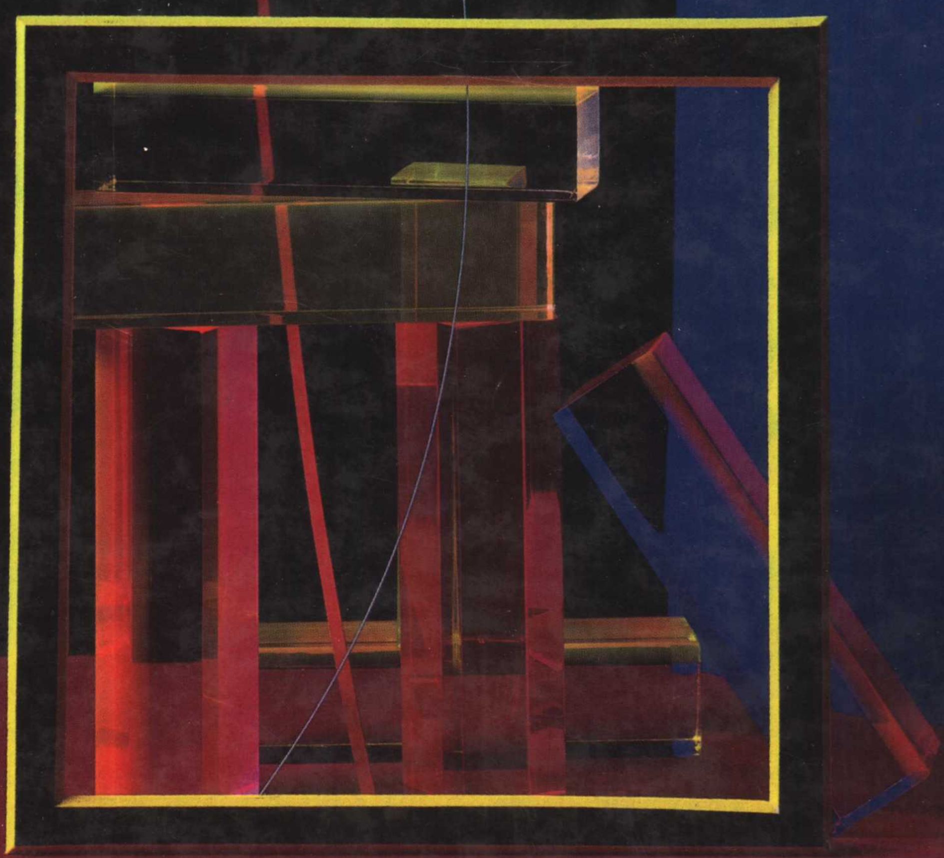
COLLEGE ALGEBRA

Concepts and Models



Larson Hostetler Munn

COLLEGE ALGEBRA
Concepts and Models

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PREFACE

College Algebra: Concepts and Models has two basic goals: First, to help students develop a good understanding of 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.

- **Problem-Solving Process** One general approach to problem solving is stressed throughout. Students are taught to form a verbal model as the first step in solving any application. This step helps students understand the underlying concepts of a problem before the algebraic representation is developed.
- **Graphics** Skill in visualizing a problem is a critical part of a student's ability to solve a problem. To encourage the development of this skill, the text has an abundance of figures in examples, exercise sets, and answers to odd-numbered exercises in the back of the text. Various types of graphics are included to show geometric representations. These include graphs of functions, geometric figures, displays of statistical information, and screen outputs from graphing technology. Graphs are computer-generated for accuracy.
- **Applications** Numerous applications are integrated throughout every section of the text, both as solved examples and as exercises. As a result, students are constantly using and reviewing their problem-solving skills. The text applications are current and have been chosen to connect mathematical concepts to students' experience and to real-world situations. Many use real data, showing that algebra is useful in today's world.
- **Discussion Problems** Appearing at the end of each section, the discussion problems offer students the opportunity to think, talk, and write about mathematics in a different way. 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.
- **Exercise Sets** The exercise sets contain numerous computational and applied problems dealing with a wide range of relevant topics. Anticipating a student's needs, these problems are carefully graded to increase in difficulty as the student's problem-solving skills develop. Each pair of consecutive problems is similar, with the answer to the odd-numbered one given in the back of the text. Exercise sets appear at the end of each text section; an additional set of review exercises is given at the end of each chapter. Other chapter review features are summaries, chapter tests, and cumulative tests. The opportunity to use calculators—to show pattern, to experiment, to calculate, or to create graphic models—is available with several topics.

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

Features of the Text

The features of this text are designed to help students improve their skills and acquire an understanding of mathematical concepts. The functional use of four colors strengthens the text as a pedagogical tool.

Chapter Opener

A list of the topics to be covered and a brief chapter overview provide a survey of the contents of each chapter, showing students how the topics fit into the overall development of algebra.

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

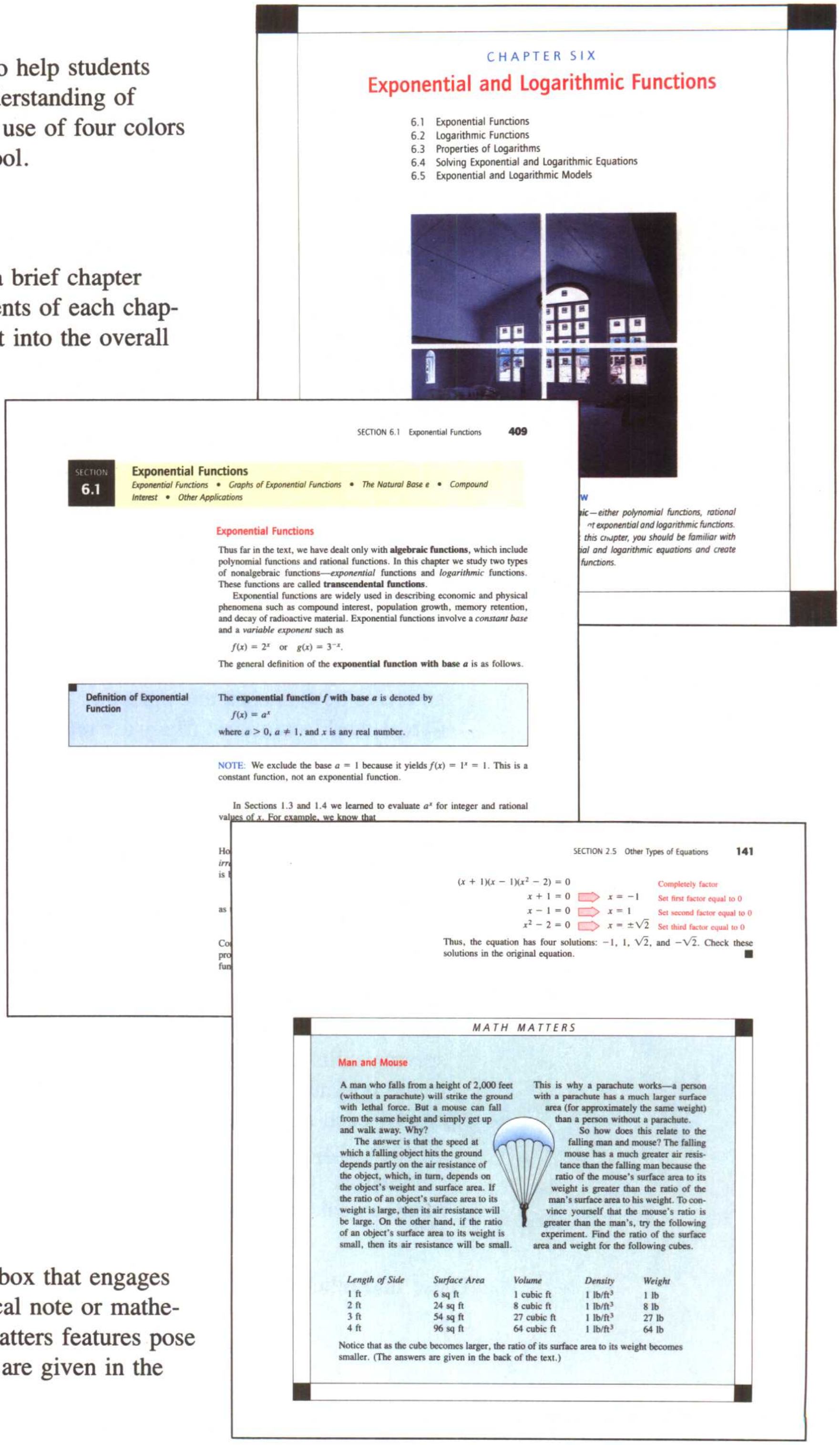
All of the important rules, formulas, and definitions are boxed for emphasis. Each is also titled for easy reference.

Notes

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

Math Matters

Each chapter contains a Math Matters box that engages student interest by discussing a historical note or mathematical problem. Some of the Math Matters features pose questions—in such cases, the answers are given in the back of the text.


CHAPTER SIX

Exponential and Logarithmic Functions

6.1 Exponential Functions
6.2 Logarithmic Functions
6.3 Properties of Logarithms
6.4 Solving Exponential and Logarithmic Equations
6.5 Exponential and Logarithmic Models

SECTION 6.1 Exponential Functions 409

SECTION 6.1 Exponential Functions

Exponential Functions • Graphs of Exponential Functions • The Natural Base e • Compound Interest • Other Applications

Exponential Functions

Thus far in the text, we have dealt only with **algebraic functions**, which include polynomial functions and rational functions. In this chapter we study two types of nonalgebraic functions—*exponential* functions and *logarithmic* functions. These functions are called **transcendental functions**.

Exponential functions are widely used in describing economic and physical phenomena such as compound interest, population growth, memory retention, and decay of radioactive material. Exponential functions involve a *constant base* and a *variable exponent* such as

$f(x) = 2^x$ or $g(x) = 3^{-x}$.

The general definition of the **exponential function with base a** is as follows.

Definition of Exponential Function — The **exponential function f with base a** is denoted by

$f(x) = a^x$

where $a > 0$, $a \neq 1$, and x is any real number.

NOTE: We exclude the base $a = 1$ because it yields $f(x) = 1^x = 1$. This is a constant function, not an exponential function.

In Sections 1.3 and 1.4 we learned to evaluate a^x for integer and rational values of x. For example, we know that

SECTION 2.5 Other Types of Equations 141

$(x + 1)(x - 1)(x^2 - 2) = 0$ — Completely factor

$x + 1 = 0 \Rightarrow x = -1$ — Set first factor equal to 0

$x - 1 = 0 \Rightarrow x = 1$ — Set second factor equal to 0

$x^2 - 2 = 0 \Rightarrow x = \pm\sqrt{2}$ — Set third factor equal to 0

Thus, the equation has four solutions: -1, 1, $\sqrt{2}$, and $-\sqrt{2}$. Check these solutions in the original equation. ■

MATH MATTERS

Man and Mouse

A man who falls from a height of 2,000 feet (without a parachute) will strike the ground with lethal force. But a mouse can fall from the same height and simply get up and walk away. Why?

The answer is that the speed at which a falling object hits the ground depends partly on the air resistance of the object, which, in turn, depends on the object's weight and surface area. If the ratio of an object's surface area to its weight is large, then its air resistance will be large. On the other hand, if the ratio of an object's surface area to its weight is small, then its air resistance will be small.

This is why a parachute works—a person with a parachute has a much larger surface area (for approximately the same weight) than a person without a parachute.

So how does this relate to the falling man and mouse? The falling mouse has a much greater air resistance than the falling man because the ratio of the mouse's surface area to its weight is greater than the ratio of the man's surface area to his weight. To convince yourself that the mouse's ratio is greater than the man's, try the following experiment. Find the ratio of the surface area and weight for the following cubes.

Length of Side	Surface Area	Volume	Density	Weight
1 ft	6 sq ft	1 cubic ft	1 lb/ft^3	1 lb
2 ft	24 sq ft	8 cubic ft	1 lb/ft^3	8 lb
3 ft	54 sq ft	27 cubic ft	1 lb/ft^3	27 lb
4 ft	96 sq ft	64 cubic ft	1 lb/ft^3	64 lb

Notice that as the cube becomes larger, the ratio of its surface area to its weight becomes smaller. (The answers are given in the back of the text.)

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 more than 590 text examples was carefully chosen to illustrate a particular concept or problem-solving technique and to enhance students' understanding. They are titled for easy reference.

120 CHAPTER 2 Algebraic Equations and Inequalities

EXAMPLE 5 ■ **Solving a Quadratic Equation by Extracting Square Roots**

In this case an extra step is needed *after* extracting square roots.

$(x - 3)^2 = 7$ Given equation

$x - 3 = \pm\sqrt{7}$ Extract square roots

$x = 3 \pm \sqrt{7}$ Add 3 to both sides

Thus, the equation has two solutions: $3 + \sqrt{7}$ and $3 - \sqrt{7}$. Check these solutions in the original equation. ■

Applications

Quadratic equations often occur in problems dealing with area. Here is a simple example: "A square room has an area of 144 square feet. Find the dimensions of the room." To solve this problem, we can let x represent the length of each side of the room. Then, by solving the equation

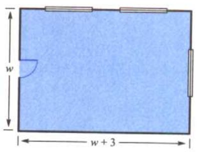
$x^2 = 144$

we can conclude that each side of the room is 12 feet long. Note that although the equation $x^2 = 144$ has two solutions, -12 and 12, the negative solution makes no sense (for this problem), so we choose the positive solution.

EXAMPLE 6 ■ **Finding the Dimensions of a Room**

A bedroom is three feet longer than it is wide and has an area of 154 square feet, as shown in Figure 2.6. Find the dimensions of the room.

FIGURE 2.6



Solution

Verbal model: Width of room · Length of room = Area of room

Labels: Area of room = 154 square feet
Width of room = w (in feet)
Length of room = $(w + 3)$ (in feet)

Algebraic equation:

$w(w + 3) = 154$

$w^2 + 3w - 154 = 0$

$(w - 11)(w + 14) = 0$

$w - 11 = 0 \Rightarrow w = 11$

$w + 14 = 0 \Rightarrow w = -14$

Choosing the positive value, we find that the width is 11 feet and the length is $w + 3 = 14$ feet. You can check this solution by observing that the length is three feet longer than the width *and* that the product of the length and the width is 154 square feet. ■

422 CHAPTER 6 Exponential and Logarithmic Functions

NOTE: The equations $y =$ lo[...] is in logarithmic form and th[...]

When evaluating logarithn[...] means that $\log_a x$ is the exp[...] instance, $\log_2 8 = 3$ because [...]

EXAMPLE 1 ■ **Evaluating Logarithms**

(a) $\log_2 32 = 5$ becaus[...]

(b) $\log_3 27 = 3$ because $3^3 = 27$.

(c) $\log_4 2 = \frac{1}{2}$ because $4^{1/2} = \sqrt{4} = 2$.

(d) $\log_{10} \frac{1}{100} = -2$ because $10^{-2} = \frac{1}{10^2} = \frac{1}{100}$.

(e) $\log_3 1 = 0$ because $3^0 = 1$.

(f) $\log_2 2 = 1$ because $2^1 = 2$. ■

Since $\log_a x$ is the inverse function of a^x, it follows that the domain of $\log_a x$ is the range of a^x, $(0, \infty)$. In other words, $\log_a x$ is defined only if x is positive.

The logarithmic function with base 10 is called the **common logarithmic function**. On most calculators, this function is denoted by [log].

EXAMPLE 2 ■ **Evaluating Logarithms on a Calculator**

Scientific Calculator

Number	*Keystrokes*	*Display*
$\log_{10} 10$	10 [log]	1
$2 \log_{10} 2.5$	2.5 [log] [×] 2 [=]	0.7958800
$\log_{10}(-2)$	2 [+/−] [log]	ERROR

Graphing Calculator

Number	*Keystrokes*	*Display*
$\log_{10} 10$	[log] 10 [ENTER]	1
$2 \log_{10} 2.5$	2 [×] [log] 2.5 [ENTER]	0.7958800
$\log_{10}(-2)$	[log] [(−)] 2 [ENTER]	ERROR

Note that the calculator displays an error message when you try to evaluate $\log_{10}(-2)$. The reason for this is that the domain of every logarithmic function is the set of *positive real numbers*. ■

Calculators

Two types of calculators are discussed: scientific and graphing. Sample keystrokes are given for both. The graphing capability of graphing calculators and computer graphing software is investigated; however, coverage of this material is optional.

Discussion Problems

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

Perpendicular Lines

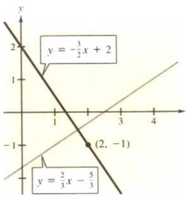
Two nonvertical lines are **perpendicular** if and only if their slopes are negative reciprocals of each other. That is,

$$m_1 = -\frac{1}{m_2}.$$

EXAMPLE 6 ■ Equations of Perpendicular Lines

Find an equation of the line that passes through the point $(2, -1)$ and is perpendicular to the line $2x - 3y = 5$.

FIGURE 3.53



Solution

By writing the given line in the form $y = \frac{2}{3}x - \frac{5}{3}$ we see that the line has a slope of $\frac{2}{3}$. Hence, any line that is perpendicular to this line must have a slope of $-\frac{3}{2}$ (because $-\frac{3}{2}$ is the negative reciprocal of $\frac{2}{3}$). Therefore, the required line through the point $(2, -1)$ has the following equation.

$$y - (-1) = -\frac{3}{2}(x - 2) \qquad \text{Point-slope form}$$

$$y = -\frac{3}{2}x + 3 - 1$$

$$y = -\frac{3}{2}x + 2 \qquad \text{Slope-intercept form}$$

The graphs of both equations are shown in Figure 3.53. ■

DISCUSSION PROBLEM ■ Comparing Forms of Equations of Lines

Write a paragraph that compares the following forms of equations of lines.

1. Slope-intercept form: $y = mx + b$
2. Point-slope form: $y - y_1 = m(x - x_1)$
3. Two-point form: $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

For each of these forms, describe a type of problem for which the form is best suited. ■

DISCUSSION PROBLEM ■ A Mathematical Fall

A mathematical **fallacy**
know is incorrect. For
$1 = 0$ (which, of cours

$$x = 1$$
$$x - 1 = 0$$
$$x(x - 1) = 0$$
$$\frac{x(x-1)}{x-1} = \frac{0}{x-1}$$
$$\frac{x(x-1)}{x-1} = 0$$
$$x = 0$$

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, perform the indicated operations and simplify your answer.

1. $(2x - 4) - (5x + 6)$
2. $(3x - 5) + (2x - 7)$
3. $2(x + 1) - (x + 2)$
4. $-3(2x - 4) + 7(x + 2)$
5. $\frac{x}{3} + \frac{x}{5}$
6. $x - \frac{x}{4}$
7. $\frac{1}{x+1} - \frac{1}{x}$
8. $\frac{2}{x} + \frac{3}{x}$
9. $\frac{4}{x} + \frac{3}{x-2}$
10. $\frac{1}{x+1} - \frac{1}{x-1}$

2.1 EXERCISES

In Exercises 1–6, determine whether the equation is an identity or a conditional equation.

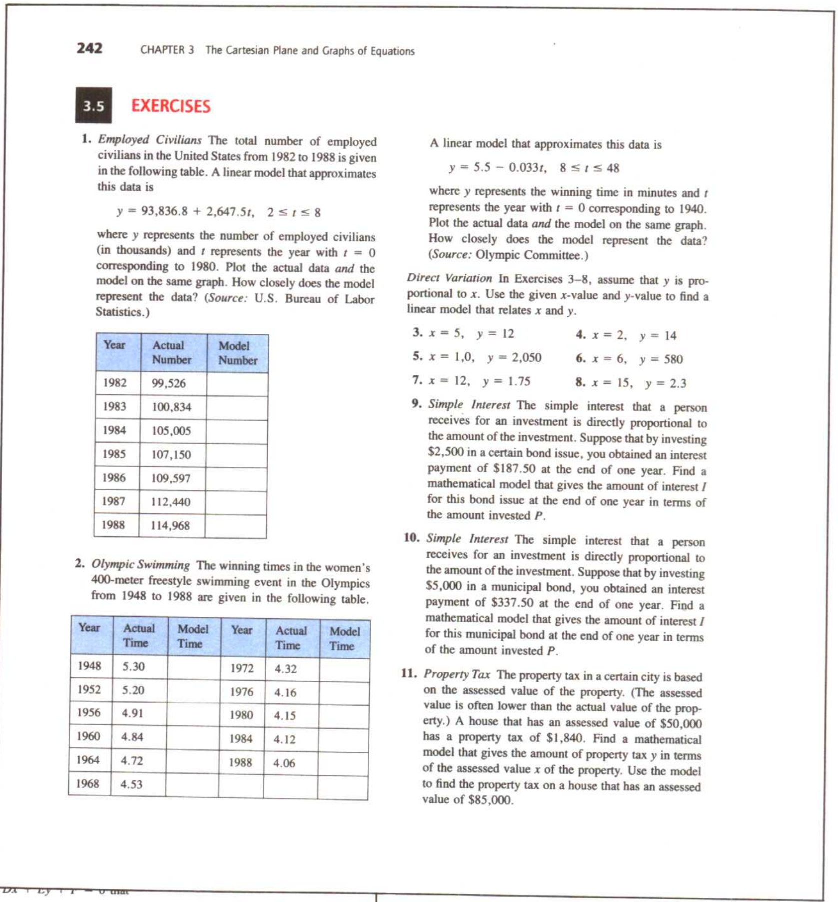
1. $2(x - 1) = 2x - 2$
2. $3(x + 2) = 3x + 6$
3. $2(x - 1) = 3x + 4$
4. $3(x + 2) = 2x + 4$
5. $2(x + 1) = 2x + 1$
6. $3(x + 4) = 3x + 4$

Warm-Up

Each section (other than Section 1.1) contains a set of 10 warm-up exercises that allows students to review and practice the previously learned skills that are necessary to master the "new skills" presented in the section. All warm-up exercises are answered in the back of the text.

Exercises

The nearly 3,900 exercises include both computational and applied problems covering a wide range of topics. These are designed to build competence, skill, and understanding. Each exercise set is graded in difficulty to allow students to gain confidence as they progress. Answers to odd-numbered exercises are in the back of the text.



242 CHAPTER 3 The Cartesian Plane and Graphs of Equations

3.5 EXERCISES

1. *Employed Civilians* The total number of employed civilians in the United States from 1982 to 1988 is given in the following table. A linear model that approximates this data is

$$y = 93{,}836.8 + 2{,}647.5t, \quad 2 \le t \le 8$$

where y represents the number of employed civilians (in thousands) and t represents the year with $t = 0$ corresponding to 1980. Plot the actual data *and* the model on the same graph. How closely does the model represent the data? (*Source:* U.S. Bureau of Labor Statistics.)

Year	Actual Number	Model Number
1982	99,526	
1983	100,834	
1984	105,005	
1985	107,150	
1986	109,597	
1987	112,440	
1988	114,968	

2. *Olympic Swimming* The winning times in the women's 400-meter freestyle swimming event in the Olympics from 1948 to 1988 are given in the following table.

Year	Actual Time	Model Time	Year	Actual Time	Model Time
1948	5.30		1972	4.32	
1952	5.20		1976	4.16	
1956	4.91		1980	4.15	
1960	4.84		1984	4.12	
1964	4.72		1988	4.06	
1968	4.53				

A linear model that approximates this data is

$$y = 5.5 - 0.033t, \quad 8 \le t \le 48$$

where y represents the winning time in minutes and t represents the year with $t = 0$ corresponding to 1940. Plot the actual data *and* the model on the same graph. How closely does the model represent the data? (*Source:* Olympic Committee.)

Direct Variation In Exercises 3–8, assume that y is proportional to x. Use the given x-value and y-value to find a linear model that relates x and y.

3. $x = 5, \quad y = 12$ **4.** $x = 2, \quad y = 14$

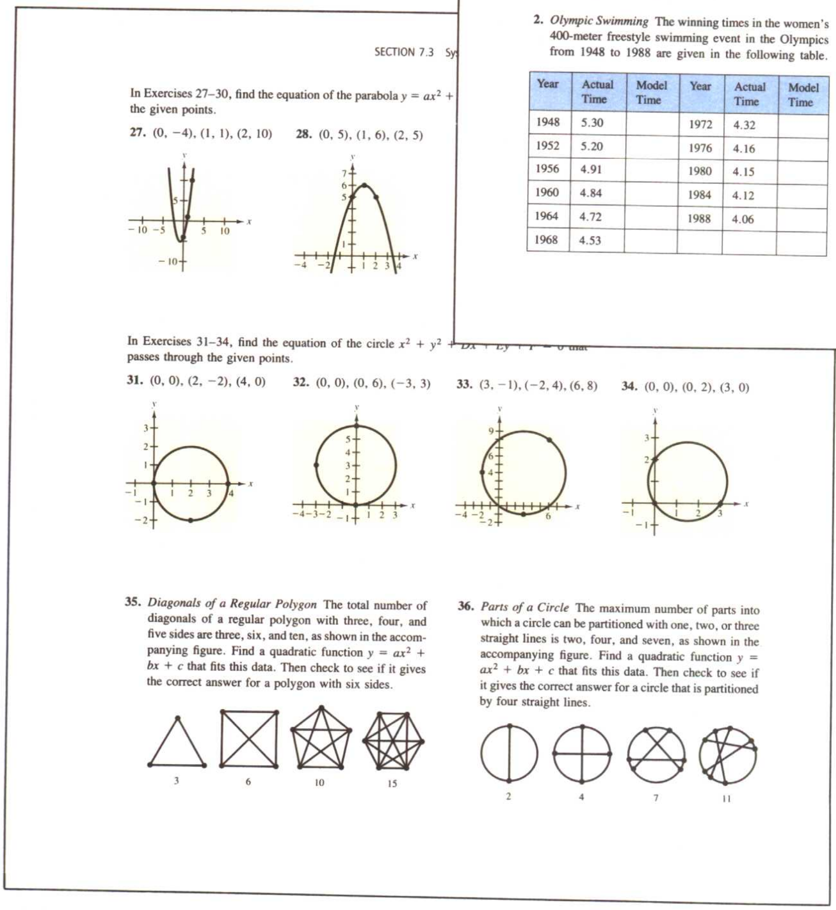
5. $x = 1{,}0, \quad y = 2{,}050$ **6.** $x = 6, \quad y = 580$

7. $x = 12, \quad y = 1.75$ **8.** $x = 15, \quad y = 2.3$

9. *Simple Interest* The simple interest that a person receives for an investment is directly proportional to the amount of the investment. Suppose that by investing \$2,500 in a certain bond issue, you obtained an interest payment of \$187.50 at the end of one year. Find a mathematical model that gives the amount of interest I for this bond issue at the end of one year in terms of the amount invested P.

10. *Simple Interest* The simple interest that a person receives for an investment is directly proportional to the amount of the investment. Suppose that by investing \$5,000 in a municipal bond, you obtained an interest payment of \$337.50 at the end of one year. Find a mathematical model that gives the amount of interest I for this municipal bond at the end of one year in terms of the amount invested P.

11. *Property Tax* The property tax in a certain city is based on the assessed value of the property. (The assessed value is often lower than the actual value of the property.) A house that has an assessed value of \$50,000 has a property tax of \$1,840. Find a mathematical model that gives the amount of property tax y in terms of the assessed value x of the property. Use the model to find the property tax on a house that has an assessed value of \$85,000.



SECTION 7.3 Sy

In Exercises 27–30, find the equation of the parabola $y = ax^2 +$ … the given points.

27. (0, −4), (1, 1), (2, 10) **28.** (0, 5), (1, 6), (2, 5)

In Exercises 31–34, find the equation of the circle $x^2 + y^2 +$ … passes through the given points.

31. (0, 0), (2, −2), (4, 0) **32.** (0, 0), (0, 6), (−3, 3) **33.** (3, −1), (−2, 4), (6, 8) **34.** (0, 0), (0, 2), (3, 0)

35. *Diagonals of a Regular Polygon* The total number of diagonals of a regular polygon with three, four, and five sides are three, six, and ten, as shown in the accompanying figure. Find a quadratic function $y = ax^2 + bx + c$ that fits this data. Then check to see if it gives the correct answer for a polygon with six sides.

3 6 10 15

36. *Parts of a Circle* The maximum number of parts into which a circle can be partitioned with one, two, or three straight lines is two, four, and seven, as shown in the accompanying figure. Find a quadratic function $y = ax^2 + bx + c$ that fits this data. Then check to see if it gives the correct answer for a circle that is partitioned by four straight lines.

2 4 7 11

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, many computer-generated for accuracy.

Applications

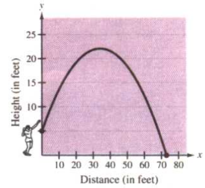
Real-world applications are integrated throughout the text in both examples and exercises. This offers students a constant review of problem-solving skills and emphasizes the relevance of the mathematics. Many of the applications use recent, real data, and all are titled for reference.

SECTION 4.6 Polynomial Functions of Higher Degree **319**

52. *Maximum Height of a Shot-Put* The winning women's shot-put in the 1988 Summer Olympics was thrown by Natalya Lisovskaya of the Soviet Union. The path of her winning toss is approximately given by

$$y \approx -0.01464x^2 + x + 5$$

where y is the height of the shot-put in feet and x is the horizontal distance in feet. How long was the winning toss? What was the maximum height of the shot-put? (See figure.)



53. *Nobel Prize* Nobel prizes are awarded in Swedish currency (krona). During the 1980s, the dollar value of a Nobel Prize fell slightly, then rose according to the model

$$N = 8.563t^2 - 43.71t + 218, \quad 0 \le t \le 10$$

where N is the approximate dollar value (in thousands of dollars) of a Nobel Prize and t represents the calendar year with $t = 0$ corresponding to 1980. (*Source:* Swedish Embassy.) During which year, from 1980 to 1990, was the dollar value of the Nobel Prize at its lowest?

54. *Unemployment Rate* The unemployment rate for married men from September, 1987, to September, 1990, can be approximated by the model

$$P = 0.251t^2 - 4.757t + 25.435, \quad 7 \le t \le 10$$

where P is the percent of married men who were unemployed and t represents the calendar year with $t = 7$ corresponding to September, 1987. (*Source:* U.S. Department of Labor.) During which month was the unemployment rate at its lowest?

SECTION **4.6** **Polynomial Functions of Higher Degree**
Graphs of Polynomial Functions • The Leading Coefficient Test • Zeros of Polynomial Functions • The Intermediate Value Theorem

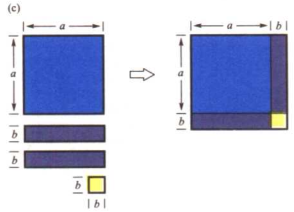
Graphs of Polynomial Functions

At this point you should be able to sketch an accurate graph of polynomial functions of degrees 0, 1, and 2.

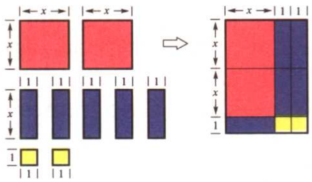
Function	*Graph*
$f(x) = a$	Horizontal line
$f(x) = ax + b$	Line of slope a
$f(x) = ax^2 + bx + c$	Parabola

The graphs of polynomial functions of degree greater than 2 are more difficult to sketch. However, in this section we show how to recognize some of the basic features of the graphs of polynomial functions. Using these features, together

(c)



In Exercises 77–80, make a "geometric factoring model" to represent the given factorization. For instance, a factoring model for $2x^2 + 5x + 2 = (2x + 1)(x + 2)$ is shown in the accompanying figure.



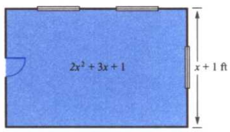
77. $3x^2 + 7x + 2 = (3x + 1)(x + 2)$

78. $x^2 + 4x + 3 = (x + 3)(x + 1)$

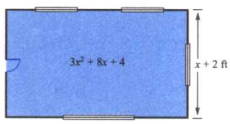
79. $2x^2 + 7x + 3 = (2x + 1)(x + 3)$

80. $x^2 + 3x + 2 = (x + 2)(x + 1)$

81. *Dimensions of a Room* The room shown in the accompanying figure has a floor space of $2x^2 + 3x + 1$ square feet. If the width of the room is $(x + 1)$ feet, what is the length?



82. *Dimensions of a Room* The room shown in the accompanying figure has a floor space of $3x^2 + 8x + 4$ square feet. If the width of the room is $(x + 2)$ feet, what is the length?



Geometry

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

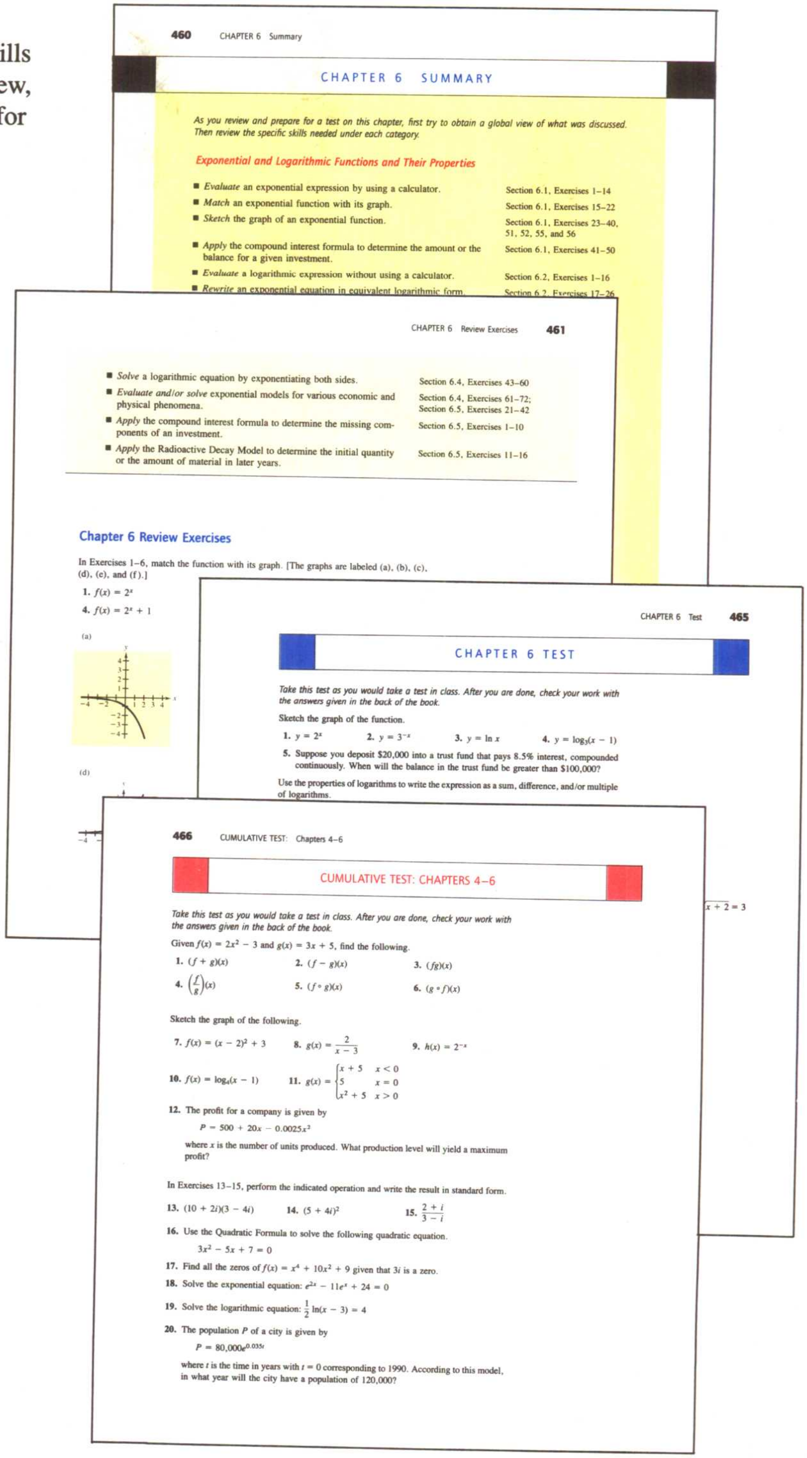
End-of-Chapter Study Aids

A Chapter Summary outlines all of the skills that are presented in the chapter. For review, section and exercise references are given for the major topics.

A set of Review Exercises at the end of each chapter gives students an opportunity for additional practice. Each set of review exercises includes both computational and applied problems covering a wide range of topics.

A Chapter Test allows students to assess their own level of success.

Cumulative Tests appear after Chapters 3, 6, and 9. These tests help students to judge their mastery of previously covered concepts. They also help students maintain the knowledge-base they have been building throughout the text—preparing them for other exams and future courses.



SUPPLEMENTS

College Algebra: Concepts and Models by Larson, Hostetler, and Munn is accompanied by a comprehensive supplements package for maximum teaching effectiveness and efficiency.

- ***Study and Solutions Guide*** by Dianna L. Zook, Indiana University–Purdue University at Fort Wayne
- ***Complete Solutions Guide*** by Dianna L. Zook, Indiana University–Purdue University at Fort Wayne
- ***Instructor's Guide*** by Anne V. Munn, Grayson County College, and Ann R. Kraus, The Pennsylvania State University
- ***Test Item File*** by Ann R. Kraus, The Pennsylvania State University
- *College Algebra: Concepts and Models* Videotapes by Dana Mosely, Valencia Community College
- *College Algebra: Concepts and Models* TUTOR by Timothy R. Larson, Paula M. Sibeto, Kristin Winnen-Smith, and John R. Musser.
- Test-Generating Software
- Classroom Demonstration Software by Timothy R. Larson, Paula M. Sibeto, Kristin Winnen-Smith, and John R. Musser.
- Gradebook Software

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. For the convenience of software users, a technical support telephone number is available with all D. C. Heath software products: (617)860-1218. The components of this comprehensive teaching and learning package are outlined in the diagram on the following page.

COLLEGE ALGEBRA: Concepts and Models

FOR INSTRUCTORS

Printed Ancillaries

Complete Solutions Guide
- Solutions to all text exercises

Test Item File
- Printed test bank
- Over 1,000 test items
- Open-ended and multiple-choice test items
- Available as a computerized test bank

Instructor's Guide
- Chapter commentary with general teaching strategies
- Section topics
- Sample tests
- Transparency masters

Software

Computerized Testing Software
- Test-Generating software
- Over 1,000 test items
- Also available as a printed test bank

Classroom Demonstration Software
- Additional examples with step-by-step solutions
- Interactive, menu-driven resource bank covering major topics
- Animated color graphics

FOR STUDENTS

Printed Ancillaries

Study and Solutions Guide
- Solutions to selected odd-numbered text exercises

Software

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

Videotapes

Videotapes
- Comprehensive coverage
- For media/resource centers
- Additional explanation of important concepts, sample problems, and applications

CLASSROOM RESOURCES

Printed Ancillaries

Instructor's Guide
- Chapter commentary with general teaching strategies
- Section topics
- Sample tests
- Transparency masters

Software

Classroom Demonstration Software
- Additional examples with step-by-step solutions
- Interactive, menu-driven resource bank covering major topics
- Animated color graphics

Gradebook software
- Grade management system

Videotapes

Videotapes
- Comprehensive coverage
- For media/resource centers
- Additional explanation of important concepts, sample problems, and applications

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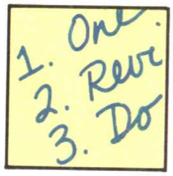
Roland E. Larson
Robert P. Hostetler
Anne V. Munn

HOW TO STUDY ALGEBRA

After years of teaching and guiding students through algebra courses, we have compiled the following list of suggestions for studying algebra. These study tips may take some time and effort—but they work!

Making a Plan



Make your own course plan right now! Determine the number of hours you need to spend on algebra each week. Write your plans on your calendar or some other schedule planner, and then *stick to your plan*.

Preparing for Class

Before attending class, read the portion of the text that is to be covered. This takes a lot of self-discipline, but it pays off. By going to class prepared, you will be able 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.

Participating in Class

As you are reading the text before class, write down any questions that you have about the material. Then, ask your instructor during class.

Taking Notes

Take notes in class, especially on definitions, examples, concepts, and rules. Then, as soon as possible after class, 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 by just watching someone else do it. You must also do it yourself. A general guideline is to spend two to four hours of study outside of class for each hour in class. When working exercises, your ultimate goal is to be able to solve the problems accurately and quickly. When you start a new exercise set, however, understanding is much more important than speed.

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 an excellent way to learn is by teaching others.

Building a Math Library

Start building a library of books that can help you with this and future math courses. You might consider using the *Study and Solutions Guide* that accompanies the text. Also, since 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.

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 services, talk with your study partner, use additional study aids such as videos or software tutorials—but 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 in later chapters.

Getting Stuck

Everyone who has ever taken a math course has had this experience: You are working on a problem and cannot see how to solve it, or you have solved it but your answer does not agree with the answer given in the back of the book. People have different approaches to this sort of 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. The point is, try not to 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. 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 in the back of the text.)

Checking Your Work

One of the nice things about algebra is that you don't have to wonder whether your solution is correct. You can tell whether it is correct by checking it in the original statement of the problem. If, in addition to your "solving skills," you work on your "checking skills," you should find your test scores improving.

Preparing for Exams

Cramming for algebra exams seldom works. If you have kept up with the work and followed the suggestions given here, you should be almost ready for the exam. At the end of each chapter, we have included three features that should help as a final preparation. Read the *Chapter Summary*, work the *Review Exercises*, and set aside an hour to take the sample *Chapter Test*.

Taking Exams

Most instructors suggest that you do *not* study right up to the minute you are taking a test. This tends to make people anxious. The best cure for anxiousness during tests is to prepare well before taking the test. Once the test has begun, read the directions carefully, and try to work at a reasonable pace. (You might want to read the entire test first, then work the problems in the order with which you feel most comfortable.) Hurrying tends to cause people to make careless errors. If you finish early, take a few moments to clear your thoughts and then take time to go over your work.

Learning from Mistakes

When you get an exam back, be sure to go over any errors that you might have made. Don't be too quick to pass off an error as just a "dumb mistake." Take advantage of any mistakes by hunting for ways to continually improve your test-taking abilities.

WHAT IS ALGEBRA?

To some, algebra is manipulating symbols or performing mathematical operations with letters instead of numbers. To others, it is factoring, solving equations, or solving word problems. And to still others, algebra is a mathematical language that can be used to model real-world problems. In fact, algebra is all of these!

As you study this text, it is helpful to view algebra from the "big picture"—to see how the various rules, operations, and strategies fit together.

The rules of arithmetic form the foundation of algebra. These rules are generalized through the use of symbols and letters to form the basic rules of algebra, which are used to *rewrite* algebraic expressions and equations in new, more useful forms. The ability to rewrite algebraic expressions and equations is the common skill involved in the three major components of algebra—*simplifying* algebraic expressions, *solving* algebraic equations, and *graphing* algebraic functions. The following chart shows how this college algebra text fits into the "big picture" of algebra.

Construct ↓ *Rewrite* ↓ *Graph*

Construct ↓ *Rewrite* ↓ *Solve*

Construct ↓ *Rewrite* ↓ *Simplify*

Rules of Arithmetic

1.1 Real Numbers

Rules of Algebra

1 Review of Fundamental Concepts of Algebra

Algebraic Expressions

1 Review of Fundamental Concepts of Algebra
2 Algebraic Equations and Inequalities
4 Functions and Graphs

Matrices, Determinants, Sequences, and Series

8 Matrices and Determinants
9 Sequences, Counting Principles, and Probability

Algebraic Equations

2 Algebraic Equations and Inequalities
5 Finding Zeros of Polynomial Functions
6 Exponential and Logarithmic Functions
7 Systems of Equations and Inequalities
9 Sequences, Counting Principles, and Probability

Functions and Graphs

3 The Cartesian Plane and Graphs of Equations
4 Functions and Graphs
5 Finding Zeros of Polynomial Functions
6 Exponential and Logarithmic Functions