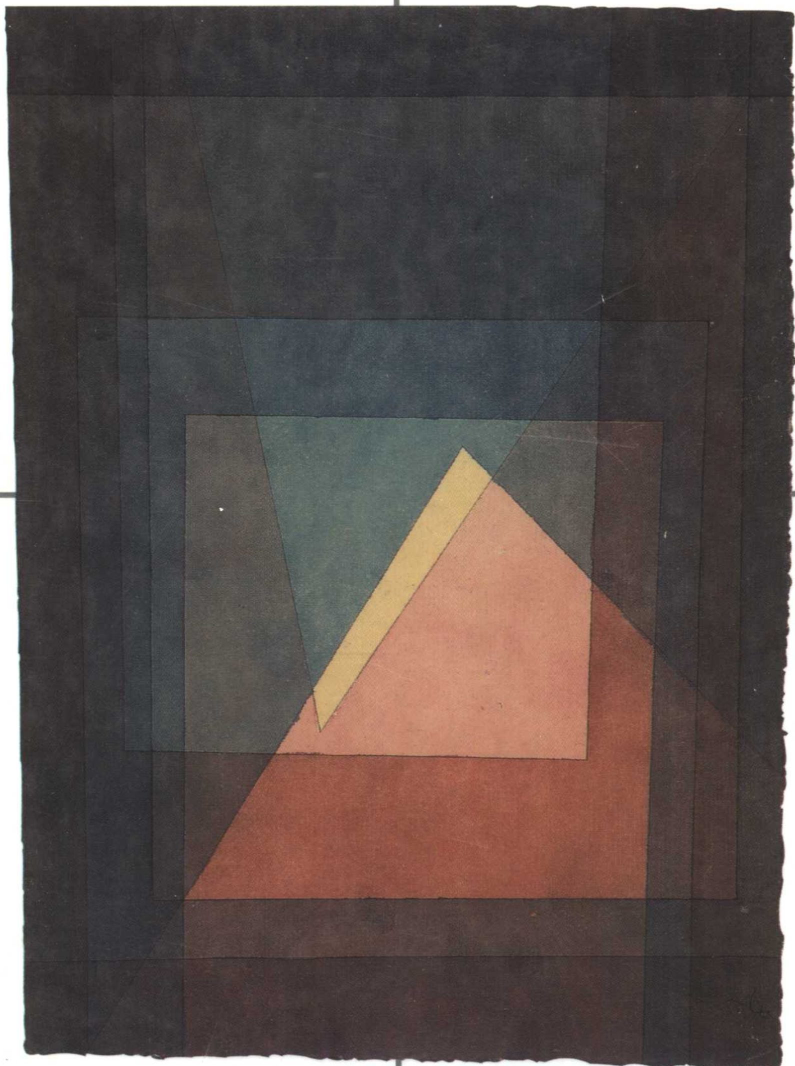
INTERMEDIATE ALGEBRA

Graphs and Functions



LARSON HOSTETLER NEPTUNE

INTERMEDIATE ALGEBRA
Graphs and Functions

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Preface

Intermediate Algebra: Graphs and Functions has two basic goals: first, to help students develop proficiency in algebra; and, second, to show students how algebra can be used as a modeling language for real-life problems. To support these two functions, the text has several key pedagogical features.

Mathematics as Problem Solving Throughout the text, students are encouraged to consider multiple approaches to problem-solving — algebraic, graphical, and numerical. For real-life problems, students are encouraged to use the following approach: construct a verbal model, label variable and constant terms, construct an algebraic model, solve the algebraic model, answer the question, and check the answer in the original statement of the problem.

Mathematics as Communication The discussion problems at the end of each section offer students the opportunity to think, talk, and write about mathematics in different ways. Students are encouraged to draw new conclusions about the concepts presented and to develop a sense of how each topic studied fits into the whole concept of algebra.

Mathematics as Reasoning While the text stresses skill development in algebra, it does so in the broader context of developing an understanding of algebraic properties and principles. Many of the examples and exercises in the text ask students to explain the reasons for choosing a particular problem-solving approach.

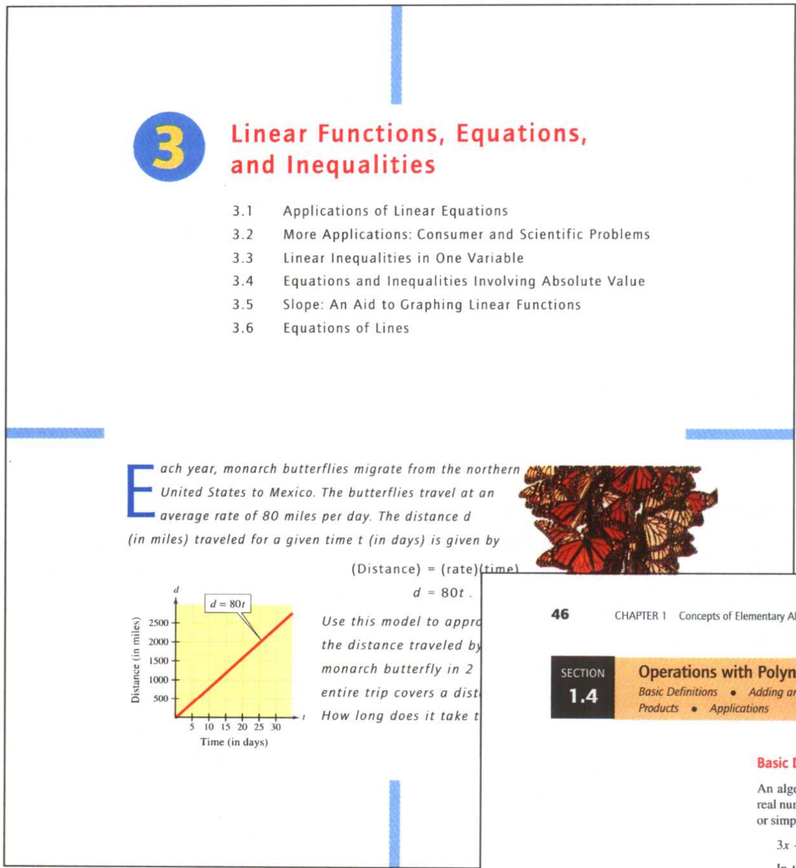
Mathematical Connections Numerous applications are integrated throughout every section of the text — both as solved examples and as exercises. As a result, students will constantly use and review their problem-solving skills. The text applications cover a wide range of relevant topics, and many use real data. The examples and exercises in the text connect algebra not only to real life, but also to other branches of mathematics, such as geometry.

These and other features of the text are described in greater detail on the following pages.

Features of the Text

Chapter Opener

Each chapter contains a list of the topics to be covered and a real-life application that helps motivate the chapter. This application poses one or two questions that are designed to pique students' curiosity.



3 Linear Functions, Equations, and Inequalities

Each year, monarch butterflies migrate from the northern United States to Mexico. The butterflies travel at an average rate of 80 miles per day. The distance d (in miles) traveled for a given time t (in days) is given by

(Distance) = (rate)(time)

$d = 80t$.

Use this model to appro[...] the distance traveled by [...] monarch butterfly in 2 [...] entire trip covers a dist[...] How long does it take t[...]

Section Topics

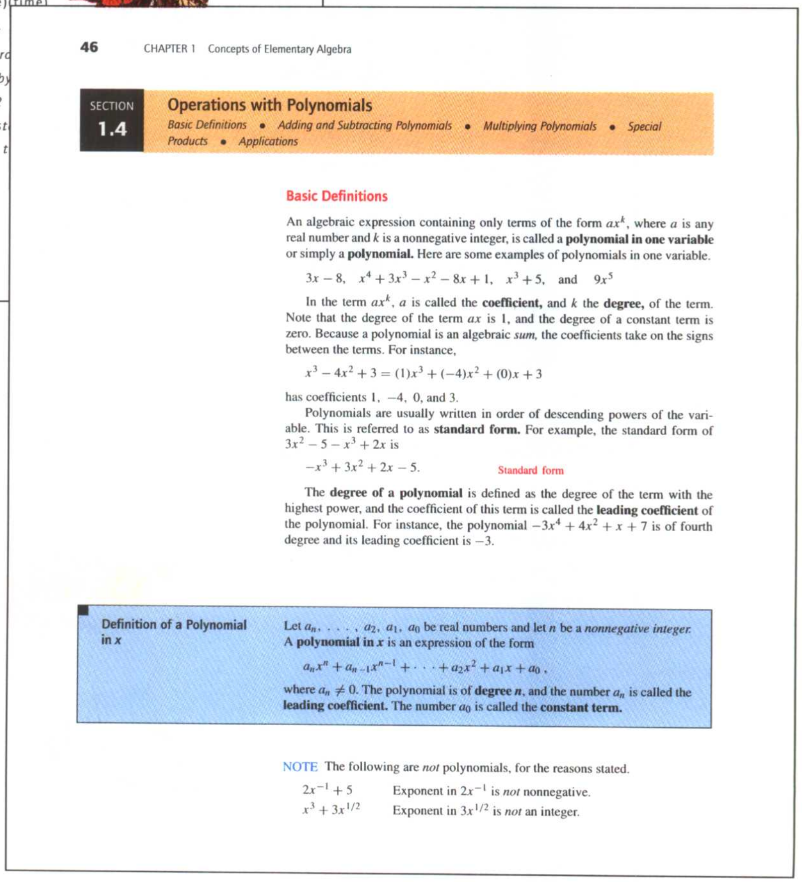
Each section begins with a list of important topics that are covered in the section. These topics are also the subsection titles and can be used for easy reference and review by students.

Definitions and Rules

All of the important rules, formulas, and definitions are boxed for emphasis. Each is also titled for easy reference.

Notes

Notes appear after definitions and examples. Anticipating students' needs, the notes give additional insight, point out common errors, and describe generalizations.



46 CHAPTER 1 Concepts of Elementary Algebra

SECTION 1.4 **Operations with Polynomials**

Basic Definitions • Adding and Subtracting Polynomials • Multiplying Polynomials • Special Products • Applications

Basic Definitions

An algebraic expression containing only terms of the form ax^k, where a is any real number and k is a nonnegative integer, is called a **polynomial in one variable** or simply a **polynomial.** Here are some examples of polynomials in one variable.

$$3x - 8, \quad x^4 + 3x^3 - x^2 - 8x + 1, \quad x^3 + 5, \quad \text{and} \quad 9x^5$$

In the term ax^k, a is called the **coefficient,** and k the **degree,** of the term. Note that the degree of the term ax is 1, and the degree of a constant term is zero. Because a polynomial is an algebraic *sum*, the coefficients take on the signs between the terms. For instance,

$$x^3 - 4x^2 + 3 = (1)x^3 + (-4)x^2 + (0)x + 3$$

has coefficients 1, −4, 0, and 3.

Polynomials are usually written in order of descending powers of the variable. This is referred to as **standard form.** For example, the standard form of $3x^2 - 5 - x^3 + 2x$ is

$$-x^3 + 3x^2 + 2x - 5. \qquad \text{Standard form}$$

The **degree of a polynomial** is defined as the degree of the term with the highest power, and the coefficient of this term is called the **leading coefficient** of the polynomial. For instance, the polynomial $-3x^4 + 4x^2 + x + 7$ is of fourth degree and its leading coefficient is −3.

Definition of a Polynomial in x

Let $a_n, \ldots, a_2, a_1, a_0$ be real numbers and let n be a *nonnegative integer.* A **polynomial in x** is an expression of the form

$$a_nx^n + a_{n-1}x^{n-1} + \cdots + a_2x^2 + a_1x + a_0 ,$$

where $a_n \neq 0$. The polynomial is of **degree n**, and the number a_n is called the **leading coefficient.** The number a_0 is called the **constant term.**

NOTE The following are *not* polynomials, for the reasons stated.

$2x^{-1} + 5$ Exponent in $2x^{-1}$ is *not* nonnegative.
$x^3 + 3x^{1/2}$ Exponent in $3x^{1/2}$ is *not* an integer.

Problem-Solving Process

Students are taught the following strategies — in keeping with the spirit of NCTM standards — for solving applied problems. (1) Construct a verbal model; (2) label variable and constant terms; (3) construct an algebraic model; (4) using the model, solve the problem; and (5) check the answer in the original statement of the problem.

Examples

Each of the nearly 900 examples was carefully chosen to illustrate a particular concept or problem-solving technique and to enhance students' understanding. The examples are titled for easy reference.

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EXAMPLE 10 ■ **Constructing a Verbal Model**

Find two consecutive integers such that the sum of the first and three times the second is 87.

Solution

Verbal model: First integer $+ 3 \cdot$ Second integer $= 87$

Labels: First integer $= n$
Second integer $= n + 1$

Algebraic equation:	$n + 3(n + 1) = 87$	Algebraic model
	$n + 3n + 3 = 87$	Distributive Property
	$4n = 84$	Subtract 3 from both sides and combine terms
	$n = 21$	Divide both sides by 4

Thus, the first integer is 21, and the second integer is $21 + 1 = 22$. You can check this by substituting 21 and 22 for two consecutive integers in the original problem. ■

EXAMPLE 11 ■ **Using a Verbal Model to Construct an Algebraic Equation**

Write an algebraic equation that represents the following problem: You have accepted a job with an annual salary of \$27,630. This salary includes a year-end bonus of \$750. If you are paid twice a month, what will be your gross pay for each paycheck?

Solution

Because there are 12 months in a year and you will be paid twice a month, it follows that you will receive 24 paychecks during the year. You can construct an algebraic equation for this problem as follows. Begin with a verbal model, then assign labels, and finally form an alge

Verbal model: Income for year =

Labels: Income for year = 27,630 (
Amount of each paycheck =
Bonus = 750 (dollars)

Algebraic equation: 27,630 = 24x

The algebraic equation for this prob
Using the techniques discussed in Se
If you do this, you will find that the s

You could solve the problems in E
instance, in Example 11 you could so
\$750 from the annual salary of \$27,63

SECTION 1.3 Algebraic Expressions 39

EXAMPLE 13 ■ **Creating a Real-Life Model**

For the years 1980 through 1990, the number B (in millions) of children's books that were sold in the United States can be modeled by $B = 18.7t + 119$, where $t = 0$ represents 1980. During the same years, the average price p of a children's book can be modeled by $p = 0.2t + 3.3$. These two models can be used to write a model for the total sales (in millions of dollars) of children's books for 1980 through 1990. Use the model to find the total sales in 1988. (*Source: Book Industry Times*)

Solution

Let S represent the yearly sales in millions of dollars.

Total yearly sales = Number sold each year · Average price per book each year

$$S = (18.7t + 119)(0.2t + 3.3)$$

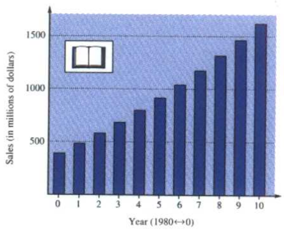
To find the total sales in 1988, substitute 8 for t in this model.

$S = (18.7t + 119)(0.2t + 3.3)$	Total sales model
$= (18.7 \cdot 8 + 119)(0.2 \cdot 8 + 3.3)$	Substitute 8 for t
$= (268.6)(4.9)$	Perform operations within parentheses
$= 1316.14$	Multiply

The total sales of children's books in 1988 was about \$1316 million (or about \$1.3 billion). The bar graph shown in Figure 1.9 shows the total sales of children's books from 1980 through 1990. ■

According to the NEA, over half of the adults in the United States read at least one book for enjoyment each year. Reading books to children increases the likelihood that the children will read for enjoyment as adults.

FIGURE 1.9



Applications

Real-world applications are integrated throughout the text both in examples and in exercises. These applications offer students a constant review of problem-solving skills and emphasize the relevance of the mathematics. Many of the applications use current, real data, and all are titled for reference.

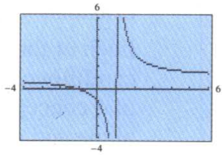
Graphing /Scientific Calculator

Each chapter contains a section devoted to the use of calculators and computers in problem solving. Exercises labeled in the text sections that follow give students the opportunity to use technology as a problem-solving tool.

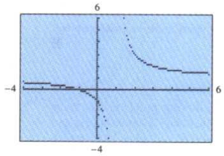
Using a Graphing Calculator

Most graphing calculators have two graphing modes: a *connected mode* and a *dot mode* (see figures below). The connected mode works well for graphs of functions that are continuous (have no holes or breaks). The connected mode does not, however, work well for the graphs of many rational functions because they are often composed of two or more disconnected branches. To correct this problem, change the calculator to dot mode.

On the screen shown at left below, notice the vertical line at approximately $x = 1$. This line is *not* part of the graph—it is simply the calculator's attempt to connect the two branches of the graph.



Connected Mode
Graph of $f(x) = \frac{x+1}{x-1}$



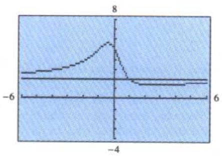
Dot Mode
Graph of $f(x) = \frac{x+1}{x-1}$

EXAMPLE 1 ■ Investigating Asymptotic Behavior

Some people think that the graph of … asymptote. This, however, is not … graph of

$$f(x) = \frac{2x^2 - 3x + 5}{x^2 + 1}$$

and its horizontal asymptote $y =$ … graph crosses its horizontal asympt…



Solution

From the screen at left, it appears t… when $x = 1$. You can confirm this …

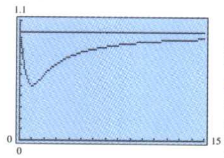
$$f(1) = \frac{2(1^2) - 3(1) + 5}{1^2 + 1} = \frac{4}{2}$$

EXAMPLE 2 ■ Pollution Level of a Pond

Some organic waste has been dumped into a pond. One component of the decomposition process is oxidation, whereby oxygen dissolved in the pond water is combined with decomposing material. Let $L = 1$ represent the normal oxygen level in the pond, and let t represent the number of weeks that have elapsed since the waste was dumped. The oxygen level in the pond can be modeled by

$$L = \frac{t^2 - t + 1}{t^2 + 1}.$$

Sketch the graph of this model, and use the graph to explain how the oxygen level has changed during the 15 weeks since the waste was dumped.



Oxygen Level of Pond

Solution

The screen at left shows the graph of the model and the line $L = 1$ (the normal oxygen level). From the graph, you can see that the oxygen dropped to 50% of its normal level after 1 week. Then, during the next several weeks, the oxygen level gradually returned to normal. Now, at the end of the 15th week, the oxygen level has reached 93% of normal. ■

EXERCISES

In Exercises 1–6, find bounds for x and y such that the calculator screen displays the basic characteristics of the graph of the rational function.

1. $f(x) = \frac{x-5}{x+1}$
2. $f(x) = \frac{2x-5}{x-4}$
3. $f(x) = \frac{x^2-1}{x^2-4}$
4. $f(x) = \frac{2x^2-7x+5}{x^2+2x+1}$
5. $f(x) = \frac{x^2-5x}{2x^2+1}$
6. $f(x) = \frac{x^3-1}{x^3+1}$

7. Use a graphing calculator to sketch the graphs of f and g on the same screen. (Use a range of $-5 \le x \le 5$ and $-4 \le y \le 20$.)

$$f(x) = x \quad \text{and} \quad g(x) = \frac{x^2+x+1}{x+1}$$

Use long division to rewrite $g(x)$. Then use the result to explain why the two graphs are close to each other for large values of $|x|$.

8. For the years 1975 to 1990, the number N (in millions) of long-playing albums sold in the United States can be approximated by the model

$$N = \frac{1000 - 74.41t + 1.45t^2}{2.94 - 0.336t + 0.0125t^2},$$

where $t = 5$ represents 1975. Sketch the graph of this function and use the graph to find the year in which the sales peaked. (*Source:* Recording Industry Association of America)

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Graphing

Graphing is introduced in Chapter 2. From that point on, students are encouraged to consider using graphs to reinforce algebraic solutions.

EXAMPLE 5 ■ Finding the Intercepts of a Graph

Find the intercepts and sketch the graph of $y = 2x - 3$.

Solution

To determine whether the graph has any x-intercepts, let y be zero and solve the resulting equation for x.

$y = 2x - 3$ — Given equation

$0 = 2x - 3$ — Let $y = 0$

$\frac{3}{2} = x$ — Solve equation for x

Therefore, the graph has one x-intercept, which occurs at the point $(\frac{3}{2}, 0)$.

To determine whether the graph has any y-intercepts, let x be zero and solve the resulting equation for y.

$y = 2x - 3$ — Given equation

$y = 2(0) - 3$ — Let $x = 0$

$y = -3$ — Solve equation for y

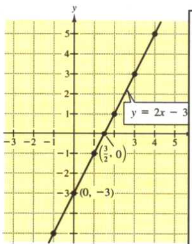
Therefore, the graph has one y-intercept, which occurs at the point $(0, -3)$.

To sketch the graph of the equation, make a table of values, as shown in Table 2.9. (Notice that the two intercepts are included in the table.) Finally, using the solution points in the table, sketch the graph of the equation, as shown in Figure 2.20.

TABLE 2.9

x	-1	0	1	$\frac{3}{2}$	2	3	4
$y = 2x - 3$	-5	-3	-1	0	1	3	5
Solution Points	$(-1, -5)$	$(0, -3)$	$(1, -1)$	$(\frac{3}{2}, 0)$	$(2, 1)$	$(3, 3)$	$(4, 5)$

FIGURE 2.20



Mid-Chapter Quiz

Each chapter contains a mid-chapter quiz after the third section. This feature allows students to perform a self-assessment midway through the chapter. Answers to mid-chapter quizzes are given at the end of the text.

2

Mid-Chapter Quiz

Take this quiz as you would take a quiz in class. After you are done, check your work against the answers in the back of the book.

In Exercises 1–8, solve the equation.

1. $24 - 2x = x$

2. $3(x - 4) + 4 = -2(x - 1)$

3. $\frac{5x}{6} - \frac{2}{3} = 1$

4. $\frac{t}{4} - \frac{t}{6} = 1$

5. $(s - 16)(s + 15) = 0$

6. $y(y + 6) = 72$

7. $4x^2 - 4x + 1 = 0$

8. $3t^2 - 4t + 6 = 10$

9. Solve for C

Temperature Conversion: $F = \frac{9}{5}C + 32$

10. Solve for l

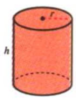
Perimeter of a Rectangle: $P = 2(l + w)$

11. The surface area of a cylinder (see figure) is given by $S = 2\pi rh + 2\pi r^2$.

(a) Solve for h.

(b) Find h is $S = 105$ square inches and $r = 3$ inches.

Figure for 11



12. An object is thrown upward from a height of 64 feet with an initial velocity of 48 feet per second. Find the time t for the object to reach the ground by solving the following equation.

$$-16t^2 + 48t + 64 = 0$$

13. Two people can complete a task in t hours, where t must satisfy the equation

$$\frac{t}{12} + \frac{t}{20} = 1.$$

Find the required time t.

14. (a) Determine the quadrant(s) in which the point (x, y) is located if $xy < 0$.

(b) Explain your reasoning.

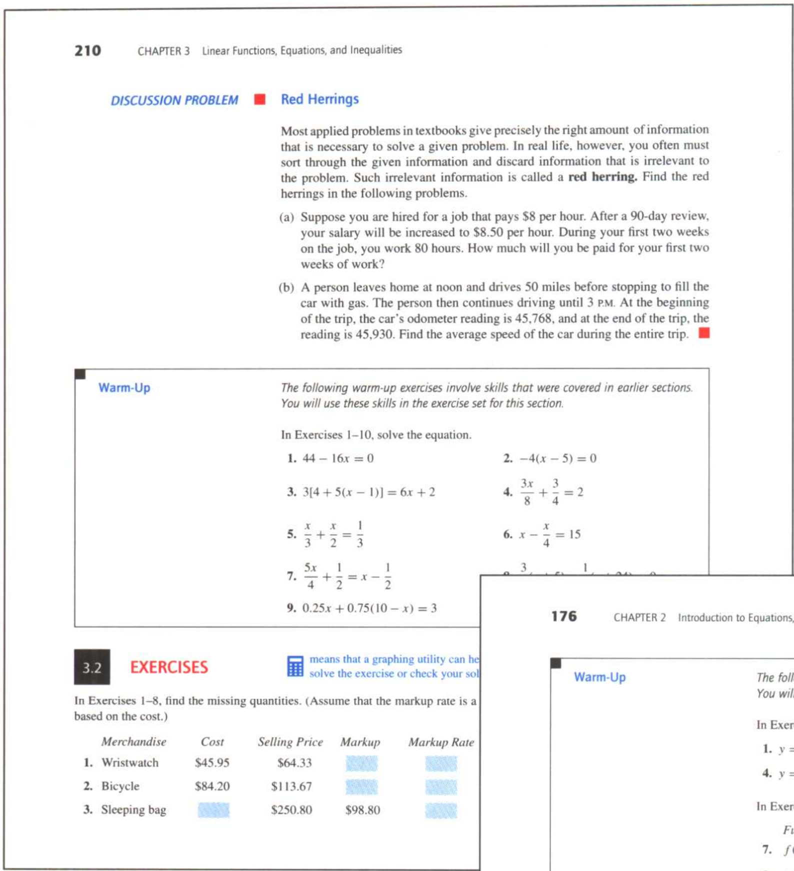
In Exercises 15 and 16, use the points $(-3, 0)$ and $(7, 3)$.

15. Plot the points in a rectangular coordinate system.

16. Find the distance between the points. Round your result to two decimal places.

17. Determine whether the ordered paris are solution points to the equation $5x - 3y + 10 = 0$.

(a) $(-2, 0)$ (b) $(0, 3)$ (c) $(1, -2)$ (d) $(-5, -5)$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DISCUSSION PROBLEM ■ Red Herrings

Most applied problems in textbooks give precisely the right amount of information that is necessary to solve a given problem. In real life, however, you often must sort through the given information and discard information that is irrelevant to the problem. Such irrelevant information is called a **red herring.** Find the red herrings in the following problems.

(a) Suppose you are hired for a job that pays \$8 per hour. After a 90-day review, your salary will be increased to \$8.50 per hour. During your first two weeks on the job, you work 80 hours. How much will you be paid for your first two weeks of work?

(b) A person leaves home at noon and drives 50 miles before stopping to fill the car with gas. The person then continues driving until 3 P.M. At the beginning of the trip, the car's odometer reading is 45,768, and at the end of the trip, the reading is 45,930. Find the average speed of the car during the entire trip. ■

Warm-Up

The following warm-up exercises involve skills that were covered in earlier sections. You will use these skills in the exercise set for this section.

In Exercises 1–10, solve the equation.

1. $44 - 16x = 0$ **2.** $-4(x-5) = 0$

3. $3[4 + 5(x-1)] = 6x + 2$ **4.** $\frac{3x}{8} + \frac{3}{4} = 2$

5. $\frac{x}{3} + \frac{x}{2} = \frac{1}{3}$ **6.** $x - \frac{x}{4} = 15$

7. $\frac{5x}{4} + \frac{1}{2} = x - \frac{1}{2}$

9. $0.25x + 0.75(10 - x) = 3$

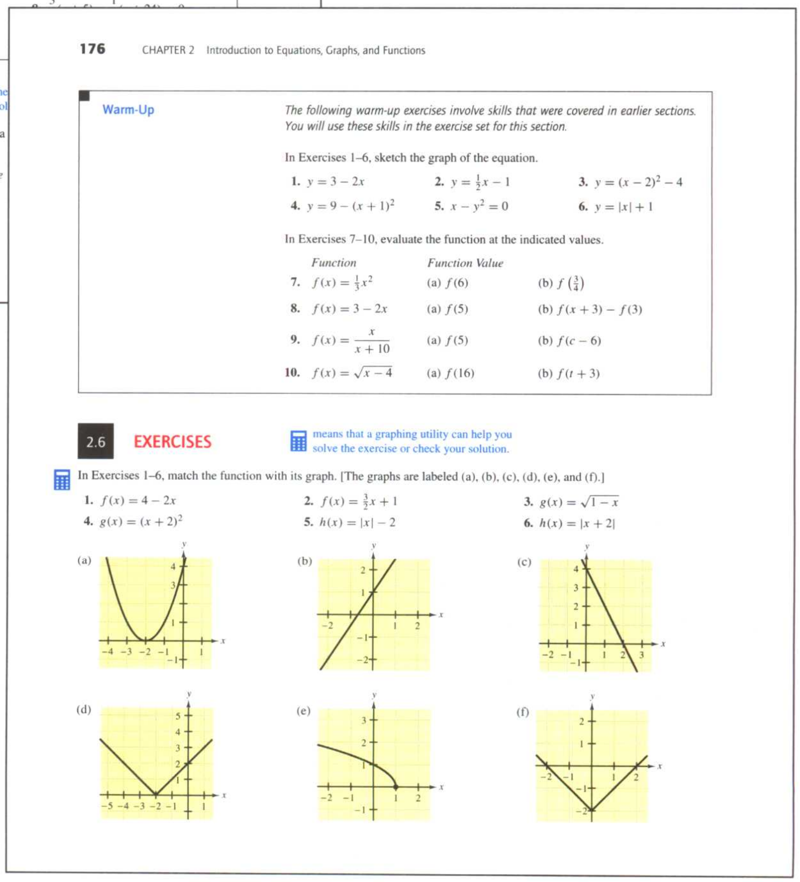
3.2 EXERCISES — means that a graphing utility can he[lp you] solve the exercise or check your sol[ution.]

In Exercises 1–8, find the missing quantities. (Assume that the markup rate is a ... based on the cost.)

	Merchandise	Cost	Selling Price	Markup	Markup Rate
1.	Wristwatch	\$45.95	\$64.33		
2.	Bicycle	\$84.20	\$113.67		
3.	Sleeping bag		\$250.80	\$98.80	

Discussion Problems

Discussion problems appear at the end of each section. They encourage students to think, talk, and write about mathematics, both individually and in groups.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Warm-Up

The following warm-up exercises involve skills that were covered in earlier sections. You will use these skills in the exercise set for this section.

In Exercises 1–6, sketch the graph of the equation.

1. $y = 3 - 2x$ **2.** $y = \frac{1}{2}x - 1$ **3.** $y = (x-2)^2 - 4$

4. $y = 9 - (x+1)^2$ **5.** $x - y^2 = 0$ **6.** $y = |x| + 1$

In Exercises 7–10, evaluate the function at the indicated values.

	Function	Function Value	
7.	$f(x) = \frac{1}{3}x^2$	(a) $f(6)$	(b) $f\left(\frac{3}{4}\right)$
8.	$f(x) = 3 - 2x$	(a) $f(5)$	(b) $f(x+3) - f(3)$
9.	$f(x) = \frac{x}{x+10}$	(a) $f(5)$	(b) $f(c-6)$
10.	$f(x) = \sqrt{x-4}$	(a) $f(16)$	(b) $f(t+3)$

2.6 EXERCISES — means that a graphing utility can help you solve the exercise or check your solution.

In Exercises 1–6, match the function with its graph. [The graphs are labeled (a), (b), (c), (d), (e), and (f).]

1. $f(x) = 4 - 2x$ **2.** $f(x) = \frac{3}{2}x + 1$ **3.** $g(x) = \sqrt{1-x}$

4. $g(x) = (x+2)^2$ **5.** $h(x) = |x| - 2$ **6.** $h(x) = |x+2|$

(a) (b) (c) (d) (e) (f)

Warm-Up

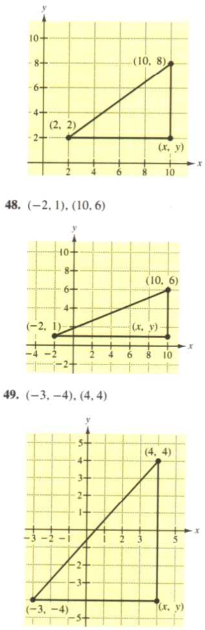
Each section (except for Section 1.1) contains a set of ten warm-up exercises that enables students to review and practice the previously learned skills necessary to master the new skills presented in the section. All warm-up exercises are answered at the end of the text.

Calculators and Computers

Two types of calculators are discussed: scientific and graphing. In examples and exercises, the graphing capability of graphing calculators and computer graphing software is investigated; however, coverage of this material is optional.

Exercise Sets

The nearly 7000 exercises contain numerous computational and applied problems dealing with a wide range of topics. Anticipating students' needs, these problems are carefully graded to increase in difficulty as students' problem-solving skills develop. Each pair of consecutive problems is similar, with the answer to the odd-numbered problem given at the end of the text. Exercise sets appear at the end of each text section. The opportunity to use calculators — to show patterns, to experiment, to calculate, or to create graphic models — is available with selected topics.



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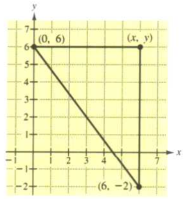
In Exercises 47–50, find (a) the missing coordinates of the one vertex of the right triangle, (b) the lengths of the vertical and horizontal sides of the triangle, (c) the length of the hypotenuse, and (d) the distance between the two given points.

47. (10, 8), (2, 2)

48. (−2, 1), (10, 6)

49. (−3, −4), (4, 4)

50. (0, 6), (6, −2)



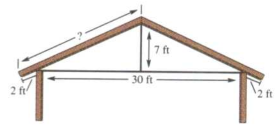
In Exercises 51–58, find the distance between the two points. If appropriate, round the result to two decimal places.

51. (1, 3), (5, 6) **52.** (3, 10), (15, 5)
53. (0, 0), (12, −9) **54.** (−5, 0), (3, 15)
55. (−2, −3), (4, 2) **56.** (−5, 4), (10, −3)
57. (1, 3), (3, −2) **58.** $(\frac{1}{2}, 1), (\frac{3}{2}, 2)$

In Exercises 59–62, determine whether the points are vertices of a right triangle.

59. (2, 3), (2, 6), (6, 3)
60. (2, 4), (−1, 6), (−3, 1)
61. (8, 3), (5, 2), (1, 9)
62. (2, 4), (1, 1), (7, −1)

63. ***Housing Construction*** A house is 30 feet wide and the ridge of the roof is 7 feet above the top of the walls (see figure). Find the length of the rafters if they overhang the edge of the walls by 2 feet.



lgebra

rinomial.

+ 169 **109.** $4s^2 + 36st + 81t^2$ **110.** $u^2 - 10uv + 25v^2$

pletely, if possible.

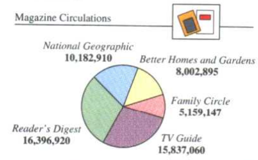
$3b + 27b^3$ **113.** $8x(2x - 3) - 4(2x - 3)$
$8x^3 + 1$ **116.** $t^3 - 216$
$x^2 - 2x + 1$ **119.** $x^2 + x - 1$
$4t^3 + 7t^2 - 2t$ **122.** $6h^3 - 22h^2 - 8h$

t the trinomial is factorable.

123. $x^2 + bx + 5$ **124.** $x^2 + bx + 6$ **125.** $2x^2 + bx - 15$ **126.** $3x^2 + bx - 22$

Magazine Circulations In Exercises 127 and 128, use the figure showing the circulations for the top five magazines in the United States for the first six months of 1990. (*Source:* Audit Bureau of Circulations)

Figure for 127 and 128



127. Determine the combined circulation for the five magazines.

128. What is the difference in circulation between *Reader's Digest* and *National Geographic*?

129. ***Total Charge*** Suppose you purchased a product by making a down payment of \$239 plus nine monthly payments of \$45 each. What is the total amount you paid for the product?

130. ***Total Charge*** Suppose you purchased a product by making a down payment of \$387 plus 12 monthly payments of \$68 each. What is the total amount you paid for the product?

131. ***Exploratory Exercise*** Enter any number between 0 and 1 in a calculator. Take the square root of the number. Then take the square root of the result, and keep repeating the process. What number does the calculator display seem to be approaching?

132. ***Calculator Experiment*** Use a calculator to calculate 12^4 in two ways.*

Scientific	*Graphing*
(a) 12 [y^x] 4 [=]	(a) 12 [^] 4 [ENTER]
(b) 12 [x^2] [x^2]	(b) 12 [x^2] [x^2] [ENTER]

Why do these two methods give the same result?

133. ***Probability*** The probability of three successes in five trials of an experiment is $10p^3(1 - p)^2$. Find this product.

*The graphing calculator keystrokes in this text correspond to the TI-81 and TI-82 graphing calculators from Texas Instruments. For other graphing calculators, the keystrokes may differ.

Graphics

The ability to visualize problems is a critical skill that students need in order to solve them. To encourage the development of this skill, the text has an abundance of figures, which are computer-generated for accuracy.

Review Exercises

A set of review exercises appears at the end of each chapter. Answers to all odd-numbered review exercises appear at the end of the text.

180 CHAPTER 2 Introduction to Equations, Graphs, and Functions

2 REVIEW EXERCISES

In Exercises 1–4, determine whether the values of the variable are solutions of the equation.

	Equation	*Values of the Variable*	
1.	$45 - 7x = 3$	(a) $x = 3$	(b) $x = 6$
2.	$3(5 - x) = 6 - x$	(a) $x = \frac{9}{2}$	(b) $x = -\frac{2}{3}$
3.	$\frac{x}{7} + \frac{x}{5} = 1$	(a) $x = \frac{35}{12}$	(b) $x = 2$
4.	$\frac{x+2}{6} = \frac{7}{2}$	(a) $x = -12$	(b) $x = 19$

In Exercises 5–24, solve the equation and check the result. (Some of the equations have no solutions.)

5. $17 - 7x = 3$ 6. $3 + 6x = 51$ 7. $4y - 6(y - 5) = 2$ 8. $7x + 2(7 - x) = 8$

9. $1.4t + 2.1 = 0.9t - 2$ 10. $8(x - 2) = 3(x - 2)$ 11. $\frac{3x}{4} = 4$ 12. $-\frac{5x}{14} = \frac{1}{2}$

13. $\frac{4}{5}x - \frac{1}{10} = \frac{3}{2}$ 14. $\frac{1}{4}s + \frac{3}{8} = \frac{5}{2}$ 15. $\frac{v - 20}{-8} = 2v$ 16. $x + \frac{2x}{5} = 1$

17. $10x(x - 3) = 0$ 18. $3x(4x + 7) = 0$ 19. $v^2 - 100 = 0$ 20. $(x + 3)^2 - 25 = 0$

21. $x^2 - 25x = -150$ 22. $4t^2 - 12t = -9$ 23. $3s^2 - 2s - 8 = 0$ 24. $z(5 - z) + 36 = 0$

In Exercises 25–28, solve the equation and round your answer to two decimal places. (A calculator may be helpful.)

25. $382x - 575 = 715$ 26. $3.625x + 3.5 = 22.125$ 27. $\frac{x}{2.33} = 14.302$ 28. $\frac{7x}{3} + 2.5 = 8.125$

In Exercises 29–32, solve the equation for the specified variable.

29. $2x - 7y + 4 = 0$, Solve for x. 30. $\frac{2}{3}u - 4v = 2v + 3$, Solve for v.

31. $V = \pi r^2 h$, Solve for h. 32. $S = 2\pi r^2 + 2\pi rh$, Solve for h.

In Exercises 33 and 34, plot the points in a rectangular coordinate system.

33. $(0, -3)$, $(\frac{5}{2}, 5)$, $(-2, -4)$ 34. $(1, -\frac{3}{2})$, $(-2, 2\frac{3}{4})$, $(5, 10)$

In Exercises 35–38, plot the points and find the distance between them. If appropriate, round the result to two decimal places.

35. $(1, 3)$, $(5, 6)$ 36. $(2, -5)$, $(6, -5)$ 37. $(-6, -1)$, $(1, 2)$ 38. $(-2, 10)$, $(3, -2)$

Graphs, and Functions

62. $h(x) = \begin{cases} x^3, & \text{if } x \le 1 \\ (x-1)^2 + 1, & \text{if } x > 1 \end{cases}$

) $- f(3)$ (a) $h(2)$ (b) $h(-\frac{1}{2})$ (c) $h(0)$ (d) $h(4) - h(3)$

64. $f(x) = 3x$

(a) $\frac{f(x+1) - f(1)}{x}$ (b) $\frac{f(x-5) - f(5)}{x}$

66. $f(x) = 8$

(a) $f(x + h)$ (b) $\frac{f(x+h) - f(x)}{h}$

ion.

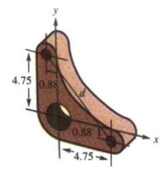
67. $h(x) = 4x^2 - 7$ 68. $g(s) = \frac{}{s}$ 69. $f(x) = \frac{1}{5 - x}$ 70. $G(x) = \sqrt{x + 4}$

In Exercises 71–76, (a) describe the transformation and (b) sketch the graph.

71. $g(x) = -(x + 1)^2$ 72. $h(x) = 9 - (x - 2)^2$ 73. $f(t) = |t - 2| - 1$

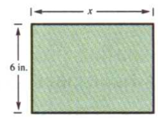
74. $f(x) = |x + 1| - 2$ 75. $g(x) = x^3 - 2$ 76. $h(x) = (x - 2)^3$

77. ***Rocker Arm Design*** Find the distance d between the centers of the two small bolt holes in the rocker arm shown in the figure. Round the result to two decimal places.

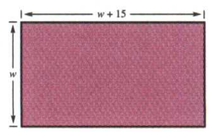


78. ***Velocity of a Ball*** The velocity of a ball thrown upward from ground level is given by $v = -32t + 80$, where t is the time in seconds and v is the velocity in feet per second.
(a) Find the velocity when $t = 2$.
(b) Find the time when the ball reaches its maximum height. (*Hint:* Find the time when $v = 0$.)
(c) Find the velocity when $t = 3$.

79. ***Dimensions of a Rectangle*** The area of the rectangle in the figure is 48 square inches. Find x.



80. ***Dimensions of a Rectangle*** The perimeter of the rectangle in the figure is 110 feet. Find the dimensions of the rectangle.



Geometry

Geometric formulas and concepts are reviewed throughout the text. For reference, common formulas are presented inside the front and back covers.

Chapter Test

Each chapter contains an end-of-chapter test. Answers to chapter tests are given at the end of the text.

2

Chapter Test

Take this test as you would take a test in class. After you are done, check your work against the answers in the back of the book.

1. Determine whether the given value of x is a solution of the equation $3(5-2x)-(3x-1)=-2$.

(a) $x=-4$ (b) $x=2$

2. Solve for r in the equation $2(r-s)=5r-4s+1$.

In Exercises 3–8, solve the equation.

3. $6x-5=19$ **4.** $15-7(1-x)=3(x+8)$ **5.** $\frac{2x}{3}=\frac{x}{2}+4$

6. $\frac{t-5}{12}=\frac{3}{8}$ **7.** $(y+2)^2-9=0$ **8.** $12+5y-3y^2=0$

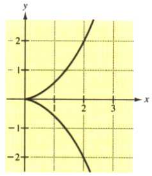
9. Determine the quadrant in which the point (x, y) lies if $xy>0$. Explain your reasoning.

10. Find the distance between the points $(0, 9)$ and $(3, 1)$.

11. Find the x- and y-intercepts of the graph of the equation $y=x(x+1)-3(x+1)$.

12. Sketch the graph of the equation $y=|x-2|$.

13. Use the vertical line test on the graph in the figure to determine whether the equation $y^2(4-x)=x^3$ represents y as a function of x.



14. Evaluate the function $f(x)=3x-2$ at the indicated values.

(a) $f(6)$ (b) $f(x+h)-f(x)$

(c) $f(t+1)$ (d) $f\left(\frac{s}{3}\right)$

15. Sketch the graph of the function $g(x)=\sqrt{x-3}+1$.

Cumulative Test

Cumulative tests have been placed after Chapters 3, 6, and 10. These tests reinforce the message that is presented throughout the text — that mathematics is a continuing story and requires constant synthesis and review. Answers are given at the end of the text.

1-3

Cumulative Test

Take this test as you would take a test in class. After you are done, check your work against the answers in the back of the book.

In Exercises 1 and 2, evaluate the expression.

1. $18-(3-8)$ **2.** $-\frac{8}{45}\div\frac{12}{25}$

In Exercises 3–6, perform the indicated operations and simplify.

3. $(2a^2b)^3(-ab^2)^2$ **4.** $3xy(x^2-2)-xy(x^2+5)$ **5.** $t(3t-1)-2t(t+4)$ **6.** $[2+(x-y)]^2$

In Exercises 7–10, solve the equation.

7. $12-5(3-x)=x+3$ **8.** $1-\frac{x+2}{4}=\frac{7}{8}$ **9.** $y^2-64=0$ **10.** $2t^2-5t-3=0$

11. Determine whether the equation $x-y^3=0$ represents y as a function of x.

12. Find the domain of the function $f(x)=\sqrt{x-2}$.

13. Given $f(x)=x^2-3x$, find (a) $f(4)$. (b) $f(c+3)$.

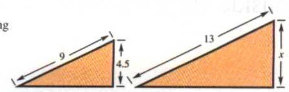
14. Write an algebraic expression for the statement, "The number n is tripled and the product is decreased by 8."

15. Find two consecutive integers such that their sum is 89 less than their product.

16. The annual insurance premium for a policyholder is $1225. Find the annual premium if the policyholder must pay a 15% surcharge because of a driving violation.

17. Solve the proportion $\frac{t-1}{4}=\frac{11}{12}$.

18. Solve for the length x of the side of the second triangle by using the fact that corresponding sides of similar triangles are proportional.



19. Solve and sketch the solution $|x-2|\geq 3$.

20. The revenue from selling x units of a product is $R=12.90x$. The cost of producing x units is $C=8.50x+450$. For a profit to be obtained, the revenue must be greater than the cost. For what values of x will this product produce a profit?

21. Consider the two points $(-4, 0)$ and $(4, 6)$. (a) Find the distance between the points. (b) Find an equation of the line through the points.

22. Sketch a graph of the linear equation $4x+3y-12=0$.

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Supplements

Intermediate Algebra: Graphs and Functions by Larson, Hostetler, and Neptune is accompanied by a comprehensive supplements package for maximum teaching effectiveness and efficiency.

Instructor's Annotated Edition

Student Study and Solutions Guide by Carolyn F. Neptune, Johnson County Community College

Complete Solutions Guide by Carolyn F. Neptune, Johnson County Community College

Test Item File with Ready-made Tests by David C. Falvo, The Pennsylvania State University, The Behrend College

Intermediate Algebra: Graphs and Functions Videotapes by Dana Mosely, Valencia Community College

Intermediate Algebra: Graphs and Functions TUTOR by Timothy R. Larson and John R. Musser

Test-Generating Software (Macintosh, IBM)

Study Skills Videotapes by Paul Nolting

This complete supplements package offers ancillary materials for students and instructors and for classroom resources. Each item is keyed directly to the textbook for ease of use. The components of this comprehensive teaching and learning package are outlined on the following page.

INTERMEDIATE ALGEBRA: GRAPHS AND FUNCTIONS

FOR INSTRUCTORS

Printed Ancillaries

Instructor's Annotated Edition
- Answers to all exercises and tests
- Teaching strategies
- Additional examples and exercises with answers at point of use

Complete Solutions Guide
- Solutions to all text exercises and tests

Test Item File with Ready-made Tests
- Printed test bank
- Over 3500 test items
- Open-ended and multiple-choice test items
- Also available as a computerized test bank

Software

Computerized Test Bank
- Test-generating software
- Over 3500 test items
- Also available as a printed test bank

Test-generating Software
- Algorithmically-based test generator

FOR STUDENTS

Printed Ancillaries

Student Study and Solutions Guide
- Section summaries
- Solutions to all odd-numbered text exercises

Software

TUTOR
- Interactive tutorial software follows text section-by-section
- Diagnostic feedback
- Additional examples
- Chapter self-tests
- Glossary

Videotapes

Intermediate Algebra: Graphs and Functions Videotapes
- Comprehensive coverage
- For media/resource centers
- Additional explanation of important concepts, sample problems, and applications
- Computer-generated graphics

Study Skills Videotapes
- Strategies for studying for and taking tests

CLASSROOM RESOURCES

Printed Ancillaries

Instructor's Annotated Edition
- Answers to all exercises and tests
- Teaching strategies
- Additional examples and exercises with answers at point of use

Videotapes

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Study Skills Videotapes
- Strategies for studying for and taking tests

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If you have suggestions for improving the text, please feel free to write to us. Over the past two decades we have received many useful comments from both instructors and students, and we value these very much.

Roland E. Larson
Robert P. Hostetler
Carolyn F. Neptune

How to Study Algebra

Studying Mathematics

Studying mathematics requires a different approach from many other subjects because it is a linear process. In other words, the material learned on one day is built upon material learned previously. It is necessary to keep up with coursework day by day — there are no shortcuts.

Making a Plan

Make your own course plan right now! Determine the number of hours per week you need to spend on algebra. A good guideline is to study two to four hours for every hour in class. After your first major test you will know if your efforts were sufficient. If you did not make the grade you wanted, then you should increase your study time, improve your study efficiency, or both.

Preparing for Class

Before attending class, read the portion of the text that is to be covered, paying special attention to the definitions and rules that are boxed in blue. This practice takes a lot of self-discipline, but it pays off. If time does not permit, then you should at least review your previous day's notes. Going to class prepared will enable you to benefit much more from your instructor's presentation. Algebra, like most other technical subjects, is easier to understand the second or third time you hear it.

Attending Class

Attend every class. Arrive on time with your text, a pen or pencil, paper for notes, and your calculator. If you have to miss a class, get the notes from another student, get help from your tutor, or view the appropriate mathematics videotape. You must learn the information that was taught in the missed class before attending the next class. Remember, learning mathematics is linear — do not miss class!

Participating in Class

As you read the text before class, write down any questions that you have about the material. Ask your instructor these questions during class to save yourself time and frustration with your homework.

Taking Notes

Take notes in class, especially on definitions, examples, concepts, and rules. Focus on the instructor's cues to indicate important material. Then, as soon after class as possible, read through your notes, adding any explanations that are necessary to make your notes understandable *to you.*

Doing the Homework

Learning algebra is like learning to play the piano or learning to play basketball. You cannot become skilled just by watching someone else do it. You must also do it yourself. The best time to do your homework is right after class, when the concepts are still fresh in your mind. Immediately doing the homework increases the chances of retaining the information in long-term memory.

Finding a Study Partner

When you get stuck on a problem, it may help to try to work with someone else. Even if you feel you are giving more help than you are getting, you will find that teaching others is also an excellent way to learn.

Building a Math Library

Start building a library of books that can help you with this course and future math courses. Consider using the *Student Study and Solutions Guide* that accompanies the text. Also, as you will probably be taking other math courses after you finish this course, we suggest that you keep the text. It will be a valuable reference book. Adding computer software and math videotapes is another way to build your mathematics library.

Keeping Up with the Work

Don't let yourself fall behind in the course. If you think that you are having trouble, seek help immediately. Ask your instructor, attend your school's tutoring service, talk with your study partner, use additional study aids such as videos or software tutorial — do something. If you are having trouble with the material in one chapter of your algebra text, there is a good chance that you will also have trouble with later chapters.

Getting Stuck

Everyone who has ever taken a math course has had this experience: you are working on a problem and cannot solve it, or you have solved it but your answer does not agree with the answer given at the end of the book. People have different approaches to this problem. You might ask for help, take a break to clear your thoughts, sleep on it, rework the problem, or reread the section in the text. Don't get frustrated or spend too much time on a single problem.

Keeping Your Skills Sharp

Before each exercise set in the text we have included a short set of *Warm-Up Exercises*. These exercises will help you review skills that you learned in previous exercises and retain them in long-term memory. These sets are designed to take only a few minutes to solve. We suggest working the entire set before you start each new exercise set. (All of the *Warm-Up Exercises* are answered at the end of the text.)