Preface to the Instructor

Instructors of developmental mathematics encounter a wide variety of challenges. The students under their tutelage often face motivational problems and lack the reading and study skills necessary to succeed. We wrote *Intermediate Algebra* to address these challenges.

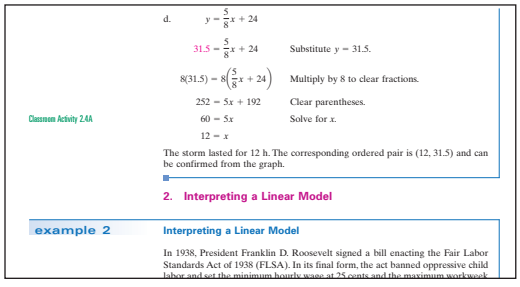
To help students overcome deficiencies in mathematical language, special "translation" problems and writing exercises are presented throughout the text. To combat motivational problems, we provide applications based on the kinds of everyday facts and information students encounter by watching the news, reading a magazine, or surfing the World Wide Web. A special "Help Yourself" preface in the Student Edition of this text offers students practical suggestions for making the most of the resources available to them. Ultimately, through these and similar features, students will have more positive experiences with mathematics and their chances for success will increase.

In writing *Intermediate Algebra,* we were mindful of the standards for introductory college mathematics prepared by the American Mathematical Association of Two-Year Colleges (AMATYC). We constructed applications and examples intending to show the presence of mathematics in a variety of disciplines. We incorporated real-world data for students to create mathematical models in the form of functions, equations, and graphs. Further emphasis is placed on the interpretation of algebraic models and their graphs in the context of the problems they represent. We designed classroom activities and writing problems to encourage students to communicate mathematical ideas, orally and in writing. Implementation of these measures is intended to help students become stronger problem solvers and critical thinkers.

While *Intermediate Algebra* offers special features to address the unique challenges of teaching today's developmental mathematics students, it also maintains a solid approach to algebraic instruction. *Intermediate Algebra* provides students with plenty of exercises and examples, clear explanations, and the core content needed to build a firm foundation in algebra.

CORE FEATURES

We draw attention to the following features, which we believe set our book apart from other intermediate algebra texts found in the marketplace.



d. $y = \frac{5}{8}x + 24$

$31.5 = \frac{5}{8}x + 24$ Substitute $y = 31.5$.

$8(31.5) = 8\left(\frac{5}{8}x + 24\right)$ Multiply by 8 to clear fractions.

$252 = 5x + 192$ Clear parentheses.

Classroom Activity 2.4A

$60 = 5x$ Solve for x.

$12 = x$

The storm lasted for 12 h. The corresponding ordered pair is (12, 31.5) and can be confirmed from the graph.

2. Interpreting a Linear Model

example 2 Interpreting a Linear Model

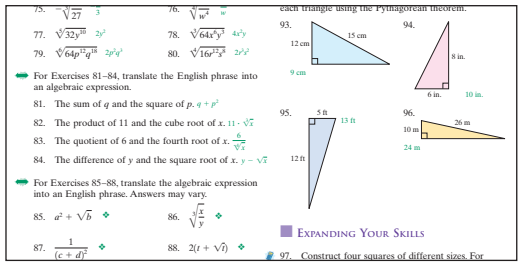
In 1938, President Franklin D. Roosevelt signed a bill enacting the Fair Labor Standards Act of 1938 (FLSA). In its final form, the act banned oppressive child labor and set the minimum hourly wage at 25 cents and the maximum workweek

Classroom Activities

References to Classroom Activities are provided in each section of the Annotated Instructor's Edition and appear near the text and examples to which the activities apply. The activities themselves are included in the *Instructor's Resource Manual** and can be used at the

*Available from your McGraw-Hill Higher Education representative, ISBN 0072554002.

discretion of the instructor. With increasing demands on faculty schedules, these ready-made lessons offer a convenient means for both full-time professors and part-time adjuncts to promote active learning in the classroom. The classroom activities can be assigned to groups or to students individually. Alternatively, these worksheets may be provided directly to students for extra practice inside or outside the classroom. In performing these activities in class, students become better conditioned to take responsibility for their learning and thereby show greater interest when asked to participate in classroom discussions.



For Exercises 81–84, translate the English phrase into an algebraic expression.

81. The sum of q and the square of p. $q + p^2$
82. The product of 11 and the cube root of x. $11 \cdot \sqrt[3]{x}$
83. The quotient of 6 and the fourth root of x. $\frac{6}{\sqrt[4]{x}}$
84. The difference of y and the square root of x. $y - \sqrt{x}$

For Exercises 85–88, translate the algebraic expression into an English phrase. Answers may vary.

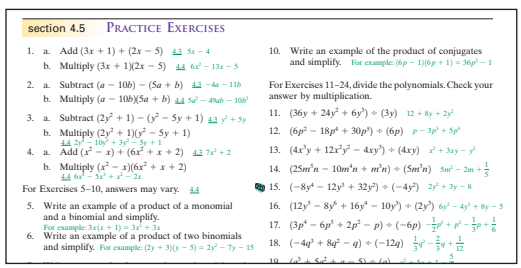
85. $a^2 + \sqrt{b}$
86. $\sqrt[3]{\frac{x}{y}}$
87. $\frac{1}{(c+d)^2}$
88. $2(t + \sqrt{t})$

Expanding Your Skills

97. Construct four squares of different sizes. For

Language of Mathematics

Throughout the text, the language of mathematics is emphasized. Special translation examples and exercises ask students to convert between English phrases and algebraic statements. Through these exercises and examples, students gain increased familiarity with mathematical symbols and terminology and, in turn, develop a fuller understanding of the content.



section 4.5 Practice Exercises

1. a. Add $(3x + 1) + (2x - 5)$ 4.3 $5x - 4$
   b. Multiply $(3x + 1)(2x - 5)$ 4.4 $6x^2 - 13x - 5$
2. a. Subtract $(a - 10b) - (5a + b)$ 4.3 $-4a - 11b$
   b. Multiply $(a - 10b)(5a + b)$ 4.4 $5a^2 - 49ab - 10b^2$
3. a. Subtract $(2y^2 + 1) - (y^2 - 5y + 1)$ 4.3 $y^2 + 5y$
   b. Multiply $(2y^2 + 1)(y^2 - 5y + 1)$ 4.4 $2y^4 - 10y^3 + 3y^2 - 5y + 1$
4. a. Add $(x^2 - x) + (6x^2 + x + 2)$ 4.3 $7x^2 + 2$
   b. Multiply $(x^2 - x)(6x^2 + x + 2)$ 4.4 $6x^4 - 5x^3 + x^2 - 2x$

For Exercises 5–10, answers may vary. 4.4

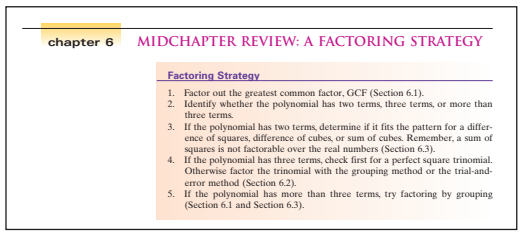
5. Write an example of a product of a monomial and a binomial and simplify. For example: $3x(x + 1) = 3x^2 + 3x$
6. Write an example of a product of two binomials and simplify. For example: $(2y + 3)(y - 5) = 2y^2 - 7y - 15$
10. Write an example of the product of conjugates and simplify. For example: $(6p - 1)(6p + 1) = 36p^2 - 1$

For Exercises 11–24, divide the polynomials. Check your answer by multiplication.

11. $(36y + 24y^2 + 6y^3) \div (3y)$ $12 + 8y + 2y^2$
12. $(6p^2 - 18p^4 + 30p^5) \div (6p)$ $p - 3p^3 + 5p^4$
13. $(4x^3y + 12x^2y^2 - 4xy^3) \div (4xy)$ $x^2 + 3xy - y^2$
14. $(25m^2n - 10m^4n + m^3n) \div (5m^2n)$ $5m^2 - 2m + \frac{1}{5}$
15. $(-8y^4 - 12y^3 + 32y^2) \div (-4y^2)$ $2y^2 + 3y - 8$
16. $(12y^3 - 8y^6 + 16y^4 - 10y^3) \div (2y^3)$ $6y^2 - 4y^3 + 8y - 5$
17. $(3p^4 - 6p^3 + 2p^2 - p) \div (-6p)$ $-\frac{1}{2}p^3 + p^2 - \frac{1}{3}p + \frac{1}{6}$
18. $(-4q^3 + 8q^2 - q) \div (-12q)$ $\frac{1}{3}q^2 - \frac{2}{3}q + \frac{1}{12}$

Concept Retention

To promote long-term concept retention, review problems have been infused in the Practice Exercises so that concepts learned earlier in the chapter are continually reinforced. These exercises appear at the beginning of the Practice Exercises and are labeled in the *Annotated Instructor's Edition* with section numbers to designate each concept's point of origin.



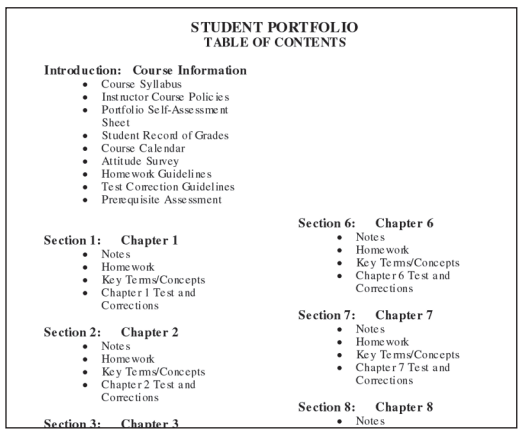
chapter 6 Midchapter Review: A Factoring Strategy

Factoring Strategy

1. Factor out the greatest common factor, GCF (Section 6.1).
2. Identify whether the polynomial has two terms, three terms, or more than three terms.
3. If the polynomial has two terms, determine if it fits the pattern for a difference of squares, difference of cubes, or sum of cubes. Remember, a sum of squares is not factorable over the real numbers (Section 6.3).
4. If the polynomial has three terms, check first for a perfect square trinomial. Otherwise factor the trinomial with the grouping method or the trial-and-error method (Section 6.2).
5. If the polynomial has more than three terms, try factoring by grouping (Section 6.1 and Section 6.3).

Midchapter Reviews

A set of retention exercises can be found in the middle of each chapter. With these questions, students can review concepts introduced in the first half of the chapter before expanding to new ideas presented in the second half. The Midchapter Reviews also help promote long-term concept retention.



STUDENT PORTFOLIO
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- Instructor Course Policies
- Portfolio Self-Assessment Sheet
- Student Record of Grades
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- Attitude Survey
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Student Portfolio

The materials that constitute the Student Portfolio, found in the *Instructor's Resource Manual,* offer students additional opportunity to take responsibility for their learning. Using the portfolio materials, students can maintain an organized notebook that contains classroom lecture notes, homework, tests, test corrections, a calendar, a record of grades, and vocabulary terms.

COVERAGE

Early Graphing and Functions

This text focuses on an algebraic approach to problem solving with graphical interpretation. The rectangular coordinate system and graphs of linear equations in two variables are presented early (Chapter 2). This provides the necessary tools to treat functions early (Chapter 3).

Chapter 3 is devoted entirely to functions. The definitions of a function and a relation are covered, along with domain, range, function notation, variation, and intervals over which a function is increasing, decreasing, or constant. These concepts are introduced through applications. Furthermore, we have carefully and deliberately emphasized the *interpretation* of functions and function notation.

After introducing functions in Chapter 3, we take a functional approach throughout the text. This includes work with polynomial, quadratic, radical, rational, exponential, and logarithmic functions.

Graphing Calculator Boxes and Graphing Calculator Exercises are found throughout the text as a tool for instructors who incorporate graphing calculator activities in their course. The Graphing Calculator Boxes demonstrate various operations that can be performed on a graphing calculator, such as analyzing a linear equation or estimating the point of intersection of two graphs. **The graphing calculator examples and exercises are self-contained and may easily be omitted by instructors who choose not to implement the graphing calculator.**

Quadratic Equations and Factoring

Factoring and the methods for solving quadratic equations are combined in Chapter 6. The rationale is to teach factoring with immediate applications to solving quadratic and polynomial equations. After learning three methods for solving quadratic equations (factoring, completing the square, and the quadratic formula), applications of these techniques are presented in the next chapter. In Chapter 7 quadratic functions, circles, and nonlinear systems of equations are graphed.

Chapter 6 Midchapter Review

The Midchapter Review for Chapter 6, found on page 440, has been specially titled "A Factoring Strategy." It is designed to provide a cumulative review of the methods used to factor different types of polynomials. This review provides an opportunity for students to see a variety of polynomials and to apply the skills they have learned in the first three sections to successfully factor each polynomial.

Identifying Equations and Inequalities

A student who completes intermediate algebra should be able to recognize and solve a variety of equations and inequalities; however, the skill of distinguishing different types of equations and inequalities is often overlooked. Chapter 9—More Equations and Inequalities—is designed as a synthesis chapter in which students are exposed to a variety of equations and inequalities appropriate at this level. Note that each section of Chapter 9 is a self-contained unit and can be introduced at the instructor's discretion at another location in the text.

Chapter A Additional Topics

Chapter A has been designed for instructors who wish to incorporate additional topics other than those found in Chapters 1–10. Chapter A is available online at www.mhhe.com/miller_oneill where text, examples, exercises, and answers are provided for each additional section.

ANCILLARIES FOR THE INSTRUCTOR

Annotated Instructor's Edition

The *Annotated Instructor's Edition* (AIE) contains answers to all exercises and tests. The answers to most exercises are found in green and are printed next to each problem (answers not appearing on the page are found in the back of the AIE in an appendix). This ancillary also provides valuable keys that serve as a useful guide to instructors as they assign homework problems and structure lessons. Icons and references are placed throughout the Practice Exercises so that instructors can easily identify problem types, such as writing exercises, "translation exercises," geometry exercises, review exercises, challenge problems (Expanding Your Skills), and calculator exercises. Students *do not see all of these icons* in the *Student Edition* of the text. Students see only the video icons, the calculator icons, and the reference to Expanding Your Skills.

Instructor's Resource Manual

Written by the authors, the *Instructor's Resource Manual* (IRM) contains numerous classroom activities designed for group or individual work, a series of Internet activities, and materials for a student portfolio. Several **Classroom Activities** are available for each section in the text to be used as a complement to lecture. These short activities can be completed in 5 to 10 minutes. In addition, Internet activities called **Technology Connections** are provided for each chapter to give students working applications of topics covered in the chapter. For instructors who want to use the Classroom Activities or Technology Connections as cooperative learning lessons, the IRM also provides strategies for successful implementation of cooperative learning.

The **Student Portfolio** is another significant feature of the *Instructor's Resource Manual.* The materials in the portfolio provide guidelines for the student to maintain an organized notebook with notes, homework, tests, test corrections, a calendar, a record of grades, and vocabulary. The portfolio is a vehicle to reinforce students' responsibility for their own learning.

This supplement is available in print form and it can also be accessed online at www.mhhe.com/miller_oneill.

Instructor's Solutions Manual

The *Instructor's Solutions Manual* contains comprehensive, worked-out solutions to all exercises in the Practice Exercise sets; the Midchapter Reviews; the end of chapter Review Exercises; the Chapter Tests; and the Cumulative Review Exercises. A *Student's Solutions Manual* is also available for sale to students. The *Student's Solutions Manual* contains worked-out solutions to the odd-numbered Practice Exercises, Midchapter Review questions, Review Exercises, Chapter Test questions, and Cumulative Review questions.

Student's Edition Prefatory "Help Yourself"

Encourage your students to read "Help Yourself," a prefatory section in the Student Edition of this book. "Help Yourself" offers students hints for success in mathematics courses. It begins with practical advice on preparing for class and for exams. Then, it encourages students to become familiar with their texts by "walking them through" the key features of the text along with sample pages that highlight the respective features. Following the "walk-through," students are provided with a list of supplements and are given brief descriptions of each. Finally, in "Putting It All Together," students are offered suggestions on how to use their text and accompanying supplements to achieve success in developmental mathematics. (*Note to instructors:* The Instructor's Preface is not included in the Student Edition.)

Instructor's Testing and Resource CD-ROM

This CD-ROM contains a computerized test bank that utilizes Brownstone Diploma® testing software. The computerized test bank allows you to create well-formatted quizzes or tests using a large bank of algorithmically generated and static questions. When creating a quiz or test, you can manually choose individual questions or have the software randomly select questions based on section, question type, difficulty level, and other criteria. Instructors also have the ability to add or edit test bank questions to create their own customized test bank. In addition to printed tests, the test generator can deliver tests over a local area network or the World Wide Web, with automatic grading.

Also available on the CD-ROM are pre-formatted tests that appear in two forms: Adobe Acrobat (.pdf) and Microsoft Word files. These files are provided for convenient access to "ready to use" tests. *Preformatted chapter tests and final tests* can also be downloaded as a Word (.doc) file or can be viewed and printed as a (.pdf) file at www.mhhe.com/miller_oneill.

Online Learning Center

The Online Learning Center (OLC), located at www.mhhe.com/miller_oneill, contains resources for students and instructors alike. The OLC consists of the Student Learning Site, the Instructor Resource Site, and the Information Center.

Through the Instructor Resource Site, instructors can access an electronic version of the *Instructor's Resource Manual* (the electronic version contains all the same elements as found in the print version), links to professional resources, a Powerpoint presentation (transparencies), printable tests, group projects, a link to PageOut, and more.

To access the Instructor Resource Site, instructors must have a passcode that can be obtained by contacting a McGraw-Hill Higher Education representative.

The Student Learning Site is also passcode-protected. Passcodes for students can be found at the front of their texts when newly purchased. *Passcodes are available free to students when they purchase a new text.* The Student Learning Site contains the student version of the Classroom Activities and Technology Connections that appear in the *Instructor's Resource Manual,* as well as the Student Portfolio. Students also have access to the group projects, tutorials, a formula card, NetTutor™, and more!

The Information Center can be accessed by students and instructors alike, without a passcode. Through the Information Center users can access general information about the text and its ancillaries.

NetTutor

NetTutor is a revolutionary system that enables students to interact with a live tutor over the World Wide Web by using NetTutor's Web-based, graphical chat capabilities. Students can also submit questions and receive answers, browse previously answered questions, and view previous live chat sessions.

NetTutor can be accessed on the Online Learning Center through the Student Learning Site.

PageOut

PageOut is McGraw-Hill's unique point-and-click course Website tool, enabling instructors to create a full-featured, professional quality course Website without knowing HTML coding. With PageOut instructors can post a syllabus online, assign McGraw-Hill Online Learning Center content, add links to important off-site resources, and maintain student results in the online grade book. Instructors can also send class announcements, copy a course site to share with colleagues, and upload original files. PageOut is free for every McGraw-Hill user. For those instructors who are short on time, there is a team on hand, ready to help build a site!

Learn more about PageOut and other McGraw-Hill digital solutions at www.mhhe.com/solutions.

Miller/O'Neill Tutorial CD-ROM

This interactive CD-ROM is a self-paced tutorial specifically linked to the text that reinforces topics through unlimited opportunities to review concepts and practice problem solving. The CD-ROM provides section-specific animated lessons with accompanying audio, practice exercises that enable students to work through problems with step-by-step guidance available, concept-matching problems that test vocabulary skills as well as identification of properties and rules, and more. The results of students' work on homework or quizzes on the CD can be reported to a centralized gradebook managed by the instructor on the World Wide Web. This browser-based CD requires virtually no computer training on the part of students and will run on both Windows and Macintosh computers. The tutorial CD-ROM is free to students who purchase a *new* text.

Miller/O'Neill Video Series (Videotapes or Video CDs)

The video series is based on problems taken directly from the Practice Exercises. The Practice Exercises contain icons (in both the student and the instructor edition) that show which problems from the text appear in the video series. A mathematics instructor presents selected problems and works through them, following the solution methodology employed in the text. The video series is also available on video CDs.

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Preparing a first edition mathematics text is an enormous undertaking that 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:

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In addition to the assistance provided by the reviewers, we would also like to thank the many people behind the scenes at McGraw-Hill who have made this project possible. Our sincerest thanks to Erin Brown, David Dietz, and Bill Barter for being patient and kind editors, to Peggy Selle for keeping us on track during production, and to Mary Kittell and Marianne Rutter for their creative ideas promoting all of our efforts. We further appreciate the hard work of Wayne Harms, Carrie Burger, Tammy Juran, and Jeff Huettman.

Finally, we give special thanks to all the students and instructors who use *Intermediate Algebra* in their classes.

Julie Miller and Molly O'Neill

Pedagogy

Chapter Openers

Each chapter opens with an application relating to topics presented in the chapter. The Chapter Openers also contain website references for **Technology Connections**, Internet activities found in the *Instructor's Resource Manual* which further the scope of the application.

chapter 4

Polynomials

To plan a vacation overseas, an understanding of currency exchange rates is important. For example, if you visit Frankfurt, Germany, you will need to know how many Euros (the main unit of currency in Germany as well as 11 other European countries) may be exchanged for $1. If you visit Japan, you will need to know how many Yen may be exchanged for $1.

Because many countries outside the United States use the metric system, it is also helpful to know unit conversions for some common units of measurement. For example, 1 kilometer (km) is approximately 0.622 miles. Therefore, the distance of 305 km between Frankfurt, Germany, and Munich, Germany, is approximately 190 miles.

A linear function can be used to perform unit conversions. If x is a distance measured in kilometers, then the function defined by

$$m(x) = 0.622x$$

gives the corresponding distance in miles.

For more information about currency exchange and unit conversion, visit currencyex and unitconv at

www.mhhe.com/miller_oneill

Concepts

section 1.3 Simplifying Expressions

1. Recognizing Terms, Factors, and Coefficients

An algebraic expression is the sum of one or more terms. A **term** is a constant or the product of a constant and one or more variables. For example, the expression

$$-6x^2 + 5xyz - 11 \quad \text{or} \quad -6x^2 + 5xyz + -11$$

consists of the terms $-6x^2$, $5xyz$, and -11.

The terms $-6x^2$ and $5xyz$ are **variable terms**, and the term -11 is called a **constant term**. It is important to distinguish between a term and the **factors** within a term. For example, the quantity $5xyz$ is one term, but the values 5, x, y, and z are factors within the term. The constant factor in a term is called the numerical coefficient (or simply **coefficient**) of the term. In the terms $-6x^2$, $5xyz$, and -11, the coefficients are -6, 5, and -11, respectively.

Terms are called ***like* terms** if they each have the same variables, and the corresponding variables are raised to the same powers. For example:

***Like* Terms**			**Un*like* Terms**			
$-6t$	and	$4t$	$-6t$	and	$4s$	(different variables)
$1.8ab$	and	$-3ab$	$1.8xy$	and	$-3x$	(different variables)
$\frac{1}{2}c^2d^3$	and	c^2d^3	$\frac{1}{2}c^2d^3$	and	c^2d	(different powers)
4	and	6	$4p$	and	6	(different variables)

example 1 **Identifying Terms, Factors, Coefficients, and *Like* Terms**

a. List the terms of the expression $-4x^2 - 7x + \frac{2}{3}$
b. Identify the coefficient of the term yz^3
c. Identify the pair of *like* terms: $16b$, $4b^2$ or $\frac{1}{2}c$, $-\frac{1}{6}c$

Solution:

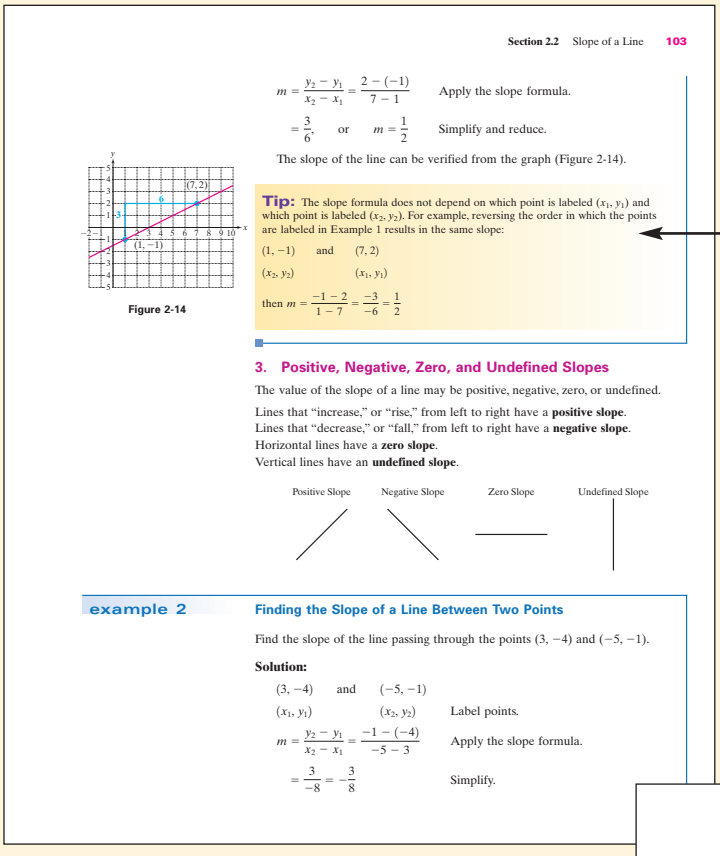
a. The terms of the expression $-4x^2 - 7x + \frac{2}{3}$ are $-4x^2$, $-7x$, and $\frac{2}{3}$.
b. The term yz^3 can be written as $1yz^3$; therefore, the coefficient is 1.
c. $\frac{1}{2}c$, $-\frac{1}{6}c$ are *like* terms because they have the same variable raised to the same power.

2. Properties of Real Numbers

Simplifying algebraic expressions requires several important properties of real numbers that are stated in Table 1-3. Assume that a, b, and c represent real numbers or real-valued algebraic expressions:

Concepts

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



Section 2.2 Slope of a Line 103

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - (-1)}{7 - 1}$ Apply the slope formula.

$= \frac{3}{6}$, or $m = \frac{1}{2}$ Simplify and reduce.

The slope of the line can be verified from the graph (Figure 2-14).

Figure 2-14

Tip: The slope formula does not depend on which point is labeled (x_1, y_1) and which point is labeled (x_2, y_2). For example, reversing the order in which the points are labeled in Example 1 results in the same slope:

$(1, -1)$ and $(7, 2)$

(x_2, y_2) (x_1, y_1)

then $m = \frac{-1 - 2}{1 - 7} = \frac{-3}{-6} = \frac{1}{2}$

3. Positive, Negative, Zero, and Undefined Slopes

The value of the slope of a line may be positive, negative, zero, or undefined.

Lines that "increase," or "rise," from left to right have a **positive slope**.
Lines that "decrease," or "fall," from left to right have a **negative slope**.
Horizontal lines have a **zero slope**.
Vertical lines have an **undefined slope**.

example 2 **Finding the Slope of a Line Between Two Points**

Find the slope of the line passing through the points $(3, -4)$ and $(-5, -1)$.

Solution:

$(3, -4)$ and $(-5, -1)$

(x_1, y_1) (x_2, y_2) Label points.

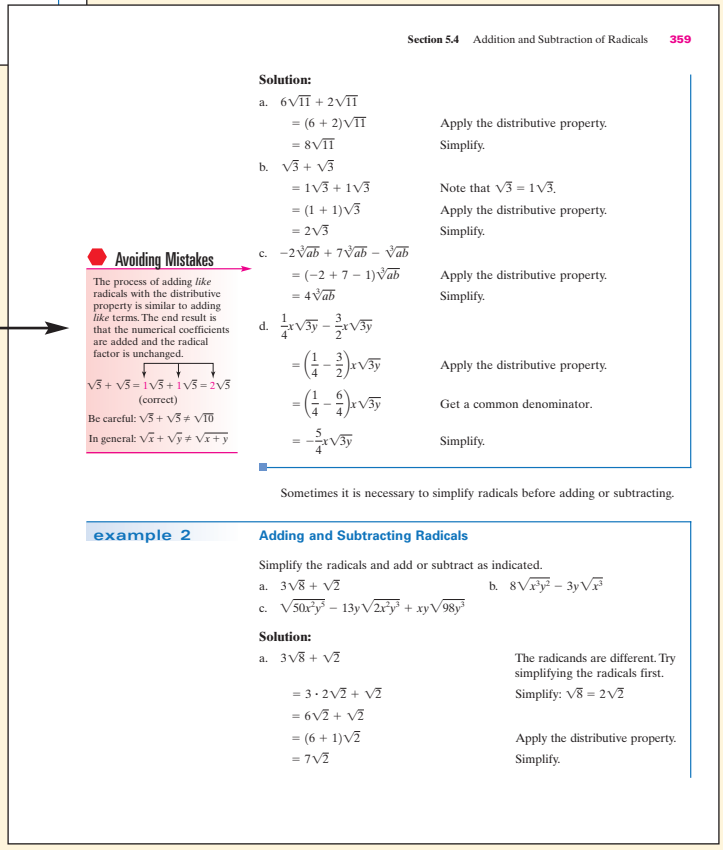
$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - (-4)}{-5 - 3}$ Apply the slope formula.

$= \frac{3}{-8} = -\frac{3}{8}$ Simplify.

Special Elements

Tips

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



Section 5.4 Addition and Subtraction of Radicals 359

Solution:

a. $6\sqrt{11} + 2\sqrt{11}$

$= (6 + 2)\sqrt{11}$ Apply the distributive property.

$= 8\sqrt{11}$ Simplify.

b. $\sqrt{3} + \sqrt{3}$

$= 1\sqrt{3} + 1\sqrt{3}$ Note that $\sqrt{3} = 1\sqrt{3}$.

$= (1 + 1)\sqrt{3}$ Apply the distributive property.

$= 2\sqrt{3}$ Simplify.

c. $-2\sqrt[3]{ab} + 7\sqrt[3]{ab} - \sqrt[3]{ab}$

$= (-2 + 7 - 1)\sqrt[3]{ab}$ Apply the distributive property.

$= 4\sqrt[3]{ab}$ Simplify.

d. $\frac{1}{4}x\sqrt{3y} - \frac{3}{2}x\sqrt{3y}$

$= \left(\frac{1}{4} - \frac{3}{2}\right)x\sqrt{3y}$ Apply the distributive property.

$= \left(\frac{1}{4} - \frac{6}{4}\right)x\sqrt{3y}$ Get a common denominator.

$= -\frac{5}{4}x\sqrt{3y}$ Simplify.

Avoiding Mistakes

The process of adding *like* radicals with the distributive property is similar to adding *like* terms. The end result is that the numerical coefficients are added and the radical factor is unchanged.

$\sqrt{5} + \sqrt{5} = 1\sqrt{5} + 1\sqrt{5} = 2\sqrt{5}$ (correct)

Be careful: $\sqrt{5} + \sqrt{5} \neq \sqrt{10}$

In general: $\sqrt{x} + \sqrt{y} \neq \sqrt{x + y}$

Sometimes it is necessary to simplify radicals before adding or subtracting.

example 2 **Adding and Subtracting Radicals**

Simplify the radicals and add or subtract as indicated.

a. $3\sqrt{8} + \sqrt{2}$ b. $8\sqrt{x^3y^2} - 3y\sqrt{x^3}$

c. $\sqrt{50x^2y^3} - 13y\sqrt{2x^2y^3} + xy\sqrt{98y^3}$

Solution:

a. $3\sqrt{8} + \sqrt{2}$ The radicands are different. Try simplifying the radicals first.

$= 3 \cdot 2\sqrt{2} + \sqrt{2}$ Simplify: $\sqrt{8} = 2\sqrt{2}$

$= 6\sqrt{2} + \sqrt{2}$

$= (6 + 1)\sqrt{2}$ Apply the distributive property.

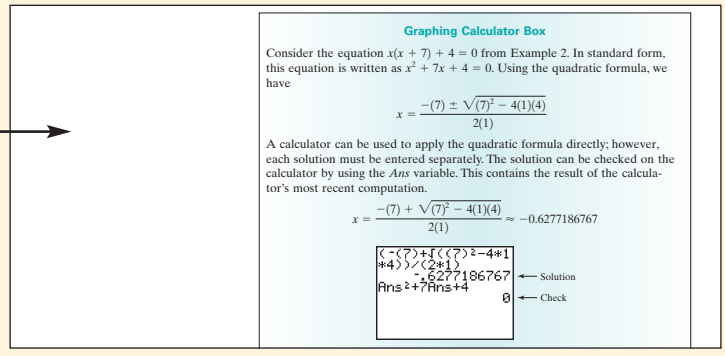
$= 7\sqrt{2}$ Simplify.

Avoiding Mistakes

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

Graphing Calculator Boxes

Optional Graphing Calculator Boxes appear throughout the text. These can be implemented at the instructor's discretion depending on the amount of emphasis placed on the graphing calculator in the course. The boxes include screen captures and show how various techniques, such as analyzing and evaluating functions, can be performed.



Graphing Calculator Box

Consider the equation $x(x + 7) + 4 = 0$ from Example 2. In standard form, this equation is written as $x^2 + 7x + 4 = 0$. Using the quadratic formula, we have

$$x = \frac{-(7) \pm \sqrt{(7)^2 - 4(1)(4)}}{2(1)}$$

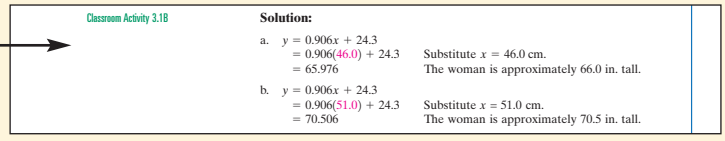
A calculator can be used to apply the quadratic formula directly; however, each solution must be entered separately. The solution can be checked on the calculator by using the *Ans* variable. This contains the result of the calculator's most recent computation.

$$x = \frac{-(7) + \sqrt{(7)^2 - 4(1)(4)}}{2(1)} \approx -0.6277186767$$

(-(7)+√((7)²-4*1*4))/(2*1)
-.6277186767 ← Solution
Ans²+7Ans+4
0 ← Check

References to Classroom Activities

Throughout each section of the *Annotated Instructor's Edition,* references are made to Classroom Activities. These references appear on the page where the activities might be introduced. The activities are described in the Instructor's Resource Manual.

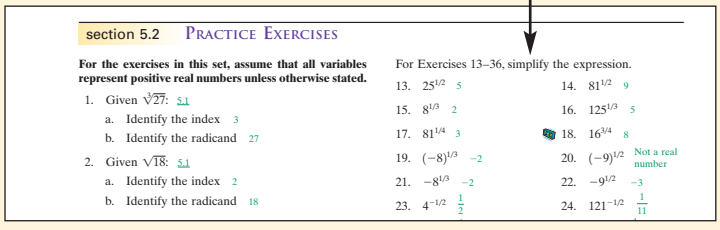


Classroom Activity 3.1B

Solution:

a. $y = 0.906x + 24.3$
$= 0.906(46.0) + 24.3$ Substitute $x = 46.0$ cm.
$= 65.976$ The woman is approximately 66.0 in. tall.

b. $y = 0.906x + 24.3$
$= 0.906(51.0) + 24.3$ Substitute $x = 51.0$ cm.
$= 70.506$ The woman is approximately 70.5 in. tall.



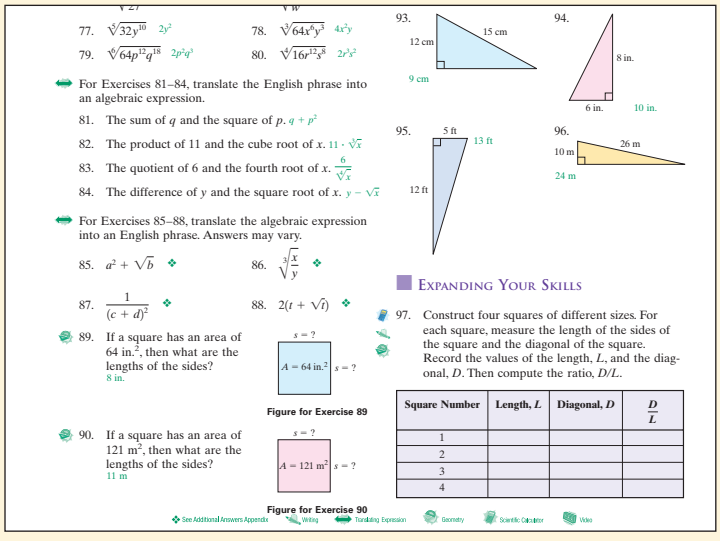
section 5.2 PRACTICE EXERCISES

For the exercises in this set, assume that all variables represent positive real numbers unless otherwise stated.

1. Given $\sqrt[3]{27}$: 5.1
   a. Identify the index 3
   b. Identify the radicand 27
2. Given $\sqrt{18}$: 5.1
   a. Identify the index 2
   b. Identify the radicand 18

For Exercises 13–36, simplify the expression.

13. $25^{1/2}$ 5
14. $81^{1/2}$ 9
15. $8^{1/3}$ 2
16. $125^{1/3}$ 5
17. $81^{1/4}$ 3
18. $16^{3/4}$ 8
19. $(-8)^{1/3}$ −2
20. $(-9)^{1/2}$ Not a real number
21. $-8^{1/3}$ −2
22. $-9^{1/2}$ −3
23. $4^{-1/2}$ $\frac{1}{2}$
24. $121^{-1/2}$ $\frac{1}{11}$



77. $\sqrt[5]{32y^{10}}$ $2y^2$
78. $\sqrt[3]{64x^6y^3}$ $4x^2y$
79. $\sqrt[6]{64p^{12}q^{18}}$ $2p^2q^3$
80. $\sqrt[4]{16r^{12}s^8}$ $2r^3s^2$

For Exercises 81–84, translate the English phrase into an algebraic expression.

81. The sum of q and the square of p. $q + p^2$
82. The product of 11 and the cube root of x. $11 \cdot \sqrt[3]{x}$
83. The quotient of 6 and the fourth root of x. $\frac{6}{\sqrt[4]{x}}$
84. The difference of y and the square root of x. $y - \sqrt{x}$

For Exercises 85–88, translate the algebraic expression into an English phrase. Answers may vary.

85. $a^2 + \sqrt{b}$
86. $\sqrt[3]{\frac{x}{y}}$
87. $\frac{1}{(c + d)^2}$
88. $2(t + \sqrt{t})$

89. If a square has an area of 64 in.^{2}, then what are the lengths of the sides? 8 in.

$s = ?$, $A = 64$ in.^{2}, $s = ?$

Figure for Exercise 89

90. If a square has an area of 121 m^2, then what are the lengths of the sides? 11 m

$s = ?$, $A = 121$ m^2, $s = ?$

Figure for Exercise 90

93. 12 cm, 15 cm, 9 cm
94. 8 in., 6 in., 10 in.
95. 5 ft, 13 ft, 12 ft
96. 10 m, 26 m, 24 m

EXPANDING YOUR SKILLS

97. Construct four squares of different sizes. For each square, measure the length of the sides of the square and the diagonal of the square. Record the values of the length, L, and the diagonal, D. Then compute the ratio, D/L.

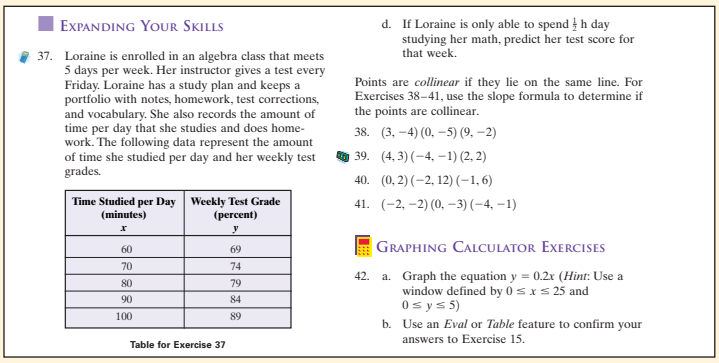
Square Number	Length, L	Diagonal, D	$\frac{D}{L}$
1			
2			
3			
4			

❖ See Additional Answers Appendix · Writing · Translating Expression · Geometry · Scientific Calculator · Video

Practice Exercises

The Practice Exercises contain a variety of problem types.

- **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** throughout the Practice Exercises encourage students to review and apply geometry concepts.
- **Review problems** appear within the Practice Exercises to help students retain their knowledge of concepts previously learned. Each review problem is labeled with a section number, referencing the section where the problem type is introduced.
- **Applications,** based on real-world facts and figures, motivate students and enable them to hone their problem-solving skills.
- **Exercises keyed to video** are labeled with an icon to help students and instructors identify those exercises that appear in the video series that accompanies *Intermediate Algebra*.
- **Calculator Exercises** cover situations when a calculator would help with time-consuming calculations. These exercises were carefully designed to demonstrate when a calculator is a handy tool rather than a "crutch." They are designed for use with either a scientific or a graphing calculator.



EXPANDING YOUR SKILLS

37. Loraine is enrolled in an algebra class that meets 5 days per week. Her instructor gives a test every Friday. Loraine has a study plan and keeps a portfolio with notes, homework, test corrections, and vocabulary. She also records the amount of time per day that she studies and does homework. The following data represent the amount of time she studied per day and her weekly test grades.

Time Studied per Day (minutes) x	Weekly Test Grade (percent) y
60	69
70	74
80	79
90	84
100	89

Table for Exercise 37

d. If Loraine is only able to spend $\frac{1}{2}$ h day studying her math, predict her test score for that week.

Points are *collinear* if they lie on the same line. For Exercises 38–41, use the slope formula to determine if the points are collinear.

38. $(3, -4)\ (0, -5)\ (9, -2)$

39. $(4, 3)\ (-4, -1)\ (2, 2)$

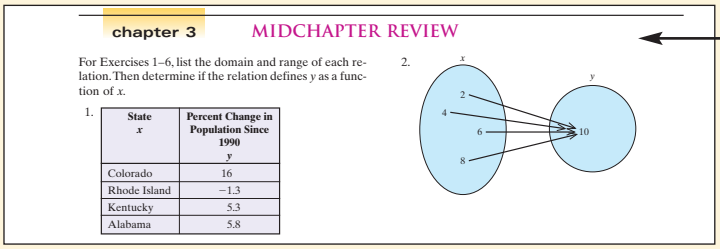
40. $(0, 2)\ (-2, 12)\ (-1, 6)$

41. $(-2, -2)\ (0, -3)\ (-4, -1)$

GRAPHING CALCULATOR EXERCISES

42. a. Graph the equation $y = 0.2x$ (*Hint*: Use a window defined by $0 \le x \le 25$ and $0 \le y \le 5$)

b. Use an *Eval* or *Table* feature to confirm your answers to Exercise 15.



chapter 3 MIDCHAPTER REVIEW

For Exercises 1–6, list the domain and range of each relation. Then determine if the relation defines y as a function of x.

1.

State x	Percent Change in Population Since 1990 y
Colorado	16
Rhode Island	−1.3
Kentucky	5.3
Alabama	5.8

2.

- **Expanding Your Skills**, found near the end of most Practice Exercise sets, challenge students' knowledge of the concepts presented.
- **Graphing Calculator Exercises**, also found at the end of appropriate exercise sets, offer students and instructors a means of using the graphing calculator to explore concepts.

Midchapter Reviews

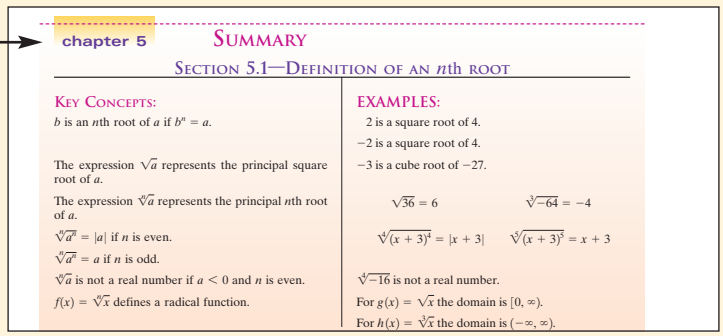
Midchapter Reviews are provided to help solidify the foundation of concepts learned in the beginning of a chapter before expanding to new ideas presented later in the chapter.

End of Chapter Summary and Exercises

The **Summary**, found at the end of each chapter, outlines key concepts for each section and illustrates those concepts with examples. The Summary also provides a list of important terms that mirror those appearing in the Vocabulary Worksheets of the Student Portfolio found in the *Instructor's Resource Manual*. With this list, students can quickly identify important ideas and vocabulary to be reviewed before quizzes or exams.

Following the Summary is a set of **Review Exercises** that are organized by section. A **Chapter Test** appears after each set of Review Exercises.

Chapters 2–10 also include a **Cumulative Review** that follows the Chapter Test. These end-of-chapter materials provide students with ample opportunity to prepare for quizzes or exams.



chapter 5 SUMMARY

SECTION 5.1—DEFINITION OF AN nth ROOT

KEY CONCEPTS:

b is an nth root of a if $b^n = a$.

The expression $\sqrt{a}$ represents the principal square root of a.

The expression $\sqrt[n]{a}$ represents the principal nth root of a.

$\sqrt[n]{a^n} = |a|$ if n is even.

$\sqrt[n]{a^n} = a$ if n is odd.

$\sqrt[n]{a}$ is not a real number if $a < 0$ and n is even.

$f(x) = \sqrt[n]{x}$ defines a radical function.

EXAMPLES:

2 is a square root of 4.

-2 is a square root of 4.

-3 is a cube root of -27.

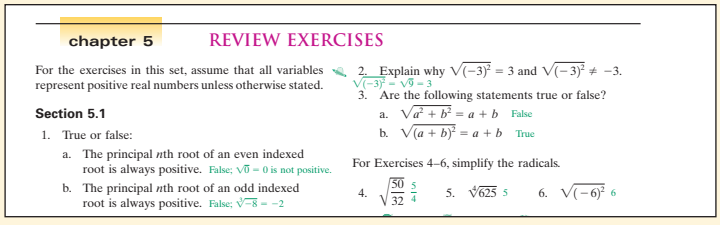
$\sqrt{36} = 6$ $\quad \sqrt[3]{-64} = -4$

$\sqrt[4]{(x+3)^4} = |x+3|$ $\quad \sqrt[5]{(x+3)^5} = x+3$

$\sqrt[4]{-16}$ is not a real number.

For $g(x) = \sqrt{x}$ the domain is $[0, \infty)$.

For $h(x) = \sqrt[3]{x}$ the domain is $(-\infty, \infty)$.



chapter 5 REVIEW EXERCISES

For the exercises in this set, assume that all variables represent positive real numbers unless otherwise stated.

Section 5.1

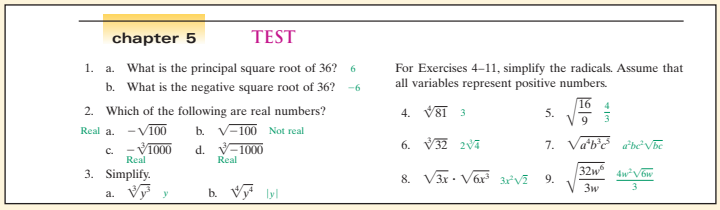
1. True or false:
   a. The principal nth root of an even indexed root is always positive. False; $\sqrt{0} = 0$ is not positive.
   b. The principal nth root of an odd indexed root is always positive. False; $\sqrt[3]{-8} = -2$

2. Explain why $\sqrt{(-3)^2} = 3$ and $\sqrt{(-3)^2} \neq -3$. $\sqrt{(-3)^2} = \sqrt{9} = 3$

3. Are the following statements true or false?
   a. $\sqrt{a^2 + b^2} = a + b$ False
   b. $\sqrt{(a+b)^2} = a + b$ True

For Exercises 4–6, simplify the radicals.

4. $\sqrt{\frac{50}{32}}$ $\frac{5}{4}$ $\quad$ 5. $\sqrt[4]{625}$ 5 $\quad$ 6. $\sqrt{(-6)^2}$ 6



chapter 5 TEST

1. a. What is the principal square root of 36? 6
   b. What is the negative square root of 36? -6

2. Which of the following are real numbers?
   a. $-\sqrt{100}$ Real $\quad$ b. $\sqrt{-100}$ Not real
   c. $-\sqrt[3]{1000}$ Real $\quad$ d. $\sqrt[3]{-1000}$ Real

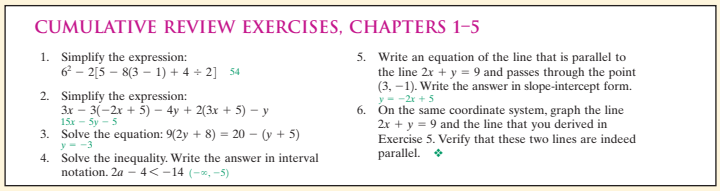
3. Simplify.
   a. $\sqrt[3]{y^3}$ y $\quad$ b. $\sqrt[4]{y^4}$ $|y|$

For Exercises 4–11, simplify the radicals. Assume that all variables represent positive numbers.

4. $\sqrt[4]{81}$ 3 $\quad$ 5. $\sqrt{\frac{16}{9}}$ $\frac{4}{3}$

6. $\sqrt[5]{32}$ $2\sqrt[5]{4}$ $\quad$ 7. $\sqrt{a^2b^2c^2}$ $a^2bc^2\sqrt{bc}$

8. $\sqrt{3x} \cdot \sqrt{6x^3}$ $3x^2\sqrt{2}$ $\quad$ 9. $\sqrt{\frac{32w^6}{3w}}$ $\frac{4w^2\sqrt{6w}}{3}$



CUMULATIVE REVIEW EXERCISES, CHAPTERS 1–5

1. Simplify the expression: $6^2 - 2[5 - 8(3 - 1) + 4 \div 2]$ 54

2. Simplify the expression: $3x - 3(-2x + 5) - 4y + 2(3x + 5) - y$ $15x - 5y - 5$

3. Solve the equation: $9(2y + 8) = 20 - (y + 5)$ $y = -3$

4. Solve the inequality. Write the answer in interval notation. $2a - 4 < -14$ $(-\infty, -5)$

5. Write an equation of the line that is parallel to the line $2x + y = 9$ and passes through the point $(3, -1)$. Write the answer in slope-intercept form. $y = -2x + 5$

6. On the same coordinate system, graph the line $2x + y = 9$ and the line that you derived in Exercise 5. Verify that these two lines are indeed parallel. ❖

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