Elementary and Intermediate Algebra

SECOND EDITION

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Elementary and Intermediate Algebra

Second Edition

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Preface

For the Instructor

An increasing number of schools are offering the traditional elementary algebra and intermediate algebra courses in combination. There are several advantages in doing this:

- Much of the redundancy encountered by teaching the elementary/intermediate sequence as two separate courses is eliminated. As a result, the students have more time to master the material.
- A combined approach promotes a smooth transition from the elementary algebra topics to the intermediate algebra topics.
- For many students, the purchase of a single textbook saves money.

However, there are several concerns inherent in offering a combination course:

- The textbook used in such a course must include enough elementary algebra to ensure that students who complete the first half of the book, and then transfer, will have the prerequisite skills to enroll in an intermediate algebra course at another college.
- The elementary algebra material should not get too difficult too fast.
- Students entering the second half of the combination course must get some review of the basic topics so that they can compete with students continuing from the first half of the course.

Elementary and Intermediate Algebra has been written to address these concerns. The first seven chapters of this book provide a complete course in elementary algebra. The standard beginning algebra topics are introduced at a reasonable pace that allows the student to develop a strong conceptual foundation on which the second half of the course can build. Chapter 8 serves as the transitional chapter. It quickly reviews the topics taught in the first part of the course and extends those topics to the intermediate algebra level. Chapters 9–14 provide a complete course in intermediate algebra.

The purpose of this textbook is to teach students how to read, write, speak, and think mathematically using the language of algebra. We have used a blend of the traditional and the reform instructional approaches to do this. In this book, you will find the vocabulary, practice, and well-defined pedagogy of a traditional approach. You will also find that we emphasize the reasoning, modeling, communicating, and technological skills that are such a big part of today's reform movement.

This textbook expands the students' mathematical reasoning abilities and gives them a set of mathematical survival skills that will help them succeed in a world that increasingly requires that every person become a better analytical thinker.

Features of the Text

Chapter 1 An Innovative Introduction to Algebra

The best way to learn a new language is to be immediately immersed in it. Therefore, Chapter 1 begins with an introduction of the fundamental algebraic concepts of variable, equation, function, and graphing. We show the students how to translate English phrases to mathematical symbols, and we introduce a problem-solving strategy that is used throughout the book. From the start, students see how algebra is a powerful tool that they can use to solve problems.

Interactivity

Most worked examples in the text are accompanied by Self Checks. This feature allows students to practice skills discussed in the example by working a similar problem. Because the Self Check problems follow the worked examples, students can easily refer to the solution and author's notes of the example as they solve the Self Check. Author's notes are used to explain the steps in the solutions of examples. The notes are extensive so as to increase the student's ability to read and write mathematics.

Example titles highlight the concept being discussed. ▶

Author's notes explain the steps in the solution process. ▶

Most examples have Self Checks. The answers are provided. ▶

EXAMPLE 12 **Combining like terms.** Simplify $7P - 8p - 12P + 25p$.

Solution The uppercase P and the lowercase p are different variables. To combine like terms, one approach is to write each subtraction as an addition of the opposite and proceed as follows.

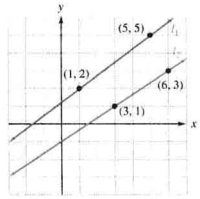
$$\begin{aligned} & 7P - 8p - 12P + 25p \\ &= 7P + (-8p) + (-12P) + 25p && \text{Rewrite each subtraction as the addition of the opposite.} \\ &= 7P + (-12P) + (-8p) + 25p && \text{Use the commutative property of addition to write the like terms together.} \\ &= -5P + 17p && \text{Combine like terms: } 7P + (-12P) = -5P \text{ and } -8p + 25p = 17p. \end{aligned}$$

SELF CHECK Simplify $8R + 7r - 14R - 21r$. *Answer:* $-6R - 14r$ ■

Color is used to facilitate students' understanding. ▶

EXAMPLE 2 **Using the slope formula.** Find the slope of line l_1 shown in Figure 3-35.

FIGURE 3-35



Solution To find the slope of l_1, we will use two points on the line whose coordinates are given: (1, 2) and (5, 5). If (x_1, y_1) is (1, 2) and (x_2, y_2) is (5, 5), then

$$x_1 = 1 \quad \text{and} \quad x_2 = 5$$
$$y_1 = 2 \quad\quad\quad y_2 = 5$$

To find the slope of line l_1, we substitute these values into the formula for slope and simplify.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} && \text{The slope formula.} \\ &= \frac{5 - 2}{5 - 1} && \text{Substitute 5 for } y_2\text{, 2 for } y_1\text{, 5 for } x_2\text{, and 1 for } x_1\text{.} \\ &= \frac{3}{4} && \text{Do the subtractions.} \end{aligned}$$

The slope of l_1 is $\frac{3}{4}$. We would have obtained the same result if we had let $(x_1, y_1) = (5, 5)$ and $(x_2, y_2) = (1, 2)$.

SELF CHECK Find the slope of line l_2 shown in Figure 3-35. *Answer:* $\frac{2}{3}$ ■

WARNING! When finding the slope of a line, always subtract the y-values and the x-values in the same order. Otherwise your answer will have the wrong sign:

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{or} \quad m = \frac{y_1 - y_2}{x_1 - x_2}$$

However,

$$m \neq \frac{y_2 - y_1}{x_1 - x_2} \quad \text{and} \quad m \neq \frac{y_1 - y_2}{x_2 - x_1}$$

In-Depth Coverage of Geometry

Perimeter, area, and volume, as well as many other geometric concepts, are used in a variety of contexts throughout the book. We have included many drawings to help students improve their ability to spot visual patterns in their everyday lives.

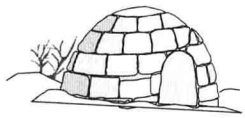
◀ Geometric topics are presented in a practical setting.

56. NATIVE AMERICAN DWELLING The teepees constructed by the Blackfoot Indians were cone-shaped tents made of long poles and animal hide, about 10 feet high and about 15 feet across at the ground. (See Illustration 13.) Estimate the volume of a teepee with these dimensions, to the nearest cubic foot.

ILLUSTRATION 13

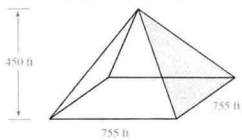
57. IGLOO During long journeys, some Canadian Inuit (Eskimos) built winter houses of snow blocks piled in the dome shape shown in Illustration 14. Estimate the volume of an igloo to the nearest cubic foot having an interior height of 5.5 feet.

ILLUSTRATION 14



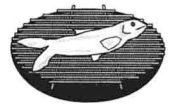
58. PYRAMID The Great Pyramid at Giza in northern Egypt is one of the most famous works of architecture in the world. Use the information in Illustration 15 to find the volume to the nearest cubic foot.

ILLUSTRATION 15

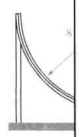


59. BARBECUING See Illustration 16. Use the fact that the fish is 18 inches long to find the area of the bar-

ILLUSTRATION 16



60. SKATEBOARDING A "half-pipe" ramp used for skateboarding [illegible] in the shape of a semicircle with a radius of 8 fee[illegible] nearest tenth o[illegible] that the skateb[illegible]



61. OHM'S LAW [illegible] tronics. Solve [illegible] peres) when th[illegible] tance R is 12 [illegible]

62. GROWTH OF [illegible] $\$P$ grows to $\$[illegible] $A = P(1 + rt)$. [illegible] years, a woma[illegible] that pays 6%.

63. POWER LOSS [illegible] current I passe[illegible] $P = I^2R$. Solve [illegible] amperes, find [illegible]

64. FORCE OF G[illegible] jects in Illustra[illegible] gravitation, F, [illegible]

where G is a c[illegible] them. Solve fo[illegible]

65. THERMODY[illegible] tion is given b[illegible] mula for the p[illegible]

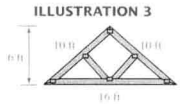
43. $C = \dfrac{5F - 160}{9}$; for F **44.** $F = \dfrac{GMm}{d^2}$; for d^2

APPLICATIONS

In Exercises 45–66, a calculator will be helpful with some problems.

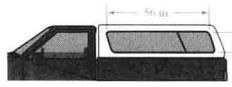
45. CARPENTRY Find the perimeter and area of the truss shown in Illustration 3.

ILLUSTRATION 3



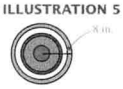
46. CAMPERS Find the area of the window of the camper shell shown in Illustration 4.

ILLUSTRATION 4



47. ARCHERY To the nearest tenth, find the circumference and area of the target shown in Illustration 5.

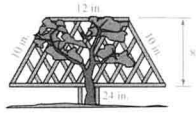
ILLUSTRATION 5



48. GEOGRAPHY The circumference of the earth is about 25,000 miles. Find its diameter to the nearest mile.

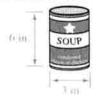
49. LANDSCAPING Find the perimeter and the area of the redwood trellis in Illustration 6.

ILLUSTRATION 6



50. VOLUME To the nearest hundredth, find the volume of the soup can shown in Illustration 7.

ILLUSTRATION 7



51. "THE WALL" The Vietnam Veterans Memorial is a black granite wall recognizing the more than 58,000 Americans who lost their lives or remain missing. A diagram of the wall is shown in Illustration 8. Find the total area of the two triangular-shaped surfaces on which the names are inscribed.

ILLUSTRATION 8

52. SIGNAGE Find the perimeter and area of the service station sign shown in Illustration 9.

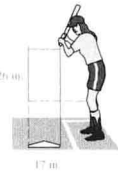
ILLUSTRATION 9

53. RUBBER MEETS THE ROAD A sport truck tire has the road surface "footprint" shown in Illustration 10. Estimate the perimeter and area of the tire's footprint. (*Hint:* First change the dimensions to decimals.)

ILLUSTRATION 10

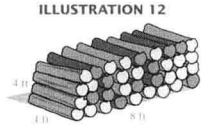
54. SOFTBALL The strike zone in fastpitch softball is between the batter's armpit and top of her knees, as shown in Illustration 11. Find the area of the strike zone.

ILLUSTRATION 11



55. FIREWOOD The dimensions of a cord of firewood are shown in Illustration 12. Find the area on which the wood is stacked and the volume the cord of firewood occupies.

ILLUSTRATION 12



Geometric topics appear throughout the text and are presented in a way that reinforces important algebra skills. ▶

Coordinate Graphing Appears Early

The foundation for coordinate graphing is laid in Chapters 1 and 2, where the students graph many different types of real numbers on the number line. In Chapter 3, students learn how to graph lines. They quickly learn that the graph of an equation in two variables is not always a straight line.

Problem-Solving Strategy

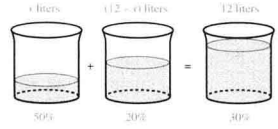
One of the major objectives of this textbook is to make students better problem solvers. To this end, we use a five-step problem-solving strategy throughout the book. The five steps are: *Analyze the problem, Form an equation, Solve the equation, State the conclusion,* and *Check the result.*

EXAMPLE 6 **Mixing a solution.** A chemistry experiment calls for a 30% sulfuric acid solution. If the lab supply room has only 50% and 20% sulfuric acid solutions on hand, how much of each should be mixed to obtain 12 liters of a 30% acid solution?

ANALYZE THE PROBLEM We must find how much of the 50% solution and how much of the 20% solution is needed to obtain 12 liters of a 30% acid solution.

FORM AN EQUATION If x represents the numbers of liters (L) of the 50% solution used in the mixture, the remaining $(12 - x)$ liters must be the 20% solution. See Figure 2-20(a). Only 50% of the x liters, and only 20% of the $(12 - x)$ liters, is pure sulfuric acid. The total of these amounts is also the amount of acid in the final mixture, which is 30% of 12 liters. This information is shown in the chart in Figure 2-20(b).

FIGURE 2-20



(a)

Solution	% acid ·	Liters =	Amount of acid
50% solution	0.50	x	$0.50x$
20% solution	0.20	$12 - x$	$0.20(12 - x)$
30% mixture	0.30	12	0.30(12)

(b)

We can form the equation.

The acid in the 50% solution	plus	the acid in the 20% solution	equals	the acid in the final mixture.
50% of x +		20% of $(12 - x)$	=	30% of 12

SOLVE THE EQUATION We then solve the equation.

$0.50x + 0.20(12 - x) = 0.30(12)$ 50% = 0.50, 20% = 0.20, and 30% = 0.30.
$5x + 2(12 - x) = 3(12)$ Multiply both sides by 10 to clear the equation of decimals.
$5x + 24 - 2x = 36$ Remove parentheses.
$3x + 24 = 36$ Combine like terms.
$3x = 12$ Subtract 24 from both sides.
$x = 4$ Divide both sides by 3.

STATE THE CONCLUSION The mixture will contain 4 liters of 50% solution and $12 - 4 = 8$ liters of 20% solution.

CHECK THE RESULT Verify that this solution checks. ■

In the next example, a *dry mixture* of a specified value is created from two differently priced components.

Applications and Connections to Other Disciplines

A distinguishing feature of this book is its wealth of application problems. We have included numerous applications from disciplines such as science, economics, business, manufacturing, history, and entertainment, as well as mathematics.

Every application problem has a title ▶

92 Chapter 2 / Real Numbers, Equations, and Inequalities

82. CREDIT CARD STATEMENT
a. What amounts in the monthly credit card statement shown in Illustration 4 could be represented by negative numbers?
b. What is the new balance?

ILLUSTRATION 4

Previous Balance	New Purchases, Fees, Advances & Debts	Payments & Credits	New Balance
3,660.66	1,408.78	3,826.58	

04/21/99 Billing Date	05/16/99 Date Payment Due	9,100 Credit Line

Periodic rates may vary.
See reverse for explanation and important information.
Please allow sufficient time for mail to reach us.

83. THE OLYMPICS The ancient Greek Olympian Games, which eventually evolved into the modern Olympic Games, were first held in 776 B.C. How many years after this did the 1996 Olympic Games in Atlanta, Georgia, take place?

89. VOTER INFORMATION What will be the effect on state government if the ballot initiative shown in Illustration 6 passes?

ILLUSTRATION 6

212 Campaign Spending Limits YES ☐ NO ☐

Limits contributions to $200 in state campaigns. Fiscal impact: Costs of $4.5 million for implementation and enforcement. Increases state revenue by $6.7 million by eliminating tax deductions for lobbying.

90. MOVIE LOSSES In 1993, the cost to Columbia Studios to produce, promote, and distribute the movie *Last Action Hero,* starring Arnold Schwarzenegger, was approximately $124 million. It is estimated that the movie earned only $44 million worldwide. What dollar loss did the studio suffer on this film?

In Exercises 91–94, use a calculator to help solve

Study Sets—More Than Just Exercises

The problems at the end of each section are called Study Sets. Each Study Set includes Vocabulary, Notation, and Writing problems designed to help students improve their ability to read, write, and communicate mathematical ideas. The problems in the Concepts section of the Study Sets encourage students to engage in independent thinking and reinforce major ideas through exploration. In the Practice section of the Study Sets, students get the drill necessary to master the material. In the Applications section, students deal with real-life situations that involve the topics being studied. Each Study Set concludes with a Review section consisting of problems selected from previous sections.

◀ Each Study Set contains Vocabulary, Concepts, Notation, Practice, Applications, Writing, and Review sections.

STUDY SET

Section 2.1

VOCABULARY

In Exercises 1–6, fill in the blanks to make the statements true.

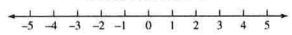
1. Real numbers that are greater than zero are called _____ real numbers.
2. Real numbers that are less than zero are called _____ real numbers.
3. The only real number that is neither positive nor negative is _____.
4. The answer to a _____ problem is called a difference.
5. The _____ property of addition states that two numbers can be added in either order to get the same result.
6. The property that allows us to group numbers in addition any way we want is called the _____ property of addition.

CONCEPTS

In Exercises 7–10, use the number line in Illustration 1 to find each sum.

7. $2 + 3$
8. $-3 + (-2)$
9. $4 + (-3)$
10. $-5 + 3$

ILLUSTRATION 1



In Exercises 11–14, fill in the blanks to make the statements true.

11. To add two real numbers with the _____ sign, add their _____ values and attach their common sign to the sum.
12. To add two real numbers with different signs, _____ their absolute values, the _____ from the _____, and attach the sign of the number with the _____ absolute value.
13. To subtract b from a, add the _____ of b to a.
14. The opposite of 7 is . The opposite of -15 is .

15. Find each sum.
    a. $5 + (-5)$
    b. $-2.2 + 2.2$
    c. $-\frac{3}{4} + \frac{3}{4}$
    d. $19 + (-19)$

16. a. Use the variables m and n to state the commutative property of addition.
    b. Use the variables r, s, and t to state the associative property of addition.

NOTATION

In Exercises 17–20, complete each solution.

17. Find $(-13 + 6) + 4$.
    $(-13 + 6) + 4 =$ $+ (6 + 4)$

ILLUSTRATION 3

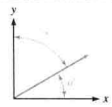


ILLUSTRATION 4

NOTATION

In Exercises 15–16, complete each solution.

15. $-7(a^2 + a - 5) = \quad \cdot a^2 + (\quad) \cdot a - (\quad) \cdot 5$
$= -7a^2 + (-7a) - (\quad)$
$= -7a^2 - \quad - (-35)$
$= -7a^2 - 7a + 35$

16. $6(b - 5) + 12b + 7 = 6 \cdot \quad - 6 \cdot \quad + 12b + 7$
$= 6b - \quad + 12b + 7$
$= 6b - \quad + 12b + 7$
$= 6b + \quad b - \quad + 7$
$= 18b - 23$

17. a. Are $2K$ and $3k$ like terms?
    b. Are $-d$ and d like terms?

18. Fill in the blank to make the statement true.
$-(x + 10$

PRACTICE

In Exercises 19–2

19. $9(7m)$
21. $5(-7q)$
23. $(-5p)(-4b)$
25. $-5(4r)(-2r)$

In Exercises 27–4 remove parenthese

27. $5(x + 3)$
29. $-2(b - 1)$
31. $(3t - 2)8$
33. $(2y - 1)6$
35. $0.4(x - 4)$
37. $-\frac{2}{3}(3w - 6)$
39. $r(r - 10)$
41. $-(x - 7)$
43. $17(2x - y + 2$
45. $-(-14 + 3p$

In Exercises 47–54, list the terms in each expression. Then identify the coefficient of each term.

47. $-5r + 4s$
48. $2m + n - 3m + 2n$
49. $-15r^2s$
50. $4b^2 - 5b + 6$
51. $50a + 2$
52. $a^2 - ab + b^2$
53. $x^3 - 125$
54. $-2.55x + 1.8$

In Exercises 55–58, identify the coefficient of each term.

55. $-b$
56. $-9.9x^3$
57. $\frac{1}{4}x$
58. $-\frac{2x}{3}$

In Exercises 59–62, tell whether the variable x is used as a factor or a term.

59. $24 - x$
60. $24x$
61. $24 + 3x$
62. $x - 12$

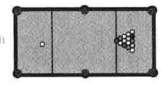
APPLICATIONS

91. THE AMERICAN RED CROSS In 1891, Clara Barton founded the Red Cross. Its symbol is a white flag bearing a red cross. If each side of the cross in Illustration 5 has length x, write an algebraic expression for the perimeter (the total distance around the outside) of the cross.

ILLUSTRATION 5

92. BILLIARDS Billiard tables vary in size, but all tables are twice as long as they are wide.
    a. If the billiard table in Illustration 6 is x feet wide, write an expression involving x that represents its length.
    b. Write an expression for the perimeter of the table.

ILLUSTRATION 6



93. PING-PONG Write an expression for the perimeter of the ping-pong table shown in Illustration 7.

94. SEWING See Illustration 8. Write an expression for the length of the yellow trim needed to outline the pennant with the given side lengths.

ILLUSTRATION 8

WRITING

95. Explain why $3x^2y$ and $5x^2y$ are like terms.
96. Explain why $3x^2y$ and $5xy^2$ are not like terms.
97. Distinguish between a *factor* and a *term* of an algebraic expression. Give examples.
98. Tell how to combine like terms.

REVIEW

In Exercises 99–102, evaluate each expression given that $x = -3$, $y = -5$, and $z = 0$.

99. $x^2z(y^3 - z)$
100. $z - y^3$
101. $\frac{x - y^2}{2y - 1 + x}$
102. $\frac{2y + 1}{x} - x$

Group Work

A one-page feature called Accent on Teamwork appears near the end of each chapter. It gives the instructor a set of problems that can be assigned as group work or to individual students as outside-of-class projects.

Key Concepts

Fourteen key algebraic concepts are highlighted in one-page Key Concept features, appearing near the end of each chapter. Each Key Concept page summarizes a concept and gives students an opportunity to review the role it plays in the overall picture.

GROUP ACTIVITIES FOR CHAPTER 3

Accent on Teamwork

Section 3.1

Daily high temperature For a 2-week period, plot the daily high temperature for your city on a rectangular coordinate system. You can normally find this information in a local newspaper. Label the x-axis "observation day" and the y-axis "daily high temperature in degrees Fahrenheit." For example, the ordered pair (3, 72) indicates that on day 3 of the observation period, the high temperature was 72°F. At the end of the 2-week period, see whether any temperature trend is apparent from the graph.

ILLUSTRATION 1

Object	Slope
Ladder, Rise 54 in., Run 12 in.	$\frac{54}{12} = 4.5$

Section 3.2

Translations On a piece of graph paper, sketch the graph of $y = |x|$ with a black marker. Using a different color, sketch the graphs of $y = |x| + 2$ and $y = |x| - 2$ on the same coordinate system. On another piece of graph paper, do the same for $y = |x|$ and $y = |x + 2|$ and $y = |x - 2|$. Make some observations about how the graph of $y = |x|$ is "moved" or "translated" by the addition or subtraction of 2. Use what you have learned to discuss the graphs of $y = x^2$, $y = x^2 + 2$, $y = x^2 - 2$, $y = (x + 2)^2$, and $y = (x - 2)^2$.

could be posted next to the scale in the produce area so that shoppers could determine from the graph the cost of a banana purchase up to 8 pounds in weight. Label the x-axis in quarters of a pound and label the y-axis in cents.

KEY CONCEPT

Describing Linear Relationships

In Chapter 3, we discussed four ways to mathematically describe linear relationships between two quantities.

Equations in Two Variables

The general form of the equation of a line is $Ax + By = C$. Two very useful forms of the equation of a line are the slope–intercept form and the point–slope form.

1. Write the equation of a line with a slope of -3 and a y-intercept of $(0, -4)$.
2. Write the equation of the line that passes through $(5, 2)$ and $(-5, 0)$. Answer in slope–intercept form.

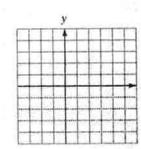
Rectangular Coordinate Graphs

The graph of an equation is a "picture" of all of its solutions (x, y). Important information can be obtained from a graph.

3. Complete the table of solutions for $2x - 4y = 8$. Then graph the equation.

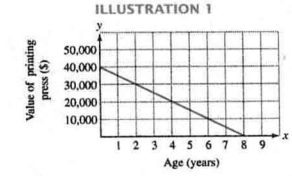
$2x - 4y = 8$

x	y
0	
	0
-2	



4. See Illustration 1.
   a. What information does the y-intercept of the graph give us?
   b. What is the slope of the line and what does it tell us?

ILLUSTRATION 1

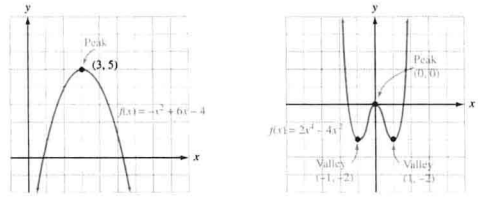


Functions and Modeling

The concept of function is introduced in Chapter 3 and is stressed throughout the text. Students learn to use function notation, graph functions, and write functions that mathematically model many interesting real-life situations. By the end of the course, students will recognize families of functions, their graphs, and areas of application.

Real data is integrated ▶ throughout the text.

FIGURE 4-6

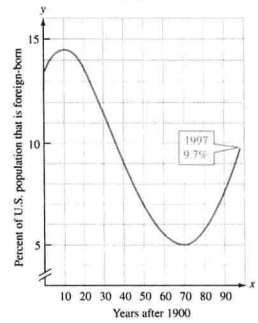


EXAMPLE 8

Immigration. The polynomial function graphed in Figure 4-7 approximates the percent of the U.S. population that was foreign born for each of the years 1900–1997. What are the coordinates of the highest point on the graph? Explain its significance.

Solution The highest point on the graph has coordinates (10, 14.5). This means that in 1910, 14.5% of the population of the United States was foreign born. This percent is the largest for the 97-year span shown on the graph.

FIGURE 4-7



Based on data from Bureau of the Census, U.S. Department of Commerce

SELF CHECK What are the coordinates of the lowest point on the graph in Figure 4-7? Explain its significance.

Answer: (70, 5). In 1970, 5% of the population was foreign born. This percent is the smallest for the 97 years shown. ■

STUDY SET

Section 4.4

VOCABULARY

In Exercises 1–10, fill in the blanks to make the statements true.

1. A _____ is an algebraic expression that is the sum of one or more terms containing whole-number exponents.
2. The numerical _____ of the term $-25x^2y^3$ is -25.
3. The degree of a polynomial is the same as the degree of its _____ with the largest degree.
4. A _____ is a polynomial with one term. A _____ is a polynomial with two terms.

Systematic Review

Each Study Set ends with a Review section that contains problems similar to those in previous sections. Each chapter ends with a Chapter Review and a Chapter Test. The chapter reviews have been designed to be "user friendly." In a unique format, the reviews list the important concepts of each section of the chapter in one column, with appropriate review problems running parallel in a second column. In addition, Cumulative Review Exercises appear after Chapters 2, 4, 6, 8, 10, 12, and 14.

CHAPTER REVIEW

Section 1.1 Describing Numerical Relationships

CONCEPTS

Tables, bar graphs, and *line graphs* are used to describe numerical relationships.

REVIEW EXERCISES

1. Illustration 1 lists the worldwide production of wide-screen TVs. Use the data to construct a bar graph. Describe the trend in the production in words.

ILLUSTRATION 1

Year	Production (millions of units)
'95	3
'96	5
'97	7
'98	11

Source: Electronic Industries Association of Japan

2. Consider the line graph in Illustra-

CHAPTER 2 Test

1. Add $(-6) + 8 + (-4)$.

2. Subtract $1.4 - (-0.8)$.

3. Multiply $(-2)(-3)(-5)$.

4. Divide $\frac{-22}{-11}$.

5. Evaluate $-7[(-5)^2 - 2(3 - 5^2)]$.

6. Evaluate $\frac{3(20 - 4^2)}{-2(6 - 2^2)}$.

In Problems 7–8, let $x = -2$, $y = 3$, and $z = 4$. Evaluate each expression.

7. $xy + z$

8. $\frac{z + 4y}{2x}$

9. What is the coefficient of the term $6x$?

10. How many terms are in the expression $3x^2 + 5x - 7$?

In Problems 11–14, simplify each expression.

11. $5(-4x)$

12. $-8(-7t)(4t)$

13. $3(x + 2) - 3(4 - x)$

14. $-1.1d^2 - 3.8d^2$

In Problems 15–22, solve each equa

15. $12x = -144$

16.

17. $\frac{c}{7} = -1$

18. 3

19. $2(x - 7) = -15$

20.

21. $23 - 5(x + 10) = -12$

22. 5

In Problems 23–24, solve each equa indicated.

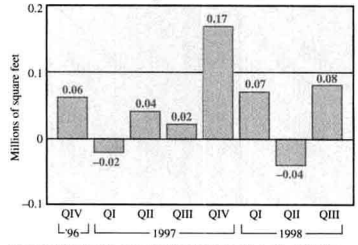
23. $d = rt$; for t

24. $A = P + Prt$; for r

25. COMMERCIAL REAL ESTATE *Net absorption* is a term used to indicate how much office space in a city is being purchased. Use the information from the graph in Illustration 1 to determine the eight-quarter average net absorption figure for Long Beach, California.

ILLUSTRATION 1

Downtown Long Beach Office Net Absorbtion



Based on information from *Los Angeles Times* (Oct. 13, 1998) Section C10.

The result of an addition is called the *sum;* of a subtraction, the *difference;* of a multiplication, the *product;* and of a division, the *quotient.*

Variables are letters used to stand for numbers.

An *equation* is a mathematical sentence that contains an = sign. Variables and/or numbers can be combined with the operations of addition, subtraction, multiplication, and division to create *algebraic expressions.*

CHAPTERS 1–2 Cumulative Review Exercises

In Exercises 1–4, tell whether the expression is an equation.

1. $m - 25$

2. $t = 25r$

3. $\frac{p + 5}{2}$

4. $x + 1 = 24$

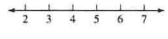
In Exercises 5–6, classify each number as a natural number, a whole number, an integer, a rational number, an irrational number, and a real number. Each number may be in several classifications.

5. 3

6. -0.25

In Exercises 7–8, graph each set of numbers on the number line.

7. The natural numbers between 2 and 7



8. The real numbers between 2 and 7

In Exercises 9–12, evaluate each expression.

9. $|-12|$

10. $|15|$

11. $-|15|$

12. $-|-12|$

In Exercises 13–16, use a calculator to find each square root to the nearest hundredth.

13. $\sqrt{77}$

14. $\sqrt{0.26}$

15. $\sqrt{\pi}$

16. $\sqrt{\frac{7}{5}}$

In Exercises 17–20, write each product using exponents.

17. $3 \cdot 3 \cdot 3$

18. $8 \cdot \pi \cdot r \cdot r$

19. $4 \cdot x \cdot x \cdot y \cdot y$

20. $m \cdot m \cdot m \cdot n$

In Exercises 21–24, evaluate each expression.

21. $13 - 3 \cdot 4$

22. $-2 \cdot 7^2$

23. $6 + 3\left(\frac{5}{2}\right) - \frac{1}{2}$

24. $\frac{12^2 - 4^2 - 2}{2(7 - 4)}$

In Exercises 25–26, write each phrase as an algebraic expression.

25. The sum of the width w and 12

26. Four less than a number n

In Exercises 27–30, complete each table of values.

27.

t	$t^2 - 4$
0	
1	
3	

28.

t	$(t - 4)^2$
0	
1	
3	

Calculators

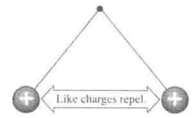
For instructors who wish to use calculators as part of the instruction in this course, the text includes an Accent on Technology feature that introduces keystrokes and shows how scientific calculators and graphing calculators can be used to solve problems. In the Study Sets, logos are used to denote problems that require a scientific calculator or a graphing calculator .

ACCENT ON TECHNOLOGY *Electric Charges*

The electric charges on each of the 0.20-gram balls that are suspended from 50-cm-long strings in Figure 4-2 are the same. For this reason, the balls repel each other. The charge q (in coulombs) on each ball is given by

$$q = \frac{2.97 \times 10^{-2}}{9.49 \times 10^{4}}$$

FIGURE 4-2



We can evaluate the expression by entering the numbers written in scientific notation with the EE key on a scientific calculator.

Keystrokes 2.97 EE +/− 2 ÷ 9.49 EE 4 =

0.000000313

In standard notation, the charge on each ball is 0.000000313 coulomb. This could be written as 3.13×10^{-7} coulomb using scientific notation.

If we use a graphing calculator, the keystrokes are similar. The result is displayed in scientific notation.

Keystrokes 2.97 2nd EE (−) 2 ÷ 9.49 2nd EE 4 ENTER

2.97E-2/9.49E4
3.129610116E-7

STUDY SET

Section 4.3

VOCABULARY

In Exercises 1–2, fill in the blanks to make the statements true.

1. A number is written in _____ notation when it is written as the product of a number between 1 (including 1) and 10.
2. The number 125,000 is written in _____ notation.

In Exercises 39–58, use a calculator to evaluate each expression to three decimal places.

39. $\sqrt{2}$
40. $\sqrt{3}$
41. $\sqrt{11}$
42. $\sqrt{53}$
43. $\sqrt{95}$
44. $\sqrt{99}$
45. $\sqrt{428}$
46. $\sqrt{844}$
47. $-\sqrt{9{,}876}$
48. $-\sqrt{3{,}619}$
49. $\sqrt{21.35}$
50. $\sqrt{13.78}$
51. $\sqrt{0.3588}$
52. $\sqrt{0.9999}$
53. $-\sqrt{0.8372}$
54. $-\sqrt{0.4279}$
55. $2\sqrt{3}$
56. $3\sqrt{2}$
57. $\frac{2+\sqrt{3}}{2}$
58. $\frac{2-\sqrt{3}}{2}$

In Exercises 59–60, tell whether each number in each set is rational, irrational, or imaginary.

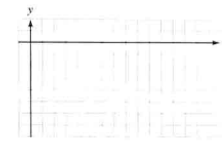
59. $\{\sqrt{9}, \sqrt{17}, \sqrt{49}, \sqrt{-49}\}$
60. $\{-\sqrt{5}, \sqrt{0}, \sqrt{-100}, -\sqrt{225}\}$

In Exercises 61–64, complete the table and then graph the function. Check your work with a graphing calculator.

61. $f(x) = 1 + \sqrt{x}$

x	$f(x)$
0	
1	
4	
9	
16	

x	$f(x)$
0	
1	
4	
9	
16	

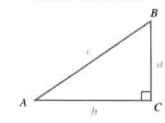


In Exercises 65–66, use a graphing calculator to graph the square root function. Use window settings of $x = -5$ to 16 and $y = -5$ to 5.

65. $f(x) = \sqrt{x+3}$
66. $f(x) = -\sqrt{x-2}$

In Exercises 67–72, refer to the right triangle in Illustration 3. Find the length of the unknown side.

ILLUSTRATION 3



67. Find c where $a = 4$ and $b = 3$.
68. Find c where $a = 5$ and $b = 12$.
69. Find b where $a = 15$ and $c = 17$.
70. Find b where $a = 21$ and $c = 29$.

Appendixes

A review of arithmetic fractions and decimal fractions is included in Appendix I. Appendix II covers synthetic division. For each, problem sets are included for student practice. Appendix III gives a table of roots and powers.

Student Support

We have included many features that make *Elementary and Intermediate Algebra* very accessible to students. (See the examples starting on page xii.)

Worked Examples

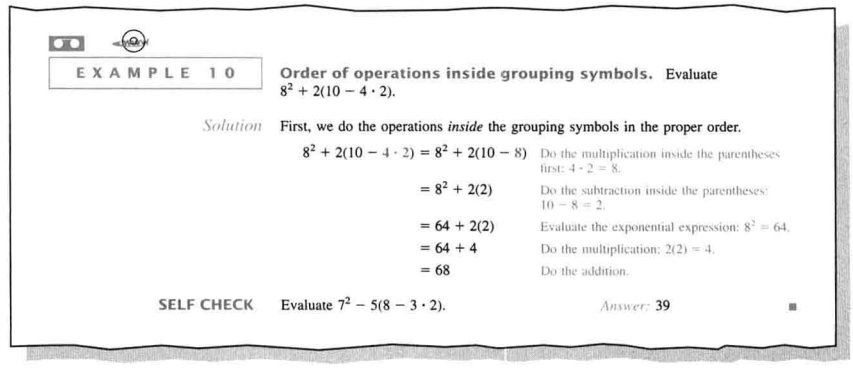
The text contains over 1,000 worked examples, many with several parts. Explanatory notes make the examples easy to follow.

Author's Notes

Author's notes, printed in red, are used to explain the steps in the solutions of examples. The notes are extensive; complete sentences are used so as to increase the students' ability to read and write mathematics.

A special logo shows which examples are included in the videotape series. ▶

Each step is explained using detailed author's notes. ▶



EXAMPLE 10 **Order of operations inside grouping symbols.** Evaluate $8^2 + 2(10 - 4 \cdot 2)$.

Solution First, we do the operations *inside* the grouping symbols in the proper order.

$8^2 + 2(10 - 4 \cdot 2) = 8^2 + 2(10 - 8)$ Do the multiplication inside the parentheses first: $4 \cdot 2 = 8$.

$= 8^2 + 2(2)$ Do the subtraction inside the parentheses: $10 - 8 = 2$.

$= 64 + 2(2)$ Evaluate the exponential expression: $8^2 = 64$.

$= 64 + 4$ Do the multiplication: $2(2) = 4$.

$= 68$ Do the addition.

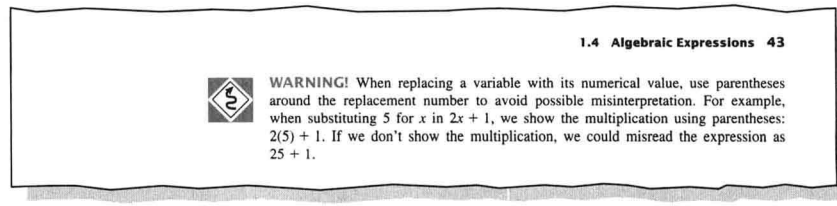
SELF CHECK Evaluate $7^2 - 5(8 - 3 \cdot 2)$. *Answer:* 39 ■

Self Checks

There are hundreds of Self Check problems that allow students to practice the skills demonstrated in the worked examples.

Warnings

Throughout the text, students are warned about common mistakes and how to avoid them.



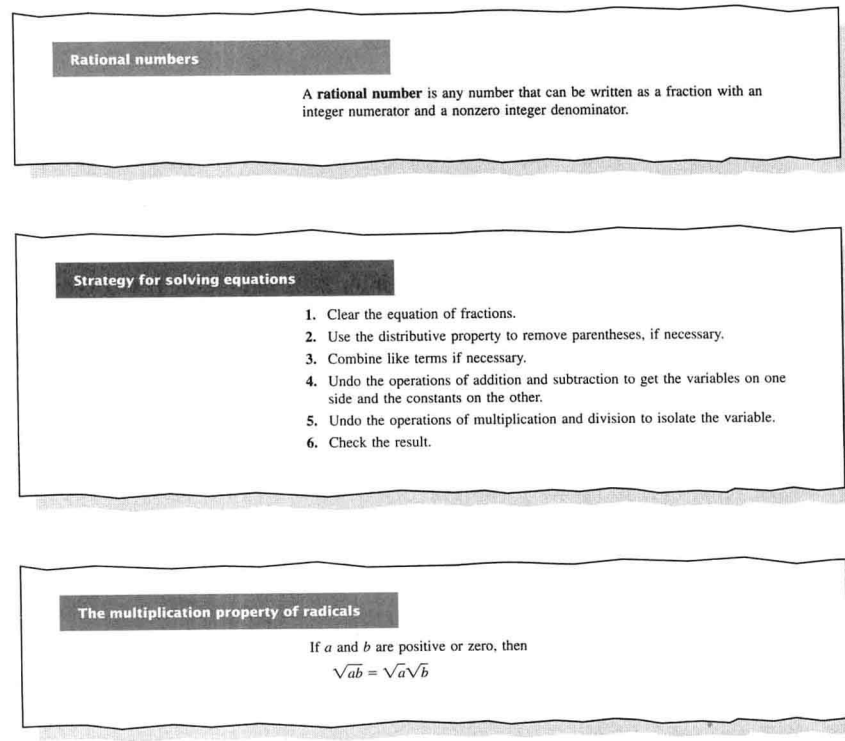
WARNING! When replacing a variable with its numerical value, use parentheses around the replacement number to avoid possible misinterpretation. For example, when substituting 5 for x in $2x + 1$, we show the multiplication using parentheses: $2(5) + 1$. If we don't show the multiplication, we could misread the expression as $25 + 1$.

Videotapes

The videotape series that accompanies this book uses eye-catching computer graphics to show students the steps in solving many examples in the text. A video logo placed next to an example indicates that the example is taught on tape. In addition, the tapes present the solutions of two Study Set problems from each section.

Functional Use of Color

For easy reference, definition boxes (light blue with a green title), strategy boxes (light yellow with a red title), and rule or property boxes (bright yellow with royal blue title), are color-coded. In addition, the book uses color to highlight terms and expressions that you would point to in a classroom discussion.



Problems and Answers

The book includes more than 10,000 carefully graded exercises. In the Student Edition, Appendix IV provides the answers to the odd-numbered exercises in the Study Sets, as well as all the answers to the Key Concept, Chapter Review, Chapter Test, and Cumulative Review problems.

Reading and Writing Mathematics

Also included (on pages xxvi–xxvii) are two features to help students improve their ability to read and write mathematics. "Reading Mathematics" helps students get the most out of the examples in this book by showing them how to read the solutions properly. "Writing Mathematics" highlights the characteristics of a well-written solution.

Study Skills and Math Anxiety

These two topics are discussed in detail in the section entitled "For the Student" at the end of this preface. In "Success in Algebra," students are asked to design a personal strategy for studying and learning the material. "Taking a Math Test" helps students prepare for a test and then gives them suggestions for improving their performance.

Ancillaries for the Instructor

Complete Solutions Manual

The *Complete Solutions Manual* provides worked-out solutions to all of the problems in the text.

Test Bank

The *Test Bank* includes three tests per chapter as well as three final exams. The tests contain a combination of multiple-choice, free-response, true/false, and fill-in-the-blank questions.

BCA Testing

Brooks/Cole Assessment is an internet-ready, text-specific testing suite that allows instructors to customize exams and track student progress in an accessible, browser-based format. *BCA* offers full algorithmic generation of problems and free-response mathematics, and completely integrates the testing and course management components. Test results flow automatically to your grade book and you can easily communicate to individuals, sections, or entire courses.

Text-Specific Video Series

The tapes work through examples from each section of the text, with additional solutions to two Study Set problems from each section.

Ancillaries for the Student

Student Solutions Manual

The *Student Solutions Manual* contains worked-out solutions to the odd-numbered problems in the text.

BCA Tutorial Student and Instructor Versions

This text-specific, interactive software is delivered via the Web (http://bca.brookscole.com) and is offered in both student and instructor versions. Like *BCA Testing,* it is browser based, making it an intuitive mathematical guide, even for students with little technological proficiency. *BCA Tutorial* allows students to work with real math notation in real time, and provides instant analysis and feedback. The tracking program built into the instructor version of the software enables instructors to monitor student progress carefully.

Interactive Video Skillbuilder CD

Packaged with the book, this single CD-ROM contains more than 8 hours of video instruction. The problems worked during each video lesson are listed next to the viewing screen, so students can work them ahead of time if they choose. In order to help students evaluate their progress, each section contains a 10-question Web quiz and each chapter contains a chapter test with answers provided.

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We are grateful to the instructors who have reviewed the text at various stages of its development. Their comments and suggestions have proven invaluable in making this a better book. We sincerely thank all of them for lending their time and talent to this project.

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Alan S. Tussy
R. David Gustafson

For the Student

Success in Algebra

To be successful in mathematics, you need to know how to study it. The following checklist will help you develop your own personal strategy to study and learn the material. The suggestions listed below require some time and self-discipline on your part, but it will be worth the effort. This will help you get the most out of this course.

As you read each of the following statements, place a check mark in the box if you can truthfully answer Yes. If you can't answer Yes, think of what you might do to make the suggestion part of your personal study plan. You should go over this checklist several times during the term to be sure you are following it.

Preparing for the Class

- ☐ I have made a commitment to myself to give this course my best effort.
- ☐ I have the proper materials: a pencil with an eraser, paper, a notebook, a ruler, a calculator, and a calendar or day planner.
- ☐ I am willing to spend a minimum of two hours doing homework for every hour of class.

- ☐ I will try to work on this subject every day.
- ☐ I have a copy of the class syllabus. I understand the requirements of the course and how I will be graded.
- ☐ I have scheduled a free hour after the class to give me time to review my notes and begin the homework assignment.

Class Participation

- ☐ I will regularly attend the class sessions and be on time.
- ☐ When I am absent, I will find out what the class studied, get a copy of any notes or handouts, and make up the work that was assigned when I was gone.
- ☐ I will sit where I can hear the instructor and see the chalkboard.
- ☐ I will pay attention in class and take careful notes.
- ☐ I will ask the instructor questions when I don't understand the material.
- ☐ When tests, quizzes, or homework papers are passed back and discussed in class, I will write down the correct solutions for the problems I missed so that I can learn from my mistakes.

Study Sessions

- ☐ I will find a comfortable and quiet place to study.
- ☐ I realize that reading a math book is different from reading a newspaper or a novel. Quite often, it will take more than one reading to understand the material.
- ☐ After studying an example in the textbook, I will work the accompanying Self Check.
- ☐ I will begin the homework assignment only after reading the assigned section.
- ☐ I will try to use the mathematical vocabulary mentioned in the book and used by my instructor when I am writing or talking about the topics studied in the course.
- ☐ I will look for opportunities to explain the material to others.
- ☐ I will check all of my answers to the problems with those provided in the back of the book (or with the *Student Solutions Manual*) and reconcile any differences.
- ☐ My homework will be organized and neat. My solutions will show all the necessary steps.
- ☐ I will work some review problems every day.
- ☐ After completing the homework assignment, I will read the next section to prepare for the coming class session.
- ☐ I will keep a notebook containing my class notes, homework papers, quizzes, tests, and any handouts—all in order by date.

Special Help

- ☐ I know my instructor's office hours and am willing to go in to ask for help.
- ☐ I have formed a study group with classmates that meets regularly to discuss the material and work on problems.
- ☐ When I need additional explanation of a topic, I view the video and check the web site.
- ☐ I take advantage of extra tutorial assistance that my school offers for mathematics courses.
- ☐ I have purchased the *Student Solutions Manual* that accompanies this text, and I use it.

To follow each of these suggestions will take time. It takes a lot of practice to learn mathematics, just as with any other skill.

No doubt, you will sometimes become frustrated along the way. This is natural. When it occurs, take a break and come back to the material after you have had time to clear your thoughts. Keep in mind that the skills and discipline you learn in this course will help make for a brighter future. Good luck!