Elementary Algebra

for College Students

Sixth Edition

Allen R. **ANGEL**

Annotated Instructor's Edition

Elementary Algebra
For College Students
Sixth Edition

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To my wife, Kathy
and my sons, Robert and Steven

Preface

This book was written for college students and other adults who have never been exposed to algebra or those who have been exposed but need a refresher course. My primary goal was to write a book that students can read, understand, and enjoy. To achieve this goal I have used short sentences, clear explanations, and many detailed, worked-out examples. I have tried to make the book relevant to college students by using practical applications of algebra throughout the text.

Features of the Text

Full-Color Format   Color is used pedagogically in the following ways:

- Important definitions and procedures are color screened.

- Color screening or color type is used to make other important items stand out.

- Artwork is enhanced and clarified with use of multiple colors.

- The full-color format allows for easy identification of important features by students.

- The full-color format makes the text more appealing and interesting to students.

Readability   One of the most important features of the text is its readability. The book is very readable, even for those with weak reading skills. Short, clear sentences are used and more easily recognized, and easy-to-understand language is used whenever possible.

Accuracy   Accuracy in a mathematics text is essential. To ensure accuracy in this book, mathematicians from around the country have read the pages carefully for typographical errors and have checked all the answers.

Connections   Many of our students do not thoroughly grasp new concepts the first time they are presented. In this text we encourage students to make connections. That is, we introduce a concept, then later in the text briefly reintroduce it and build upon it.

Often an important concept is used in many sections of the text. Students are reminded where the material was seen before, or where it will be used again. This also serves to emphasize the importance of the concept. Important concepts are also reinforced throughout the text in the Cumulative Review Exercises and Cumulative Review Tests.

Chapter Opening Application   Each chapter begins with a real-life application related to the material covered in the chapter. By the time students complete the chapter, they should have the knowledge to work the problem.

A Look Ahead   This feature at the beginning of each chapter gives students a preview of the chapter and also indicates where this material will be used again in other chapters of the book. This material helps students see the connections between various topics in the book and the connection to real-world situations.

The Use of Icons   At the beginning of each chapter and of each section, a variety of icons are illustrated. These icons are provided to tell students where they may be able to get extra help if needed. There are icons for the *Student's Solution Manual*, ▮; the *Student's Study Guide*, ▯; *CDs and videotapes*, ▱; *Math Pro 4/5 Software*, ◉; the *Prentice Hall Tutor Center*, ▰; and the *Angel Website*, ▱ . Each of these items will be discussed shortly.

Keyed Section Objectives   Each section opens with a list of skills that the student should learn in that section. The objectives are then keyed to the appropriate portions of the sections with red numbers such as **1**.

Problem Solving   Polya's five-step problem-solving procedure is discussed in Section 1.2. Throughout the book problem solving and Polya's problem-solving procedure are emphasized.

Practical Applications   Practical applications of algebra are stressed throughout the text. Students need to learn how to translate application problems into

algebraic symbols. The problem-solving approach used throughout this text gives students ample practice in setting up and solving application problems. The use of practical applications motivates students.

Detailed, Worked-Out Examples   A wealth of examples have been worked out in a step-by-step, detailed manner. Important steps are highlighted in color, and no steps are omitted until after the student has seen a sufficient number of similar examples.

Now Try Exercise   In each section, students are asked to work exercises that parallel the examples given in the text. These Now Try Exercises make the students *active*, rather than passive, learners and they reinforce the concepts as students work the exercises. Through these exercises students have the opportunity to immediately apply what they have learned. Now Try Exercises are indicated in green type such as 35, in the exercise sets.

Study Skills Section   Many students taking this course have poor study skills in mathematics. Section 1.1, the first section of this text, discusses the study skills needed to be successful in mathematics. This section should be very beneficial for your students and should help them to achieve success in mathematics.

Helpful Hints   The Helpful Hint boxes offer useful suggestions for problem solving and other varied topics. They are set off in a special manner so that students will be sure to read them.

Helpful Hints—Study Tips   This is a new feature. These Helpful Hint—Study Tips boxes offer valuable information on items related to studying and learning the material.

Avoiding Common Errors   Errors that students often make are illustrated. The reasons why certain procedures are wrong are explained, and the correct procedure for working the problem is illustrated. These Avoiding Common Errors boxes will help prevent your students from making those errors we see so often.

Mathematics in Action   This new feature stresses the need for and the uses of mathematics in real-life situations. Examples of the use of mathematics in many professions, and how we use mathematics daily without ever giving it much thought, are given. This can be a motivational feature for your students and can give them a better appreciation of mathematics.

Using Your Calculator   The Using Your Calculator boxes, placed at appropriate locations in the text, are written to reinforce the algebraic topics presented in the section and to give the student pertinent information on using a scientific calculator to solve algebraic problems.

Using Your Graphing Calculator   Using Your Graphing Calculator boxes are placed at appropriate locations throughout the text. They reinforce the algebraic topics taught and sometimes offer alternate methods of working problems. This book is designed to give the instructor the option of using or not using a graphing calculator in his or her course. Some of the Using Your Graphing Calculator boxes contain graphing calculator exercises, whose answers appear in the answer section of the book. The illustrations shown in the Using Your Graphing Calculator boxes are from a Texas Instruments 83 Plus calculator. The Using Your Graphing Calculator boxes are written assuming that the student has no prior graphing calculator experience.

Exercise Sets

The exercise sets are broken into three main categories: Concept/Writing Exercises, Practice the Skills, and Problem Solving. Many exercise sets also contain Challenge Problems and/or Group Activities. Each exercise set is graded in difficulty. The early problems help develop the student's confidence, and then students are eased gradually into the more difficult problems. A sufficient number and variety of examples are given in each section for the student to successfully complete even the more difficult exercises. The number of exercises in each section is more than ample for student assignments and practice.

Concept/Writing Exercises   Most exercise sets include exercises that require students to write out the answers in words. These exercises improve students' understanding and comprehension of the material. Many of these exercises involve problem solving and conceptualization and help develop better reasoning and critical thinking skills. Writing exercises are indicated by the symbol ↘.

Problem Solving Exercises   These exercises have been added to help students become better thinkers and problem solvers. Many of these exercises involve real-life applications of algebra. It is important for students to be able to apply what they learn to real-life situations. Many problem solving exercises help with this.

Challenge Problems   These exercises, which are part of many exercise sets, provide a variety of problems. Many were written to stimulate student thinking.

Others provide additional applications of algebra or present material from future sections of the book so that students can see and learn the material on their own before it is covered in class. Others are more challenging than those in the regular exercise set.

Video Icon Exercises   The exercises that are worked out in detail on the videotapes are marked with the video icon, ⬛. This will prove helpful for your students.

Cumulative Review Exercises   All exercise sets (after the first two) contain questions from previous sections in the chapter and from previous chapters. These cumulative review exercises will reinforce topics that were previously covered and help students retain the earlier material, while they are learning the new material. For the students' benefit the Cumulative Review Exercises are keyed to the section where the material is covered, using brackets, such as *[3.4]*.

Group Activities   Many exercise sets have group activity exercises that lead to interesting group discussions. Many students learn well in a cooperative learning atmosphere, and these exercises will get students talking mathematics to one another.

Chapter Summary   At the end of each chapter is a chapter summary that includes a glossary and important chapter facts.

Chapter Review Exercises   At the end of each chapter are review exercises that cover all types of exercises presented in the chapter. The review exercises are keyed, using color numbers and brackets, to the sections where the material was first introduced.

Chapter Practice Tests   The comprehensive end-of-chapter practice test will enable the students to see how well they are prepared for the actual class test. The Instructor's Test Manual includes several forms of each chapter test that are similar to the student's practice test. Multiple choice tests are also included in the Instructor's Test Manual.

Cumulative Review Tests   These tests, which appear at the end of each chapter after the first, test the students' knowledge of material from the beginning of the book to the end of that chapter. Students can use these tests for review, as well as for preparation for the final exam. These exams, like the cumulative review exercises, will serve to reinforce topics taught earlier. The answers to the Cumulative Review Test questions directly follow the test so that students can quickly check their work. After each answer the section and

objective numbers where that material was covered are given using brackets, such as [See 4.2, obj. 5].

Answers   The *odd answers* are provided for the exercise sets. *All answers* are provided for the Using Your Graphing Calculator Exercises, Cumulative Review Exercises, Review Exercises, Practice Tests, and Cumulative Review Tests. *Answers* are not provided for the Group Activity exercises since we want students to reach agreement by themselves on the answers to these exercises.

National Standards

Recommendations of the *Curriculum and Evaluation Standards for School Mathematics*, prepared by the National Council of Teachers of Mathematics (NCTM), and *Crossroads in Mathematics: Standards for Introductory College Mathematics Before Calculus*, prepared by the American Mathematical Association of Two Year Colleges (AMATYC), are incorporated into this edition.

Prerequisite

This text assumes no prior knowledge of algebra. However, a working knowledge of arithmetic skills is important. Fractions are reviewed early in the text, and decimals are reviewed in Appendix A.

Modes of Instruction

The format and readability of this book lends itself to many different modes of instruction. The constant reinforcement of concepts will result in greater understanding and retention of the material by your students.

The features of the text and the large variety of supplements available make this text suitable for many types of instructional modes including:

- lecture
- distance learning
- self-paced instruction
- modified lecture
- cooperative or group study
- learning laboratory

Changes in the Sixth Edition

When I wrote the sixth edition I considered many letters and reviews I got from students and faculty alike. I would like to thank all of you who made suggestions

for improving the sixth edition. I would also like to thank the many instructors and students who wrote to inform me of how much they enjoyed, appreciated, and learned from the text. Some of the changes made in the sixth edition of the text include:

- Chapter 3, Formulas and Applications of Algebra, has been rewritten. Many of the exercises have been shortened and additional explanations have been added where necessary. Section 3.5 has been reorganized for greater clarity. The real-life application problems have been updated.

- Addition and subtraction of fractions in Chapter 1 have been greatly enhanced.

- Solving equations containing fractions is now introduced in Chapter 2. Many examples and exercises containing fractions were added.

- There is expanded coverage of order of operations with nested parentheses.

- The identity properties and inverse properties have been added to this edition.

- The Pythagorean Theorem has been moved earlier, to Chapter 5, at the request of many instructors.

- Direct and Inverse Variation has been added as the last section in Chapter 6.

- There is now an entire section dedicated to Applications of Quadratic Equations.

- A greater variety of exercises has been added to exercise sets throughout the book. In general, the exercise sets have been greatly enhanced.

- There is more emphasis on geometry than in the previous edition. More sections have examples and exercises that relate to geometry.

- In selected sections, more difficult exercises have been added at the end of exercise sets.

- Rational numbers have been explained more completely.

- A brief introduction to complex numbers has been added to Chapter 10 for those instructors who wish to introduce this topic to their students.

- The book has a new design with the purpose of making the exercise sets flow more smoothly so that exercises will be easy to spot and identify.

- The Cumulative Review Tests now have the answers directly following the test so that students can get immediate feedback. In addition, the section and objective numbers where the material was discussed are given after the answer.

- A Look Ahead has replaced the Preview and Perspectives. The information provided gives students an overview of the chapter and how it relates to other material in the book and to real-life situations.

- A new feature called Mathematics in Action has been added. This feature stresses the need for and the importance of mathematics in real life. This may be motivational for your students.

- More and new Helpful Hints and Avoiding Common Errors have been added where appropriate.

- Helpful Hint—Study Tips have been added. These reinforce and expand upon the Study Skills for Success in Mathematics covered in Section 1.1.

- Application problems throughout the book have been updated and made more interesting.

- Using Your Graphing Calculator boxes now show keystrokes and screens from a Texas Instruments 83 Plus calculator.

- A fraction raised to a negative exponent is covered more completely.

- The balance bars have been removed from the explanations in Chapter 2.

- When factoring by grouping, the common factor is now placed on the left for consistency with other factoring problems.

- Perpendicular lines are now introduced in the text rather than in the exercise set.

- Chapter 9, Roots and Radicals, has been rewritten and reorganized for greater clarity and understanding. The material also now flows more smoothly.

- Variables other than x and y are used more often in examples and exercises.

- More photos have been added to the text to make it more attractive and interesting for students.

- The basic colors used in the text have been softened to make the text easier to read.

- A brief introduction to metric units of measurement is now presented in the Scientific Notation section.

Supplements to the Sixth Edition

For this edition of the book the author has personally coordinated the development of the *Student's Solution*

Manual and the *Instructor's Solution Manual*. Experienced mathematics professors who have prior experience in writing supplements, and whose works have been of superior quality, have been carefully selected for authoring the supplements.

For Instructors

Printed Supplements

Annotated Instructor's Edition (0-13-140024-X)

- Contains all of the content found in the current edition.

- Answers to exercises are printed on the same text page (graphed answers are in a special graphing section at the back of the text).

- Teaching Tips throughout the text are placed at key points in the margin.

NEW! Instructor's Examples Manual
(0-13-141761-4)

- Provides similar examples for every example presented in the text. Instructors will find this very convenient when they wish to work additional examples on the chalkboard.

Instructor's Solutions Manual (0-13-140026-6)

- Solutions to even-numbered section exercises.

- Solutions to every exercise found in the Chapter Reviews, Chapter Tests, and Cumulative Review Tests.

Instructor's Test Manual (0-13-140027-4)

- Two free-response Pretests per chapter.

- Eight Chapter Tests per chapter (3 multiple choice, 5 free response).

- Two Cumulative Review Tests (one multiple choice, one free response) every two chapters.

- Eight Final Exams (3 multiple choice, 5 free response).

- Twenty additional exercises per section for added test exercises if needed.

Media Supplements

NEW! TestGen-EQ with QuizMaster CD-ROM
(Windows/Macintosh) (0-13-140035-5)

- Algorithmically driven, text-specific testing program.

- Networkable for administering tests and capturing grades online.

- Edit and add your own questions to create a nearly unlimited number of tests and worksheets.

- Use the new "Function Plotter" to create graphs.

- Tests can be easily exported to HTML so they can be posted to the Web for student practice.

- Includes an e-mail function for network users, enabling instructors to send a message to a specific student or an entire group.

- Network-based reports and summaries for a class or student and for cumulative or selected scores available.

NEW! MathPro5
MathPro 4/5 (Instructor Version) (0-13-140030-4)

- Online customizable tutorial, diagnostic, and assessment program.

- Text-specific at the learning objective level.

- Diagnostic option identifies student skills, and provides individual learning plan and tutorial reinforcement.

- Integration of TestGen-EQ allows for testing to operate within the tutorial environment.

- Course management tracking of tutorial and testing activity.

MathPro Explorer 4.0
MathPro 4/5 (Network Version IBM/Mac)
(0-13-140028-2)

- Enables instructors to create either customized or algorithmically generated practice quizzes from any section of a chapter.

- Includes e-mail function for network users enabling instructors to send a message to a specific student or to an entire group.

- Network-based reports and summaries for a class or student and for cumulative or selected scores.

Companion Website (*www.prenhall.com/angel*)

- Create a customized online syllabus with Syllabus Manager.

- Assign quizzes or monitor student self-quizzes by having students e-mail results.

- Destination links provide additional opportunities to explore related sites.

For Students

Printed Supplements

Student's Solutions Manual
SSM (0-13-140025-8)

- Solutions to odd-numbered section exercises.
- Solutions to every (even and odd) exercise found in the Cumulative Review Exercises, Chapter Tests, and Cumulative Review Tests.

Student's Study Guide
Study Guide (0-13-141760-6)

- Includes additional worked-out examples and additional exercises, practice tests, and answers.
- Emphasizes important concepts and includes information to help students study and succeed in mathematics.

Media Supplements

NEW! MathPro5 (Student Version)
MathPro 4/5 (0-13-140034-7)

- Online customizable tutorial, diagnostic, and assessment program.
- Text-specific at the learning objective level.
- Algorithmically driven for a virtually unlimited number of practice problems with immediate feedback.
- Includes "Watch" screen videoclips.
- Step-by-step solutions.
- Summary of progress.

MathPro 4.0 Explorer Student Version
MathPro 4/5 (IBM/Mac) (0-13-140033-9)

- Available on CD-Rom for stand-alone use or can be networked in the school laboratory.
- Text-specific tutorial exercises and instructions at the objective level.
- Algorithmically generated Practice Problems.
- Includes "Watch" screen videoclips.

Videotape Series
CD/Video (0-13-140031-2)

- Keyed to each section of the text.
- Step-by-step solutions to exercises from each section of the text. Exercises from the text that are worked in the videos are marked with a video icon.

NEW! Digitized Lecture Videos on CD-ROM
CD/Video (0-13-140032-0)

- The entire set of Angel, *Elementary Algebra*, Sixth Edition, lecture videotapes in digital form.
- Convenient access anytime to video tutorial support from a computer at home or on campus.
- Available shrinkwrapped with the text or stand-alone.

NEW! Prentice Hall Mathematics
PH Math Tutor Center Tutor Center

- Staffed with developmental math instructors and open 5 days a week, 7 hours per day.
- Obtain help for examples and exercises in Angel, *Elementary Algebra*, Sixth Edition, via toll-free telephone, fax, or e-mail.
- The Prentice Hall Mathematics Tutor Center is accessed through a registration number that may be bundled with a new text or purchased separately with a used book. Visit *http://www.prenhall.com/ tutorcenter* to learn more.

Companion Website
prenhall.com/Angel (*www.prenhall.com/angel*)

- Practice problems and quizzes with instant feedback.
- Graphing calculator keystroke instructions.
- Destination links provide additional opportunities to explore related sites.

Acknowledgments

Focus on Pedagogy

The Angel series is well-known and widely respected for its realistic, practical approach to algebra. The Angel approach offers thoughtful pedagogy, integrated, up-to-date real-world examples and data, and superior exercise sets.

A Look Ahead

In this chapter we provide the building blocks for this course and all other mathematics courses you will take. For many students, Section 1.1, Study Skills for Success in Mathematics, may be the most important section in the book. *Read it carefully and follow the advice given*. If you follow this advice carefully, you will greatly enhance your chance of success in this course.

In Section 1.2, we introduce a 5-step problem-solving procedure that we will use throughout the book. Other important topics covered in this chapter are fractions and the structure of the real number system. It is essential that you understand *addition, subtraction, multiplication, and division of real numbers* covered in Sections 1.6 through 1.8 before you go on to the next chapter.

1.1 STUDY SKILLS FOR SUCCESS IN MATHEMATICS

SSM · Study Guide · CD/Video · MathPro 4/5 · PH Math Tutor Center · prenhall.com/Angel
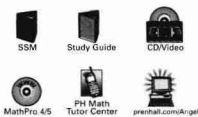
1 Understand the goals of this text.
2 Learn proper study skills.
3 Prepare for and take exams.
4 Learn to manage time.
5 Purchase a calculator.

This section is extremely important. Take the time to read it carefully and follow the advice given. For many of you this section may be the most important section of the text.

Most of you taking this course fall into one of three categories: (1) those who did not take algebra in high school, (2) those who took algebra in high school but did not understand the material, or (3) those who took algebra in high school and were successful but have been out of school for some time and need to take the course again. Whichever the case, you will need to acquire study skills for mathematics courses.

Before we discuss study skills, we will present the goals of this text. These goals may help you realize why certain topics are covered in the text and why they are covered as they are.

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A Look Ahead

Every chapter begins with **A Look Ahead** to give students an overview of the chapter and how it relates to other material in the book and to real-life situations.

Study Skills for Success In Mathematics (Section 1.1)

Following the study skills presented in this section greatly increases a student's chance for success in this and all other mathematics courses.

In-text Examples

A wealth of **in-text examples** illustrate the concept being presented and provide a step-by-step annotated solution.

Now Try Exercises

Now Try Exercises appear after selected examples to reinforce important concepts. Now Try Exercises provide students with immediate practice and make the student an active learner.

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EXAMPLE 10 **Perimeter of Rectangle** The formula for the perimeter of a rectangle is $P = 2l + 2w$. Solve this formula for the length, l.

Solution We must get l all by itself on one side of the equation. We begin by removing the $2w$ from the right side of the equation to isolate the term containing the l.

$$P = 2l + 2w$$
$$P - 2w = 2l + 2w - 2w \qquad \text{Subtract } 2w \text{ from both sides.}$$
$$P - 2w = 2l$$
$$\frac{P - 2w}{2} = \frac{2l}{2} \qquad \text{Divide both sides by 2.}$$
$$\frac{P - 2w}{2} = l \quad \left(\text{or} \quad l = \frac{P}{2} - w \right)$$

NOW TRY EXERCISE 45

EXAMPLE 11 **Simple Interest Formula** We used the simple interest formula, $i = prt$, in Example 1. Solve the simple interest formula for the principal, p.

Solution We must isolate the p. Since p is multiplied by both r and t, we divide both sides of the equation by rt.

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The Angel series is designed to help students see the important information that they need to learn concepts and topics.

Definitions, Procedures and Important Facts

Definitions, **Procedures** and **Important Facts** are presented in boxes throughout the text to make it easy for students to focus on this material when studying or preparing for quizzes and tests.

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Multiplication Symbols

If a and b represent any two mathematical quantities, then each of the following may be used to indicate the product of a and b ("a times b").

$$ab \quad a \cdot b \quad a(b) \quad (a)b \quad (a)(b)$$

Examples

3 times 4 may be written:	3 times x may be written:	x times y may be written:
	$3x$	xy
$3(4)$	$3(x)$	$x(y)$
$(3)4$	$(3)x$	$(x)y$
$(3)(4)$	$(3)(x)$	$(x)(y)$

Now we will introduce the term *factors*, which we shall be using throughout the text. Below we define factors.

DEFINITION

The numbers or variables that are multiplied in a multiplication problem are called **factors**.

If $a \cdot b = c$, then a and b are *factors* of c.

For example, in $3 \cdot 5 = 15$, the numbers 3 and 5 are factors of the product 15. In $2 \cdot 15 = 30$, the numbers 2 and 15 are factors of the product 30. Note that 30 has many other factors. Since $5 \cdot 6 = 30$, the numbers 5 and 6 are also factors of 30. Since $3x$ means 3 times x, both the 3 and the x are factors of $3x$.

HELPFUL HINT

From Examples 2 and 3, we can see that when a factor is moved from the denominator to the numerator or from the numerator to the denominator, the sign of the *exponent* changes.

$$x^{-4} = \frac{1}{x^4} \qquad \frac{1}{x^{-4}} = x^4$$

$$3^{-5} = \frac{1}{3^5} \qquad \frac{1}{3^{-5}} = 3^5$$

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Helpful Hints

Helpful Hints offer useful suggestions for problem solving and various other topics.

HELPFUL HINT

STUDY TIP

Here are some suggestions if you find you are having some difficulty with application problems.

1. Instructor—Make an appointment to see your instructor. Make sure you have read the material in the book and attempted all the homework problems. Go with specific questions for your instructor.
2. Videotapes—Find out if the videotapes that accompany this book are available at your college. If so, view the videotapes that go with this chapter. Using the pause control, you can watch the videotapes at your own pace.
3. Student's Study Guide—If a copy of the Student's Study Guide is available, you may wish to read the material related to this chapter.

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Helpful Hints— Study Tips

Helpful Hints—Study Tips reinforce and expand upon the Study Skills for success in Mathematics covered in Section 1.1

AVOIDING COMMON ERRORS

An expression raised to the zero power is not equal to 0; it is equal to 1.

CORRECT	INCORRECT
$x^0 = 1$	$x^0 = 0$
$5^0 = 1$	$5^0 = 0$

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Avoiding Common Errors

Avoiding Common Errors boxes illustrate common mistakes, explain why certain procedures are wrong, and show the correct methods for working the problem.

Focus on Problem Solving

The sixth editions of the Angel series continue to place a strong focus on problem solving. Angel's exemplary approach to Problem Solving helps students learn to solve problems with confidence. In the process, the Angel texts help students understand *why* they are working on a certain operation while teaching them *how* to perform it. Problem solving is introduced early and incorporated as a theme throughout the texts.

Five-Step Problem-Solving Procedure

The in-text examples demonstrate how to solve each exercise based on Polya's five-step problem-solving procedure: **Understand, Translate, Carry Out, Check,** and **State Answer.**

Guidelines for Problem Solving

1. **Understand the problem.**
   - Read the problem *carefully* at least twice. In the first reading, get a general overview of the problem. In the second reading, determine **(a)** exactly what you are being asked to find and **(b)** what information the problem provides.
   - Make a list of the given facts. Determine which are pertinent to solving the problem.
   - Determine whether you can substitute smaller or simpler numbers to make the problem more understandable.
   - If it will help you organize the information, list the information in a table.
   - If possible, make a sketch to illustrate the problem. Label the information given.

2. **Translate the problem to mathematical language.**
   - This will generally involve expressing the problem in terms of an algebraic expression or equation. (We will explain how to express application problems as equations in Chapter 3.)
   - Determine whether there is a formula that can be used to solve the problem.

3. **Carry out the mathematical calculations necessary to solve the problem.**

4. **Check the answer obtained in step 3.**
   - Ask yourself, "Does the answer make sense?" "Is the answer reasonable?" If the answer is not reasonable, recheck your method for solving the problem and your calculations.
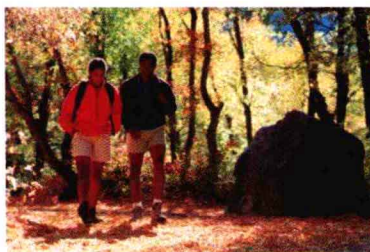   - Check the solution in the original problem if possible.

5. **Make sure you have answered the question.**
   - State the answer clearly.

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Problem Solving

17. ***Commissions*** Barbara Riedell earns a 5% commission on appliances she sells. Her sales last week totaled $9400. Find her week's earnings.

18. ***Empire State Building*** May 1, 1931, was the opening day of the Empire State Building. It stands 1454 feet or 443 meters high. Use this information to determine the approximate number of feet in a meter.

19. ***Sales Tax*** **a)** The sales tax in Jefferson County is 7%. What was the sales tax that Jack Mayleben paid on a used car that cost $16,700 before tax?
    b) What is the total cost of the car including tax?

20. ***Checking Account*** The balance in Lois Heater's checking account is $312.60. She purchased five compact disks at $17.11 each including tax. If she pays by check, what is the new balance in her checking account?

21. ***Buying a Computer*** Scott Borden wants to purchase a computer that sells for $950. He can either pay the total amount at the time of purchase or agree to pay the store $200 down and $33 a month for 24 months.
    a) If he pays the down payment and monthly charge, how much will he pay for the computer?
    b) How much money can he save by paying the total amount at the time of purchase?

24. ***Energy Values*** The following table gives the approximate energy values of some foods and the approximate energy consumption of some activities, in kilojoules (kJ).
    Determine how long it would take for you to use up the energy from the following.
    a) a hamburger by running
    b) a chocolate milkshake by walking
   **c)** a glass of skim milk by cycling

Problem-Solving Exercises

Problem Solving exercises are designed to help students become better thinkers.

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Each chapter begins with an illustrated, real-world application to motivate students and encourage them to see algebra as an important part of their daily lives. Problems that are based on real data from a broad range of subjects appear throughout the text, in the end-of-chapter material, and in the exercise sets.

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28. *Electricity Cost* Using the graph shown, determine the approximate difference in the cost of electricity for a family that used 1500 kilowatt hours of electricity in December, 1999, versus December, 2000, if they received their electricity from Pacific Gas & Electric Company.

Cost of Electricity in California

Source: Pacific Gas & Electric Co.
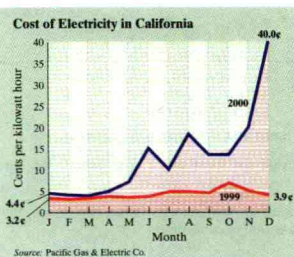
leap) year?

b) If water costs $5.20 per 1000 gallons, how much additional money per year is being spent on the water bill?

32. *Tire Pressure* When Sandra Hakanson's car tire pressure is 28 pounds per square inch (psi), her car averages 17.3 miles per gallon (mpg) of gasoline. If her tire pressure is increased to 32 psi, it averages 18.0 mpg.

a) How much farther will she travel on a gallon of gas if her tires are inflated to the higher pressure?

b) If she drives an average of 12,000 miles per year, how many gallons of gasoline will she save in a year by increasing her tire pressure from 28 to 32 psi?

c) If gasoline costs $1.40 per gallon, how much money will she save in a year

33. *Taxi Ride* A taxicab charges $2 upon a customer's entering the taxi, then 30 cents for each $\frac{1}{4}$ mile traveled and 20 cents for each 30 seconds stopped in traffic. David Lopez takes a taxi ride for a distance of 3 miles where the taxi spends 90 seconds stopped in traffic. De-

Real-World Applications

An abundance of wonderfully updated, **real-world applications** give students needed practice with practical applications of algebra. **Real data** is used and real-world situations emphasize the relevance of the material being covered to students' everyday lives.
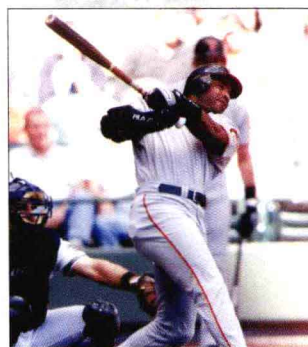
Chapter-Opening Applications

New chapter-opening applications emphasize the role of mathematics in everyday life, and in the workplace, giving students an applied, real-world introduction to the chapter material.

Chapter 2

Solving Linear Equations and Inequalities

2.1 Combining Like Terms

2.2 The Addition Property of Equality

2.3 The Multiplication Property of Equality

2.4 Solving Linear Equations with a Variable on Only One Side of the Equation

2.5 Solving Linear Equations with the Variable on Both Sides of the Equation

2.6 Ratios and Proportions

2.7 Inequalities in One Variable

Chapter Summary
Chapter Review Exercises
Chapter Practice Test
Cumulative Review Test

When trying to predict whether an athlete will set a new record, journalists and coaches often compare the athlete's current pace and performance with the pace set by the record holder at different times during a record-breaking season. On page 156, we use proportions to determine how many home runs during the first 50 games of a baseball season a player would need to hit to be on schedule to break Barry Bond's record of 73 home runs from the 2001 baseball season.

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Mathematics in Action

The Air You Breathe
The Environmental Protection Agency (EPA) has identified indoor air quality as the number one environmental health concern of today. It is largely poor outdoor air quality that creates substandard indoor air quality, particularly in urban areas. Contaminants such as dust, pollen, and automobile pollutants often make their way directly into buildings. With more and more chemicals being used, people are increasingly suffering from chemical sensitivities to formaldehyde, pesticides, ozone, cleaning solvents, fiberglass, asbestos, lead, and radon. Allergies to molds are now more widespread than ever. No building or workplace is immune.

For workplaces involved with pharmaceuticals and biotechnology, the issue of contaminant-free air becomes even more crucial. One type of filter used in these setting is the HEPA (High Efficiency Particulate Air), which was originally developed to remove radioactive contaminants from the air in the development of the first atomic bomb.

The science of filtration involves the trapping of objects ranging from coal dust to viruses. The size of the particles being filtered is typically expressed in microns, where 1 micron (which is short for 1 micrometer) = 1 millionth of a meter = 10^{-6} meters = 0.000001 meters. The measurement refers to the diameter of the particle.

Mathematics In Action

Mathematics In Action emphasizes the need for and the importance of mathematics in real-life.

Focus on Exercises

Exercise sets throughout the text have been greatly enhanced. Each exercise set progresses in difficulty to help students gain confidence and succeed with more difficult exercises. The end of each exercise set also includes a set of Challenge Problems.

Concept/Writing Exercises

Concept/Writing exercises encourage students to analyze and write about the concepts they are learning.

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Exercise Set 3.1

Concept/Writing Exercises

1. What is a formula?
2. What does it mean to *evaluate a formula*?
3. Write the simple interest formula, then indicate what each letter in the formula represents.
4. What is a quadrilateral?
5. What is the relationship between the radius and the diameter of a circle?
6. Is π equal to 3.14? Explain your answer.
7. By using any formula for area, explain why area is measured in square units.
8. By using any formula for volume, explain why volume is measured in cubic units.

Practice the Skills Exercises

Practice the Skills exercises cover all types of exercises presented in the chapter.

Practice the Skills

Simplify each fraction. If a fraction is already simplified, so state.

21. $\frac{3}{12}$
22. $\frac{40}{10}$
23. $\frac{10}{15}$
24. $\frac{19}{25}$
25. $\frac{17}{17}$
26. $\frac{9}{21}$
27. $\frac{36}{76}$
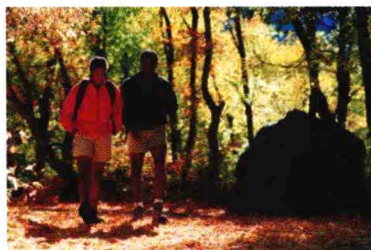28. $\frac{16}{72}$
29. $\frac{40}{264}$
30. $\frac{60}{105}$
31. $\frac{12}{25}$
32. $\frac{80}{124}$

Problem Solving

17. **Commissions** Barbara Riedell earns a 5% commission on appliances she sells. Her sales last week totaled $9400. Find her week's earnings.

18. **Empire State Building** May 1, 1931, was the opening day of the Empire State Building. It stands 1454 feet or 443 meters high. Use this information to determine the approximate number of feet in a meter.

19. **Sales Tax** a) The sales tax in Jefferson County is 7%. What was the sales tax that Jack Mayleben paid on a used car that cost $16,700 before tax?
    b) What is the total cost of the car including tax?

20. **Checking Account** The balance in Lois Heater's checking account is $312.60. She purchased five compact disks at $17.11 each including tax. If she pays by check, what is the new balance in her checking account?

21. **Buying a Computer** Scott Borden wants to purchase a computer that sells for $950. He can either pay the total amount at the time of purchase or agree to pay the store $200 down and $33 a month for 24 months.
    a) If he pays the down payment and monthly charge, how much will he pay for the computer?
    b) How much money can he save by paying the total amount at the time of purchase?

24. **Energy Values** The following table gives the approximate energy values of some foods and the approximate energy consumption of some activities, in kilojoules (kJ).
    Determine how long it would take for you to use up the energy from the following.
    a) a hamburger by running
    b) a chocolate milkshake by walking
    c) a glass of skim milk by cycling

Problem-Solving Exercises

Problem-Solving exercises are designed to help students become better thinkers.

Challenge Problems

Challenge Problems stimulate student interest with exercises that are conceptually and computationally more demanding.

Group Activity

Group Activities provide students with opportunities for collaborative learning.

Cumulative Review Exercises

Cumulative Review Exercises reinforce previously covered topics. These exercises are keyed to sections where the material is explained.

Challenge Problems

111. *Cereal Box* A cereal box is to be made by folding the cardboard along the dashed lines as shown in the figure on the right.
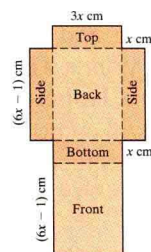
a) Using the formula

$$\text{volume} = \text{length} \cdot \text{width} \cdot \text{height}$$

write an equation for the volume of the box.

b) Find the volume of the box when $x = 7$ cm.

c) Write an equation for the surface area of the box.

d) Find the surface area when $x = 7$ cm.

Figure labels: $3x$ cm, Top, x cm, $(6x - 1)$ cm, Side, Back, Side, Bottom, x cm, $(6x - 1)$ cm, Front

Group Activity

112. *Square Face on Cube* Consider the following photo. The front of the figure is a square with a smaller black square painted on the center of the larger square. Suppose the length of one side of the larger square is A, and length of one side of the smaller (the black square) is B. Also the thickness of the block is C.

a) Group member one: Determine an expression for the surface area of the black square.

b) Group member two: Determine an expression for the surface area of the larger square (which includes the smaller square).

c) Group member three: Determine the surface area of the larger square minus the black square (the purple area shown).

d) As a group, write an expression for the volume of the entire solid block.

e) As a group, determine the volume of the entire solid block if its length is 1.5 feet and its width is 0.8 feet.

Cumulative Review Exercises

[1.9] **113.** Evaluate. $[4(12 \div 2^2 - 3)^2]^2$.

[2.6] **114.** *Horses* A stable has four Morgan and six Arabian horses. Find the ratio of Arabians to Morgans.

115. *Emptying Pool* It takes 3 minutes to siphon 25 gallons of water out of a swimming pool. How long will it take to empty a 13,500-gallon swimming pool by siphoning? Write a proportion that can be used to solve the problem, and then find the desired value.

[2.7] **116.** Solve $2(x - 4) \geq 3x + 9$.