Jim for his help and support

—Molly O'Neill

To my family, Mom, Rich, and Lynn

—Nancy Hyde

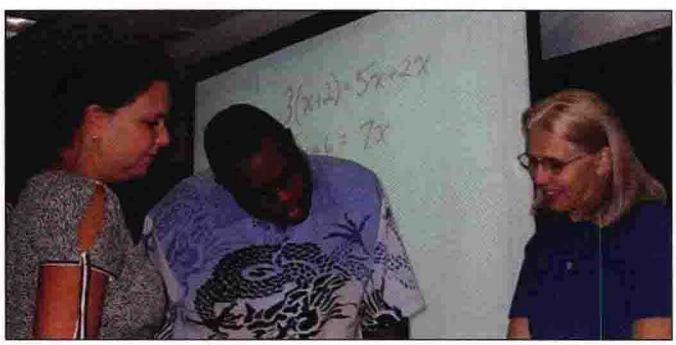
About the Authors

JULIE MILLER

Julie Miller has been on the faculty of the Mathematics Department at Daytona Beach Community College for 16 years, where she has taught developmental and upper-level courses. Prior to her work at DBCC, she worked as a software engineer for General Electric in the area of flight and radar simulation. Julie earned a bachelor of science in applied mathematics from Union College in Schenectady, New York, and a master of science in mathematics from the University of Florida. In addition to this textbook, she has authored several course supplements for college algebra, trigonometry, and precalculus, as well as several short works of fiction and nonfiction for young readers.

"My father is a medical researcher, and I got hooked on math and science when I was young and would visit his laboratory. I can remember using graph paper to plot data points for his experiments and doing simple calculations. He would then tell me what the peaks and features in the graph meant in the context of his experiment. I think that applications and hands-on experience made math come alive for me and I'd like to see math come alive for my students."

—Julie Miller



MOLLY O'NEILL

Molly O'Neill is also from Daytona Beach Community College, where she has taught for 18 years in the Mathematics Department. She has taught a variety of courses from developmental mathematics to calculus. Before she came to Florida, Molly taught as an adjunct instructor at the University of Michigan–Dearborn, Eastern Michigan University, Wayne State University, and Oakland Community College. Molly earned a bachelor of science in mathematics and a master of arts and teaching from Western Michigan University in Kalamazoo, Michigan. Besides this textbook, she has authored several course supplements for college algebra, trigonometry, and precalculus and has reviewed texts for developmental mathematics.

"I differ from many of my colleagues in that math was not always easy for me. But in seventh grade I had a teacher who taught me that if I follow the rules of mathematics, even I could solve math problems. Once I understood this, I enjoyed math to the point of choosing it for my career. I now have the greatest job because I get to do math everyday and I have the opportunity to influence my students just as I was influenced. Authoring these texts has given me another avenue to reach even more students."

—Molly O'Neill

Nancy Hyde has been a full time faculty member of the Mathematics Department at Broward Community College for 24 years. During this time she has taught the full spectrum of courses from developmental math through differential equations. She received a bachelor of science degree in math education from Florida State University and a master's degree in math education from Florida Atlantic University. She has conducted workshops and seminars for both students and teachers on the use of technology in the classroom. In addition to this textbook, she has authored a graphing calculator supplement for College Algebra.

NANCY HYDE

"I grew up in Brevard County, Florida with my father working at Cape Canaveral. I was always excited by mathematics and physics in relation to the space program. As I studied higher levels of mathematics I became more intrigued by its abstract nature and infinite possibilities. It is enjoyable and rewarding to convey this perspective to students while helping them to understand mathematics."

—Nancy Hyde

Mitchel Levy of Broward Community College joins the team as the exercise consultant for the Miller/O'Neill/Hyde paperback series. Mitchel received his BA in mathematics in 1983 from the State University of New York at Albany and his MA in mathematical statistics from the University of Maryland, College Park in 1988. With over 17 years of teaching and extensive reviewing experience, Mitchel knows what makes exercise sets work for students. In 1987 he received the first annual "Excellence in Teaching" award for graduate teaching assistants at the University of Maryland. Mitchel was honored as the Broward Community College Professor of the year in 1994, and has co-coached the Broward math team to 3 state championships over 7 years.

MITCHEL LEVY

"I love teaching all level of mathematics from Elementary Algebra through Calculus and Statistics."

—Mitchel Levy

Preface

From the Authors

First and foremost, we would like to thank the students and colleagues who have helped us prepare this text. The content and organization are based on a wealth of resources. In addition to an accumulation of our own notes and experiences as teachers, we recognize the influence of colleagues at Daytona Beach Community College and Broward Community College as well as fellow presenters and attendees of national mathematics conferences and meetings. Perhaps our single greatest source of inspiration has been our students, who ask good, probing questions every day and challenge us to find new and better ways to convey mathematical concepts. We gratefully acknowledge the part that each has played in the writing of this book.

In designing the framework for this text, the time we have spent with our students has proved especially invaluable. Over the years we have observed that students struggle consistently with certain topics. We have also come to know the influence of forces beyond the math, particularly motivational issues. An awareness of the various pitfalls has enabled us to tailor pedagogy and techniques that directly address students' needs and promote their success. Those techniques and pedagogy are outlined here.

Active Classroom

First, we believe students retain more of what they learn when they are actively engaged in the classroom. Consequently, as we wrote each section of text, we also wrote accompanying worksheets called **Classroom Activities** to foster accountability and to encourage classroom participation. Classroom Activities resemble the examples that students encounter in the textbook. The activities can be assigned to individual students or to pairs or groups of students. Most of the activities have been tested in the classroom with our own students. In one class in particular, the introduction of Classroom Activities transformed a group of "clock watchers" into students who literally had to be ushered out of the classroom so that the next class could come in. The activities can be found in the *Instructor's Resource Manual*, which is available through MathZone.

Conceptual Support

While we believe students must practice basic skills to be successful in any mathematics class, we also believe concepts are important. To this end, we have included **Concept Connections** questions and homework exercises that ask students to **"interpret the meaning in the context of the problem."** These questions make students stop and think, so they can process what they learn. In this way, students will learn underlying concepts. They will also form an understanding of what their answers mean in the contexts of the problems they solve.

Writing Style

Many students believe that reading a mathematics text is an exercise in futility. However, students who take the time to read the text and features within the

margins may cast that notion aside. In particular, the **Tips** and **Avoiding Mistakes** boxes should prove especially enlightening. They offer the types of insights and hints that are usually only revealed during classroom lecture. On the whole, students should be very comfortable with the reading level, as the language and tone are consistent with those used daily within our own developmental mathematics classes.

Real-World Applications

Another critical component of the text is the inclusion of **contemporary real-world examples and applications**. We based examples and applications on information that students encounter daily when they turn on the news, read a magazine, or surf the World Wide Web. We incorporated data for students to answer mathematical questions based on information in tables and graphs. When students encounter facts or information that is meaningful to them, they will relate better to the material and remember more of what they learn.

Study Skills

Many students in this course lack the basic study skills needed to be successful. Therefore, at the beginning of every set of homework exercises, we included a set of **Study Skills Exercises**. The exercises focus on one of nine areas: learning about the course, using the text, taking notes, completing homework assignments, test taking, time management, learning styles, preparing for a final exam, and defining **key terms**. Through completion of these exercises, students will be in a better position to pass the class and adopt techniques that will benefit them throughout their academic careers.

Language of Mathematics

Finally, for students to succeed in mathematics, they must be able to understand its language and notation. We place special emphasis on the skill of translating mathematical notation to English expressions and vice versa through **Translating Expressions Exercises**. These appear intermittently throughout the text. We also include key terms in the homework exercises and ask students to define these terms.

While we have made every effort to fine-tune this textbook to serve the needs of all students, we acknowledge that no textbook can satisfy every student's needs entirely. However, we do trust that the thoughtfully designed pedagogy and contents of this textbook offer any willing student the opportunity to achieve success, opening the door to a wider world of possibilities.

Listening to Students' and Instructors' Concerns

Our editorial staff has amassed the results of reviewer questionnaires, user diaries, focus groups, and symposia. We have consulted with an eight-member panel of introductory algebra instructors and their students on the development of this book. In addition, we have read hundreds of pages of reviews from instructors across the country. At McGraw-Hill symposia, faculty from across the United States gathered to discuss issues and trends in developmental mathematics. These efforts have involved hundreds of faculty and have explored issues such as content, readability, and even the aesthetics of page layout.

What Sets This Book Apart?

While this textbook offers complete coverage of the introductory algebra curriculum, there are several concepts that receive special emphasis.

Chapter R

Chapter R is a reference chapter. We designed it to help students reacquaint themselves with the fundamentals of fractions, decimals, percents, and geometry. This chapter also addresses study skills and helpful hints to use the resources provided in the text and supplements.

Factoring

Many years ago, we experimented in the classroom with our approach to factoring. We began factoring trinomials with the general case first, that is, with leading coefficient not equal to 1. This gave the students one rule for all cases, and it provided us with an extra class day for practice and group work. Most importantly, this approach forces students always to consider the leading coefficient, whether it be 1 or some other number. Thus, when students take the product of the inner terms and the product of the outer terms, the factors of the leading coefficient always come into play.

Calculator Usage

The use of a scientific or a graphing calculator often inspires great debate among faculty who teach developmental mathematics. Our Calculator Connections boxes offer screen shots and some keystrokes to support applications where a calculator might enhance learning. Our approach is to use a calculator as a verification tool after analytical methods have been applied. The Calculator Connections boxes are self-contained units and may be employed or easily omitted at the recommendation of the instructor.

Suggestions Welcome!

Many features of this book, and many refinements in writing, illustrations, and content, came about because of suggestions and questions from instructors and their students. We invite your comments with regard to this textbook as we work to further shape and refine its contents.

Julie Miller
millerj@dbcc.edu

Molly O'Neill
oneillm@dbcc.edu

Nancy Hyde
hyde_n@firn.edu

Acknowledgments and Reviewers

The development of this textbook would never have been possible without the creative ideas and constructive feedback offered by many reviewers. We are especially thankful to the following instructors for their valuable feedback and careful review of the manuscript.

Board of Advisers

James Butterbach, *Joliet Junior College*
John Close, *Salt Lake Community College*
Barbara Elzey-Miller, *Lexington Community College*
Alan Hayashi, *Oxnard College*
Kelly Jackson, *Camden County College*
Angie Matthews, *Broward Community College*
Patricia Roux, *Delgado Community College*

Special acknowledgment goes to the following instructors for their ideas and recommendations:

Yvonne Aucoin, *Tidewater Community College–Norfolk*
Alina Coronel, *Miami-Dade College–Kendall*
David French, *Tidewater Community College–Chesapeake*
Donna Gerken, *Miami-Dade College–Kendall*
Rebecca Hubiak, *Tidewater Community College–Virginia Beach*
Patricia Jayne, *Miami-Dade College–Kendall*
Mike Kirby, *Tidewater Community College–Virginia Beach*
Charlotte Newsom, *Tidewater Community College–Virginia Beach*
Drago Stoyanovich, *Miami-Dade College–Kendall*

Manuscript Reviewers

Sheila Anderson, *Housatonic Community College*
Janeen Apalatea, *MiraCosta College*
Alfred Basta, *American Intercontinental University*
Lynn Beckett-Lemus, *El Camino College*
Sandra Belcher, *Midwestern State University*
Chad Bemis, *Riverside Community College*
Hien Bui, *Hillsborough Community College*
Annette M. Burden, *Youngstown State University*
Susan Caldiero, *Cosumnes River College*
Carol Caponigro, *Lake Michigan College*
Mallahe Leslie Chandrakantha, *John Jay College, CUNY*
Alan Chutsky, *Queensborough Community College*
John F. Close, *Salt Lake Community College*
Delaine E. Cochran, *Indiana University Southeast*
Dr. Laura A. Dyer, *Southwestern Illinois College*
Karen A. Estes, *St. Petersburg College*
C. P. Folsom, *Pensacola Junior College*
Cynthia Gubitose, *Southern Connecticut State University*
Jim Hardman, *Sinclair Community College*
Robert Hunt, *Humboldt State University*
Juan Carlos Jiménez, *Springfield Technical Community College*
Randa Lee Kress, *Idaho State University*
Theodore Lai, *Hudson County Community College*
Kathryn Lavelle, *Westchester Community College*
Richard Leedy, *Polk Community College*

Keith Luoma, *Augusta State University*
Diane Lussier, *Pima Community College*
Dorothy S. Marshall, *Edison College*
Marianne Morea, *SUNY College at Old Westbury*
Danielle Morgan, *San Jacinto College South*
Valerie Morgan-Krick, *Tacoma Community College*
Michael Morse, *East Los Angeles College*
Linda J. Murphy, *Northern Essex Community College*
Michael Neill, *Carl Sandburg College*
Charles Odion, *Houston Community College*
Faith Peters, *Miami–Dade College*
Marilyn G. Platt, *Gaston College*
Marylyn Russ, IHM, *Marygrove College*
Dr. Jorge Sarmiento, *County College of Morris*
Mark Sigfrids, *Kalamazoo Valley Community College*
Cynthia Singleton, *Southern University at New Orleans*
Sharon Testone, *Onondaga Community College*
Stephen Thomas Whittle, *Augusta State University*
Bernadette Turner, *Lincoln University*
Terry Valentine, *Columbia–Greene Community College*
Abbas Zadegan, *Florida Memorial College*

Special thanks go to Carrie Green for preparing the *Instructor's Solutions Manual* and the *Student's Solutions Manual*, to Yolanda Davis and Patricia Jayne for their appearance in and work on the video series, and to Carrie Green for her work in ensuring accuracy. Further thanks go to Kelly Jackson for preparing instructor notes.

Finally, we are forever grateful to the many people behind the scenes at McGraw-Hill, our publishing family. To Erin Brown, our lifeline on this project, without you we'd be lost. To Liz Haefele, your passion for excellence has been a constant inspiration. To Michael Lange and David Dietz, thanks for your vision and input and for being there all these years. To Barb Owca and David Millage, we marvel at your creative ideas in a world that's forever changing. To Jeff Huettman and Amber Huebner for your awesome work with the technology and to Jodi Rhomberg for her support and keen attention to detail during production.

Most importantly, we give special thanks to all the students and instructors who use *Introductory Algebra* in their classes.

Julie Miller Molly O'Neill Nancy Hyde

A COMMITMENT TO ACCURACY

You have a right to expect an accurate textbook, and McGraw-Hill invests considerable time and effort to make sure that we deliver one. Listed below are the many steps we take to make sure this happens.

OUR ACCURACY VERIFICATION PROCESS

First Round

Step 1: Numerous **college math instructors** review the manuscript and report on any errors that they may find, and the authors make these corrections in their final manuscript.

Second Round

Step 2: Once the manuscript has been typeset, the **authors** check their manuscript against the first page proofs to ensure that all illustrations, graphs, examples, exercises, solutions, and answers have been correctly laid out on the pages, and that all notation is correctly used.

Step 3: An outside, **professional mathematician** works through every example and exercise in the page proofs to verify the accuracy of the answers.

Step 4: A **proofreader** adds a triple layer of accuracy assurance in the first pages by hunting for errors, then a second, corrected round of page proofs is produced.

Third Round

Step 5: The **author team** reviews the second round of page proofs for two reasons: 1) to make certain that any previous corrections were properly made, and 2) to look for any errors they might have missed on the first round.

Step 6: A **second proofreader** is added to the project to examine the new round of page proofs to double check the author team's work and to lend a fresh, critical eye to the book before the third round of paging.

Fourth Round

Step 7: A **third proofreader** inspects the third round of page proofs to verify that all previous corrections have been properly made and that there are no new or remaining errors.

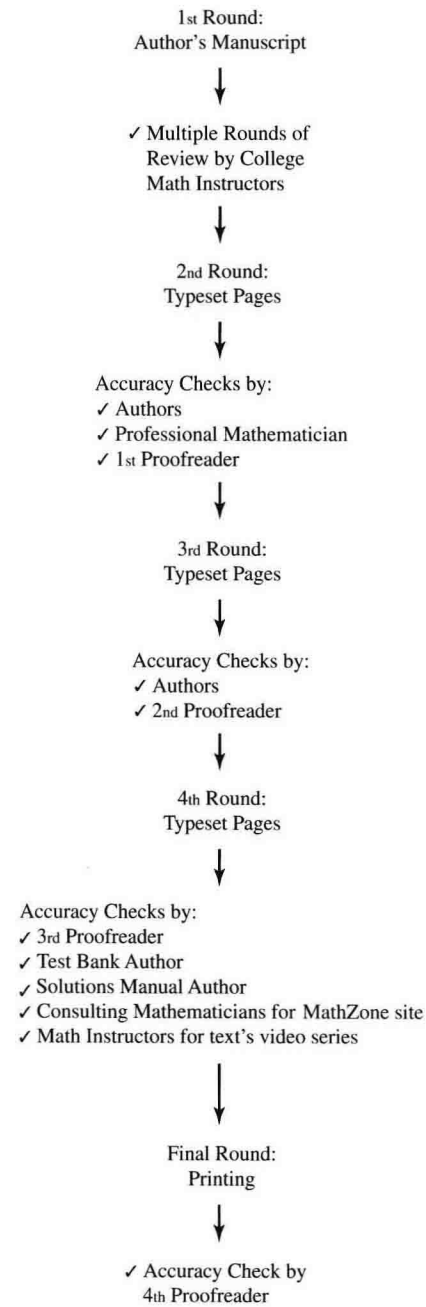
Step 8: Meanwhile, in partnership with **independent mathematicians,** the text accuracy is verified from a variety of fresh perspectives:

- The **test bank author** checks for consistency and accuracy as they prepare the computerized test item file.
- The **solutions manual author** works every single exercise and verifies their answers, reporting any errors to the publisher.
- A **consulting group of mathematicians,** who write material for the text's MathZone site, notifies the publisher of any errors they encounter in the page proofs.
- A video production company employing **expert math instructors** for the text's videos will alert the publisher of any errors they might find in the page proofs.

Final Round

Step 9: The **project manager,** who has overseen the book from the beginning, performs a **fourth proofread** of the textbook during the printing process, providing a final accuracy review.

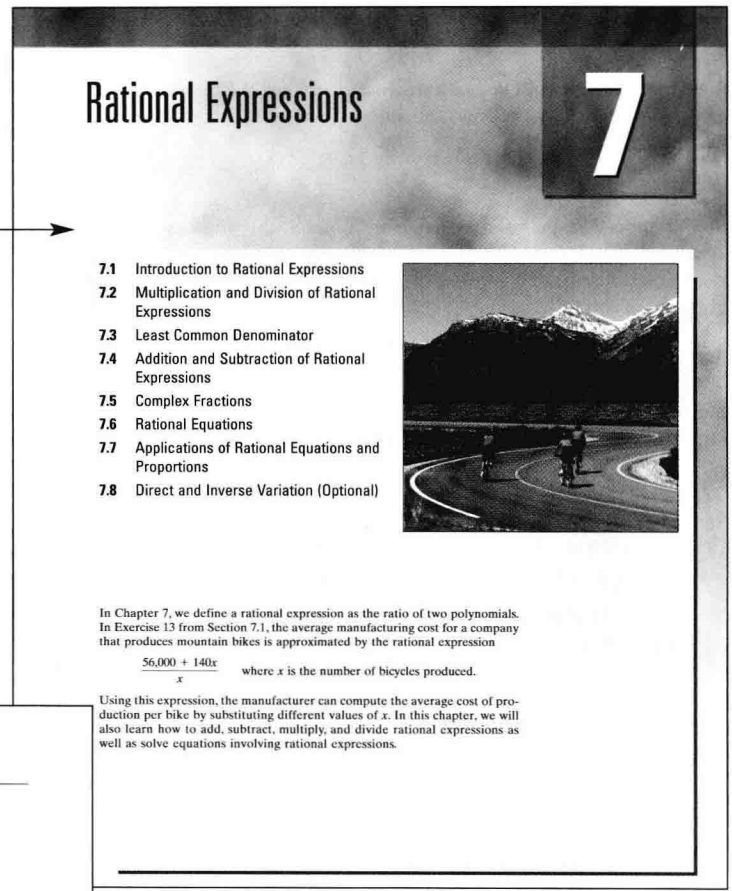
⇒ What results is a mathematics textbook that is as accurate and error-free as is humanly possible, and our authors and publishing staff are confident that our many layers of quality assurance have produced textbooks that are the leaders of the industry for their integrity and correctness.



Guided Tour

Chapter Opener

Each chapter opens with an application relating to an exercise presented in the chapter. Section titles are clearly listed for easy reference.



Rational Expressions

7

In Chapter 7, we define a rational expression as the ratio of two polynomials. In Exercise 13 from Section 7.1, the average manufacturing cost for a company that produces mountain bikes is approximated by the rational expression

$$\frac{56{,}000 + 140x}{x}$$ where x is the number of bicycles produced.

Using this expression, the manufacturer can compute the average cost of production per bike by substituting different values of x. In this chapter, we will also learn how to add, subtract, multiply, and divide rational expressions as well as solve equations involving rational expressions.

chapter 7 preview

The exercises in this chapter preview contain concepts that have not yet been presented. These exercises are provided for students who want to compare their levels of understanding before and after studying the chapter. Alternatively, you may prefer to work these exercises when the chapter is completed and before taking the exam.

Section 7.1

1. Find the domain of the rational expression, and express the answer in set-builder notation. $\frac{x-10}{2x+6}$

For Exercises 2–3, reduce to lowest terms.

2. $\frac{5a-10}{a-2}$ **3.** $\frac{y^2-2y-3}{y^2-9}$

Section 7.2

For Exercises 4–5, perform the indicated operations.

4. $\frac{4x}{5} \cdot \frac{3}{2x}$ **5.** $\frac{t^2+8t+7}{t^2-2t-3} \div \frac{t+7}{3-t}$

Section 7.3

6. Given: $\frac{x}{x+2}, \frac{2}{x-3}$

a. Find the LCD of the rational expressions.

b. Convert each expression to an equivalent fraction with denominator equal to the LCD.

Section 7.4

For Exercises 7–8, add or subtract as indicated.

7. $\frac{5}{2y} - \frac{2}{3y^2}$ **8.** $\frac{3}{x-2} - \frac{4}{x+1}$

Section 7.5

9. Simplify: $\frac{\frac{3}{4} - \frac{1}{a}}{\frac{2}{a} + \frac{1}{2}}$

Section 7.6

For Exercises 10–11, solve the equations.

10. $\frac{x}{2} + \frac{2}{x} = \frac{5}{2}$

11. $\frac{2}{z-3} + \frac{3}{z+3} = \frac{4z}{z^2-9}$

12. Solve the equation for b. $\frac{A}{b} = c$

Section 7.7

13. The instructions for mixing a concrete cleaner require a mixture of 3 gallons of water for every 2 gallons of cleaner. How many gallons of water should be mixed with 5 gallons of cleaner?

14. Shane runs 5 miles from his home to a park and walks back. His running speed is twice as fast as his walking speed. The time it takes him to run to the park is $\frac{1}{2}$ hour less than it takes him to walk back. Find his speeds going and returning.

15. Carlos can paint a room in 4 hours. Anna can paint the same size room in 6 hours. How long will it take them to paint the room if they work together?

Section 7.8

16. The property taxes on a home vary directly as the selling price of the home. The property tax on a home that sells for $128,000 is $2560. Find the property tax on a home that sells for $85,000.

Chapter Preview

A Chapter Preview appears at the beginning of each chapter. It contains exercises, grouped by section. The exercises are based on topics not yet presented, offering students an opportunity to compare their levels of understanding before and after studying the chapter.

Objectives

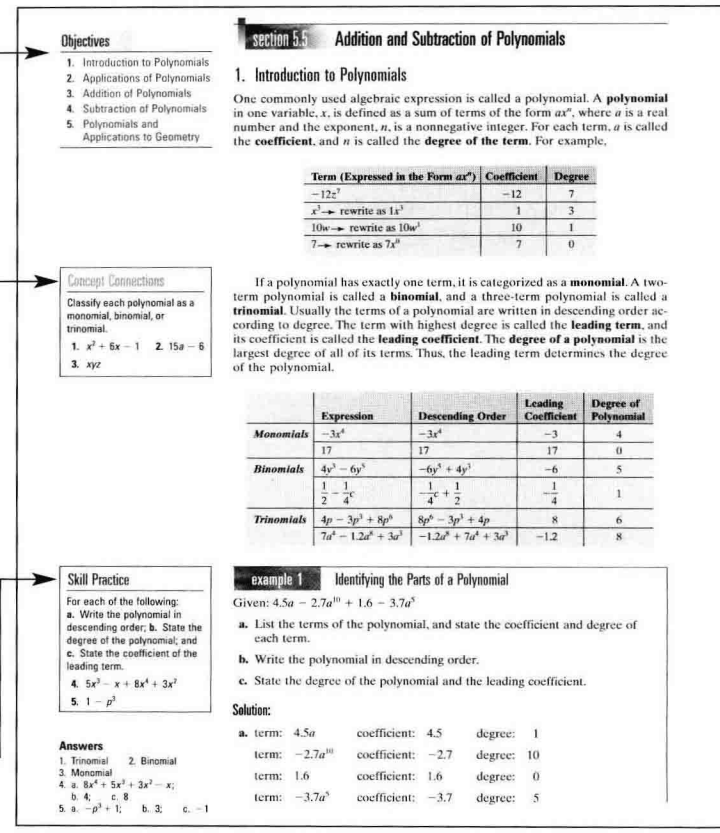
A list of important learning objectives is provided at the beginning of each section. Each objective corresponds to a heading within the section and within the exercises, making it easy for students to locate topics as they study or as they work through homework exercises.

Concept Connections

Students can test their understanding of what they have read by completing the Concept Connections exercises that appear in the margins. These questions test how well students grasp concepts. Students can check their responses by referring to the answers at the bottom of the page.

Skill Practice Exercises

Every worked example is paired with a Skill Practice exercise. These exercises appear in the margin directly beside the worked examples and offer students an immediate opportunity to work problems that mirror the examples. Students can then check their work by referring to the answers at the bottom of the page.



Objectives
1. Introduction to Polynomials
2. Applications of Polynomials
3. Addition of Polynomials
4. Subtraction of Polynomials
5. Polynomials and Applications to Geometry

Concept Connections
Classify each polynomial as a monomial, binomial, or trinomial.
1. $x^2 + 6x - 1$ 2. $15a - 6$
3. xyz

Skill Practice
For each of the following:
a. Write the polynomial in descending order; b. State the degree of the polynomial; and c. State the coefficient of the leading term.
4. $5x^3 - x + 8x^4 + 3x^2$
5. $1 - p^3$

Answers
1. Trinomial 2. Binomial
3. Monomial
4. a. $8x^4 + 5x^3 + 3x^2 - x$; b. 4; c. 8
5. a. $-p^3 + 1$; b. 3; c. -1

section 5.5 Addition and Subtraction of Polynomials

1. Introduction to Polynomials

One commonly used algebraic expression is called a polynomial. A **polynomial** in one variable, x, is defined as a sum of terms of the form ax^n, where a is a real number and the exponent, n, is a nonnegative integer. For each term, a is called the **coefficient**, and n is called the **degree of the term**. For example,

Term (Expressed in the Form ax^n)	Coefficient	Degree
$-12z^7$	-12	7
$x^3 \rightarrow$ rewrite as $1x^3$	1	3
$10w \rightarrow$ rewrite as $10w^1$	10	1
$7 \rightarrow$ rewrite as $7x^0$	7	0

If a polynomial has exactly one term, it is categorized as a **monomial**. A two-term polynomial is called a **binomial**, and a three-term polynomial is called a **trinomial**. Usually the terms of a polynomial are written in descending order according to degree. The term with highest degree is called the **leading term**, and its coefficient is called the **leading coefficient**. The **degree of a polynomial** is the largest degree of all of its terms. Thus, the leading term determines the degree of the polynomial.

	Expression	Descending Order	Leading Coefficient	Degree of Polynomial
Monomials	$-3x^4$	$-3x^4$	-3	4
	17	17	17	0
Binomials	$4y^3 - 6y^5$	$-6y^5 + 4y^3$	-6	5
	$\frac{1}{2} - \frac{1}{4}c$	$-\frac{1}{4}c + \frac{1}{2}$	$-\frac{1}{4}$	1
Trinomials	$4p - 3p^3 + 8p^6$	$8p^6 - 3p^3 + 4p$	8	6
	$7a^4 - 1.2a^8 + 3a^3$	$-1.2a^8 + 7a^4 + 3a^3$	-1.2	8

example 1 Identifying the Parts of a Polynomial

Given: $4.5a - 2.7a^{10} + 1.6 - 3.7a^5$

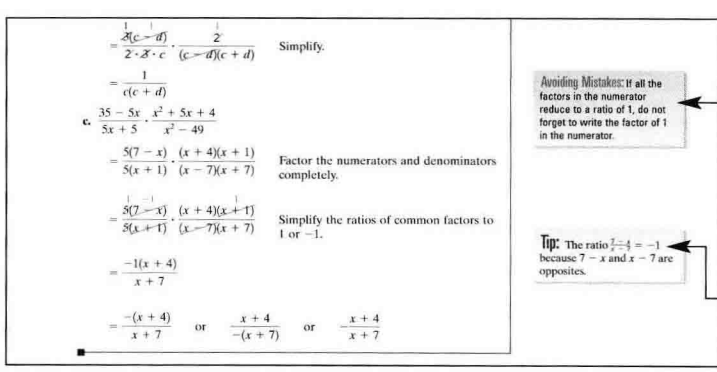
a. List the terms of the polynomial, and state the coefficient and degree of each term.

b. Write the polynomial in descending order.

c. State the degree of the polynomial and the leading coefficient.

Solution:

a. term: $4.5a$ coefficient: 4.5 degree: 1
term: $-2.7a^{10}$ coefficient: -2.7 degree: 10
term: 1.6 coefficient: 1.6 degree: 0
term: $-3.7a^5$ coefficient: -3.7 degree: 5



$= \frac{1}{c(c+d)}$ Simplify.

c. $\frac{35-5x}{5x+5} \cdot \frac{x^2+5x+4}{x^2-49}$

$= \frac{5(7-x)}{5(x+1)} \cdot \frac{(x+4)(x+1)}{(x-7)(x+7)}$ Factor the numerators and denominators completely.

$= \frac{5(7-x)}{5(x+1)} \cdot \frac{(x+4)(x+1)}{(x-7)(x+7)}$ Simplify the ratios of common factors to 1 or -1.

$= \frac{-1(x+4)}{x+7}$

$= \frac{-(x+4)}{x+7}$ or $\frac{x+4}{-(x+7)}$ or $\frac{x+4}{x+7}$

Avoiding Mistakes: If all the factors in the numerator reduce to a ratio of 1, do not forget to write the factor of 1 in the numerator.

Tip: The ratio $\frac{7-x}{x-7} = -1$ because $7 - x$ and $x - 7$ are opposites.

Avoiding Mistakes

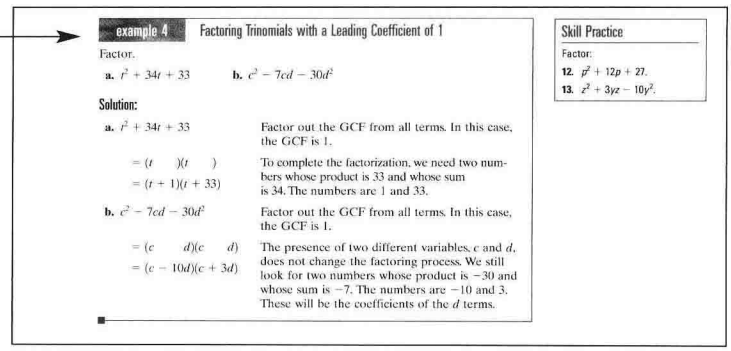
Through notes labeled Avoiding Mistakes students are alerted to common errors and are shown methods to avoid them.

Tips

Tip boxes appear throughout the text and offer helpful hints and insight.

Worked Examples

Examples are set off in boxes and organized so that students can easily follow the solutions. Explanations appear beside each step, and color coding is used, where appropriate. For additional step-by-step instruction, students can run the "e-Professors" in MathZone. The e-Professors are based on worked examples from the text and use the solution methodologies presented in the text.



example 4 Factoring Trinomials with a Leading Coefficient of 1

Factor.

a. $t^2 + 34t + 33$ **b.** $c^2 - 7cd - 30d^2$

Solution:

a. $t^2 + 34t + 33$ — Factor out the GCF from all terms. In this case, the GCF is 1.

$= (t \quad)(t \quad)$
$= (t + 1)(t + 33)$ — To complete the factorization, we need two numbers whose product is 33 and whose sum is 34. The numbers are 1 and 33.

b. $c^2 - 7cd - 30d^2$ — Factor out the GCF from all terms. In this case, the GCF is 1.

$= (c \quad d)(c \quad d)$
$= (c - 10d)(c + 3d)$ — The presence of two different variables, c and d, does not change the factoring process. We still look for two numbers whose product is -30 and whose sum is -7. The numbers are -10 and 3. These will be the coefficients of the d terms.

Skill Practice

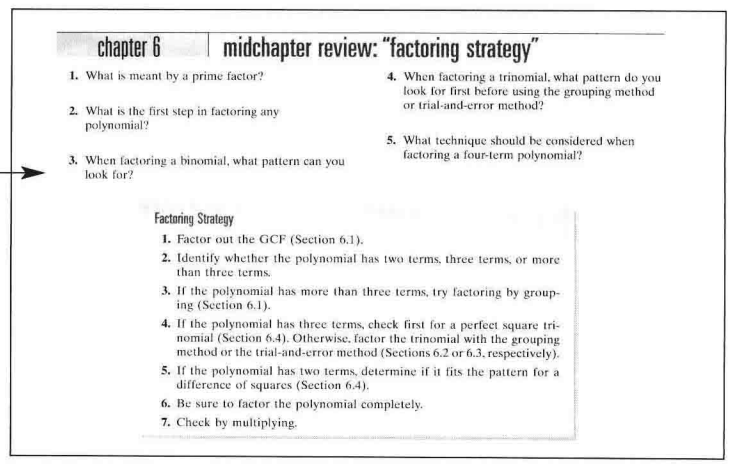
Factor:

12. $p^2 + 12p + 27$.

13. $z^2 + 3yz - 10y^2$.

Midchapter Review

Midchapter Reviews are provided to help solidify the foundation of concepts learned in the beginning of a chapter before expanding to new ideas presented later in the chapter.



chapter 6 midchapter review: "factoring strategy"

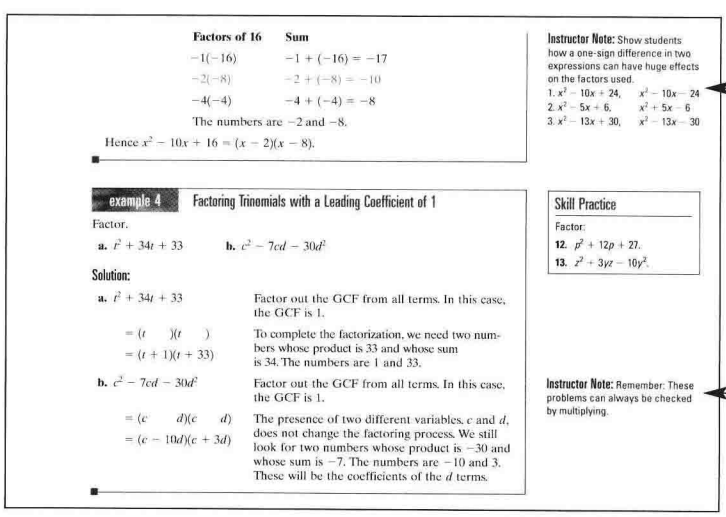
1. What is meant by a prime factor?
2. What is the first step in factoring any polynomial?
3. When factoring a binomial, what pattern can you look for?
4. When factoring a trinomial, what pattern do you look for first before using the grouping method or trial-and-error method?
5. What technique should be considered when factoring a four-term polynomial?

Factoring Strategy

1. Factor out the GCF (Section 6.1).
2. Identify whether the polynomial has two terms, three terms, or more than three terms.
3. If the polynomial has more than three terms, try factoring by grouping (Section 6.1).
4. If the polynomial has three terms, check first for a perfect square trinomial (Section 6.4). Otherwise, factor the trinomial with the grouping method or the trial-and-error method (Sections 6.2 or 6.3, respectively).
5. If the polynomial has two terms, determine if it fits the pattern for a difference of squares (Section 6.4).
6. Be sure to factor the polynomial completely.
7. Check by multiplying.

Instructor Note (*AIE* only)

Throughout each section of the *Annotated Instructor's Edition* (*AIE*), notes to the instructor can be found in the margins. The notes may assist with lecture preparation in that they point out items that tend to confuse students, or lead students to err.



Factors of 16	Sum
$-1(-16)$	$-1 + (-16) = -17$
$-2(-8)$	$-2 + (-8) = -10$
$-4(-4)$	$-4 + (-4) = -8$

The numbers are -2 and -8.

Hence $x^2 - 10x + 16 = (x - 2)(x - 8)$.

Instructor Note: Show students how a one-sign difference in two expressions can have huge effects on the factors used.
1. $x^2 - 10x + 24$, $x^2 - 10x - 24$
2. $x^2 - 5x + 6$, $x^2 + 5x - 6$
3. $x^2 - 13x + 30$, $x^2 - 13x - 30$

example 4 Factoring Trinomials with a Leading Coefficient of 1

Factor.

a. $t^2 + 34t + 33$ **b.** $c^2 - 7cd - 30d^2$

Solution:

a. $t^2 + 34t + 33$ — Factor out the GCF from all terms. In this case, the GCF is 1.

$= (t \quad)(t \quad)$
$= (t + 1)(t + 33)$ — To complete the factorization, we need two numbers whose product is 33 and whose sum is 34. The numbers are 1 and 33.

b. $c^2 - 7cd - 30d^2$ — Factor out the GCF from all terms. In this case, the GCF is 1.

$= (c \quad d)(c \quad d)$
$= (c - 10d)(c + 3d)$ — The presence of two different variables, c and d, does not change the factoring process. We still look for two numbers whose product is -30 and whose sum is -7. The numbers are -10 and 3. These will be the coefficients of the d terms.

Skill Practice

Factor:

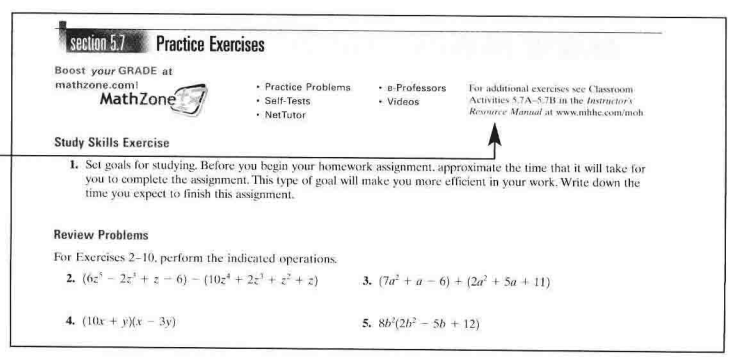
12. $p^2 + 12p + 27$.

13. $z^2 + 3yz - 10y^2$.

Instructor Note: Remember: These problems can always be checked by multiplying.

References to Classroom Activities (*AIE* only)

References are made to Classroom Activities at the beginning of each set of Practice Exercises in the *AIE*. The activities may be found in the *Instructor's Resource Manual*, which is available through MathZone and can be used during lecture or assigned for additional practice.



section 5.7 Practice Exercises

Boost *your* GRADE at mathzone.com! MathZone

- Practice Problems
- Self-Tests
- NetTutor
- e-Professors
- Videos

For additional exercises see Classroom Activities 5.7A–5.7B in the *Instructor's Resource Manual* at www.mhhe.com/mch

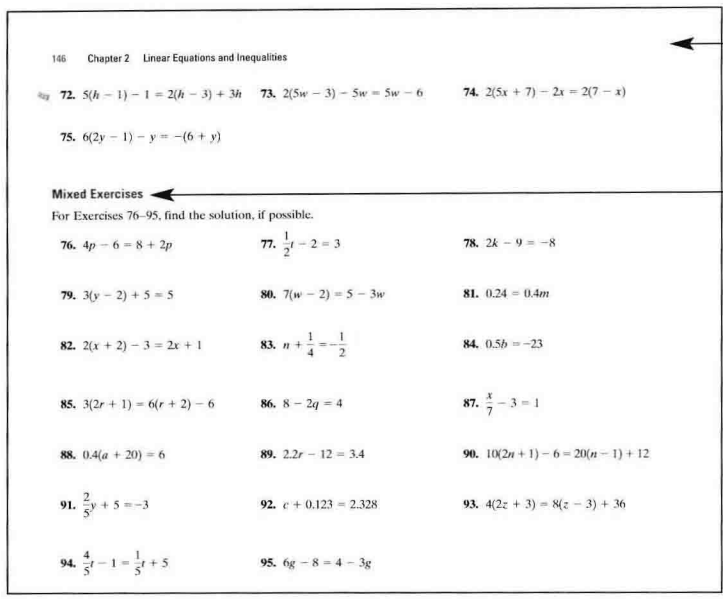
Study Skills Exercise

1. Set goals for studying. Before you begin your homework assignment, approximate the time that it will take for you to complete the assignment. This type of goal will make you more efficient in your work. Write down the time you expect to finish this assignment.

Review Problems

For Exercises 2–10, perform the indicated operations.

2. $(6z^3 - 2z^2 + z - 6) - (10z^4 + 2z^3 + z^2 + z)$
3. $(7a^2 + a - 6) + (2a^2 + 5a + 11)$
4. $(10x + y)(x - 3y)$
5. $8b^2(2b^2 - 5b + 12)$



146 Chapter 2 Linear Equations and Inequalities

72. $5(h-1)-1=2(h-3)+3h$ **73.** $2(5w-3)-5w=5w-6$ **74.** $2(5x+7)-2x=2(7-x)$

75. $6(2y-1)-y=-(6+y)$

Mixed Exercises

For Exercises 76–95, find the solution, if possible.

76. $4p-6=8+2p$ **77.** $\frac{1}{2}t-2=3$ **78.** $2k-9=-8$

79. $3(y-2)+5=5$ **80.** $7(w-2)=5-3w$ **81.** $0.24=0.4m$

82. $2(x+2)-3=2x+1$ **83.** $n+\frac{1}{4}=-\frac{1}{2}$ **84.** $0.5b=-23$

85. $3(2r+1)=6(r+2)-6$ **86.** $8-2q=4$ **87.** $\frac{x}{7}-3=1$

88. $0.4(a+20)=6$ **89.** $2.2r-12=3.4$ **90.** $10(2n+1)-6=20(n-1)+12$

91. $\frac{2}{5}y+5=-3$ **92.** $c+0.123=2.328$ **93.** $4(2z+3)=8(z-3)+36$

94. $\frac{4}{5}t-1=\frac{1}{5}t+5$ **95.** $6g-8=4-3g$

Practice Exercises

A variety of problem types appear in the section-ending Practice Exercises. Problem types are clearly labeled with either a heading or an icon for easy identification. References to MathZone are also found at the beginning of the Practice Exercises to remind students and instructors that additional help and practice problems are available. The core exercises for each section are organized by section objective. General references to examples are provided for blocks of core exercises. **Mixed Exercises** are also provided in some sections where no reference to objectives or examples is offered.

Icon Key

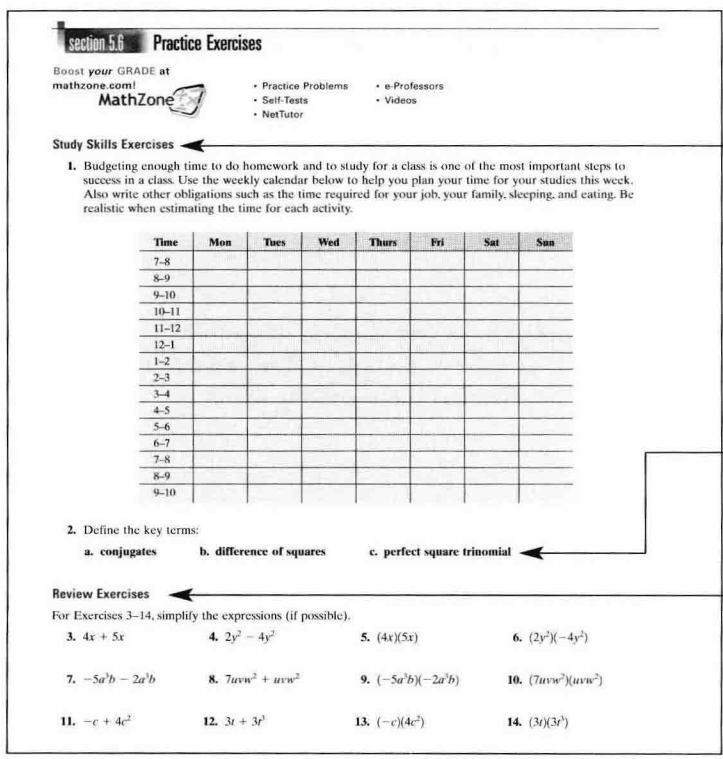
The following key has been prepared for easy identification of "themed" exercises appearing within the Practice Exercises.

Student Edition

- Exercises Keyed to Video
- Calculator Exercises

AIE only

- Writing
- Translating Expressions
- Geometry



section 5.6 Practice Exercises

Boost *your* GRADE at mathzone.com!

MathZone

- Practice Problems
- Self-Tests
- NetTutor
- e-Professors
- Videos

Study Skills Exercises

1. Budgeting enough time to do homework and to study for a class is one of the most important steps to success in a class. Use the weekly calendar below to help you plan your time for your studies this week. Also write other obligations such as the time required for your job, your family, sleeping, and eating. Be realistic when estimating the time for each activity.

Time	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
7–8							
8–9							
9–10							
10–11							
11–12							
12–1							
1–2							
2–3							
3–4							
4–5							
5–6							
6–7							
7–8							
8–9							
9–10							

2. Define the key terms:

a. conjugates **b. difference of squares** **c. perfect square trinomial**

Review Exercises

For Exercises 3–14, simplify the expressions (if possible).

3. $4x+5x$ **4.** $2y^2-4y^2$ **5.** $(4x)(5x)$ **6.** $(2y^2)(-4y^2)$

7. $-5a^3b-2a^3b$ **8.** $7uvw^2+uvw^2$ **9.** $(-5a^3b)(-2a^3b)$ **10.** $(7uvw^2)(uvw^2)$

11. $-c+4c^2$ **12.** $3t+3t^3$ **13.** $(-c)(4c^2)$ **14.** $(3t)(3t^3)$

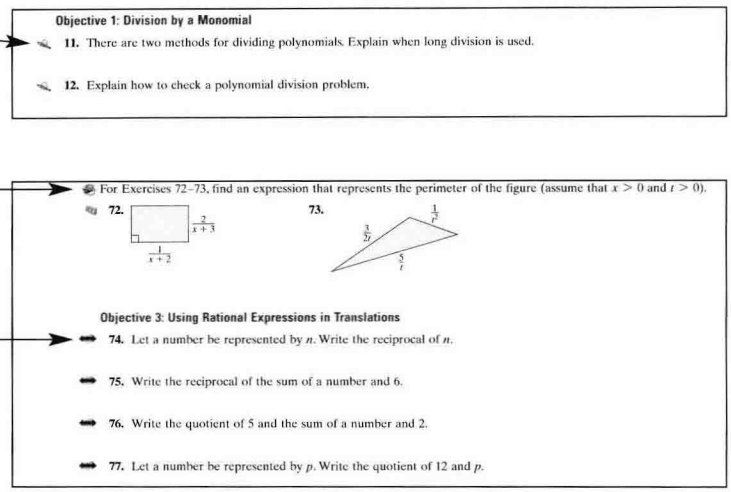
Study Skills Exercises appear at the beginning of the exercise set. They are designed to help students learn techniques to improve their study habits including exam preparation, note taking, and time management.

In the Practice Exercises, where appropriate, students are asked to define the **Key Terms** that are presented in the section. Assigning these exercises will help students to develop and expand their mathematical vocabularies.

Review Exercises also appear at the start of the Practice Exercises. The purpose of the Review Exercises is to help students retain their knowledge of concepts previously learned.

Writing Exercises offer students an opportunity to conceptualize and communicate their understanding of algebra. These, along with the **Translating Expressions Exercises**, enable students to strengthen their command of mathematical language and notation and improve their reading and writing skills.

Geometry Exercises appear throughout the Practice Exercises and encourage students to review and apply geometry concepts.



Objective 1: Division by a Monomial

11. There are two methods for dividing polynomials. Explain when long division is used.

12. Explain how to check a polynomial division problem.

For Exercises 72–73, find an expression that represents the perimeter of the figure (assume that $x > 0$ and $t > 0$).

72.

73.

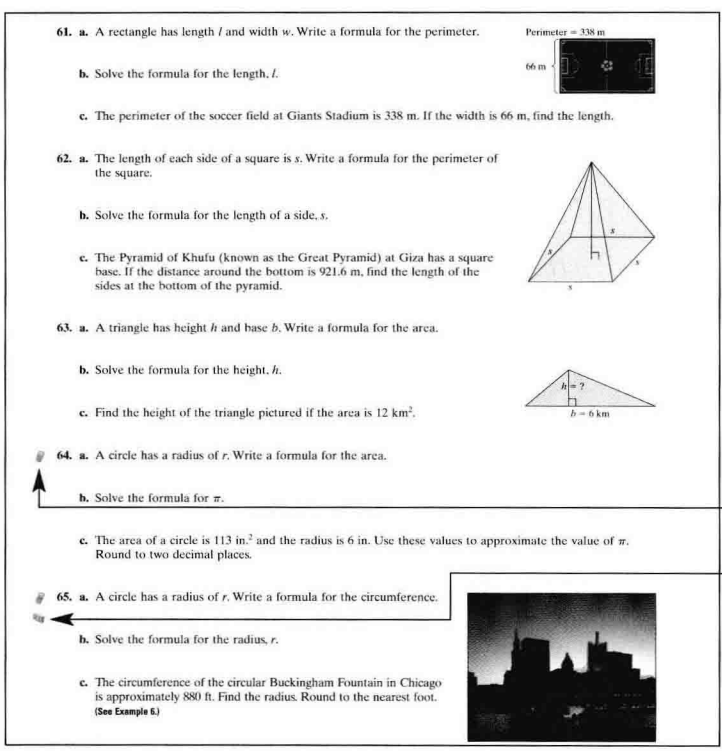
Objective 3: Using Rational Expressions in Translations

74. Let a number be represented by n. Write the reciprocal of n.

75. Write the reciprocal of the sum of a number and 6.

76. Write the quotient of 5 and the sum of a number and 2.

77. Let a number be represented by p. Write the quotient of 12 and p.



61. a. A rectangle has length l and width w. Write a formula for the perimeter.

b. Solve the formula for the length, l.

c. The perimeter of the soccer field at Giants Stadium is 338 m. If the width is 66 m, find the length.

62. a. The length of each side of a square is s. Write a formula for the perimeter of the square.

b. Solve the formula for the length of a side, s.

c. The Pyramid of Khufu (known as the Great Pyramid) at Giza has a square base. If the distance around the bottom is 921.6 m, find the length of the sides at the bottom of the pyramid.

63. a. A triangle has height h and base b. Write a formula for the area.

b. Solve the formula for the height, h.

c. Find the height of the triangle pictured if the area is 12 km^2.

64. a. A circle has a radius of r. Write a formula for the area.

b. Solve the formula for π.

c. The area of a circle is 113 in.^{2} and the radius is 6 in. Use these values to approximate the value of π. Round to two decimal places.

65. a. A circle has a radius of r. Write a formula for the circumference.

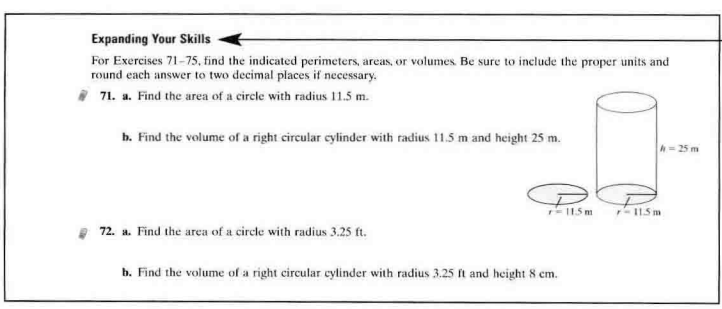
b. Solve the formula for the radius, r.

c. The circumference of the circular Buckingham Fountain in Chicago is approximately 880 ft. Find the radius. Round to the nearest foot. (See Example 6.)

Calculator Exercises signify situations where a calculator would provide assistance for time-consuming calculations. These exercises were carefully designed to demonstrate the types of situations in which a calculator is a handy tool rather than a "crutch."

Exercises Keyed to Video are labeled with an icon to help students and instructors identify those exercises for which accompanying video instruction is available.

Applications based on real-world facts and figures motivate students and enable them to hone their problem-solving skills.



Expanding Your Skills

For Exercises 71–75, find the indicated perimeters, areas, or volumes. Be sure to include the proper units and round each answer to two decimal places if necessary.

71. a. Find the area of a circle with radius 11.5 m.

b. Find the volume of a right circular cylinder with radius 11.5 m and height 25 m.

72. a. Find the area of a circle with radius 3.25 ft.

b. Find the volume of a right circular cylinder with radius 3.25 ft and height 8 cm.

Expanding Your Skills exercises, found near the end of most Practice Exercises, challenge students' knowledge of the concepts presented.