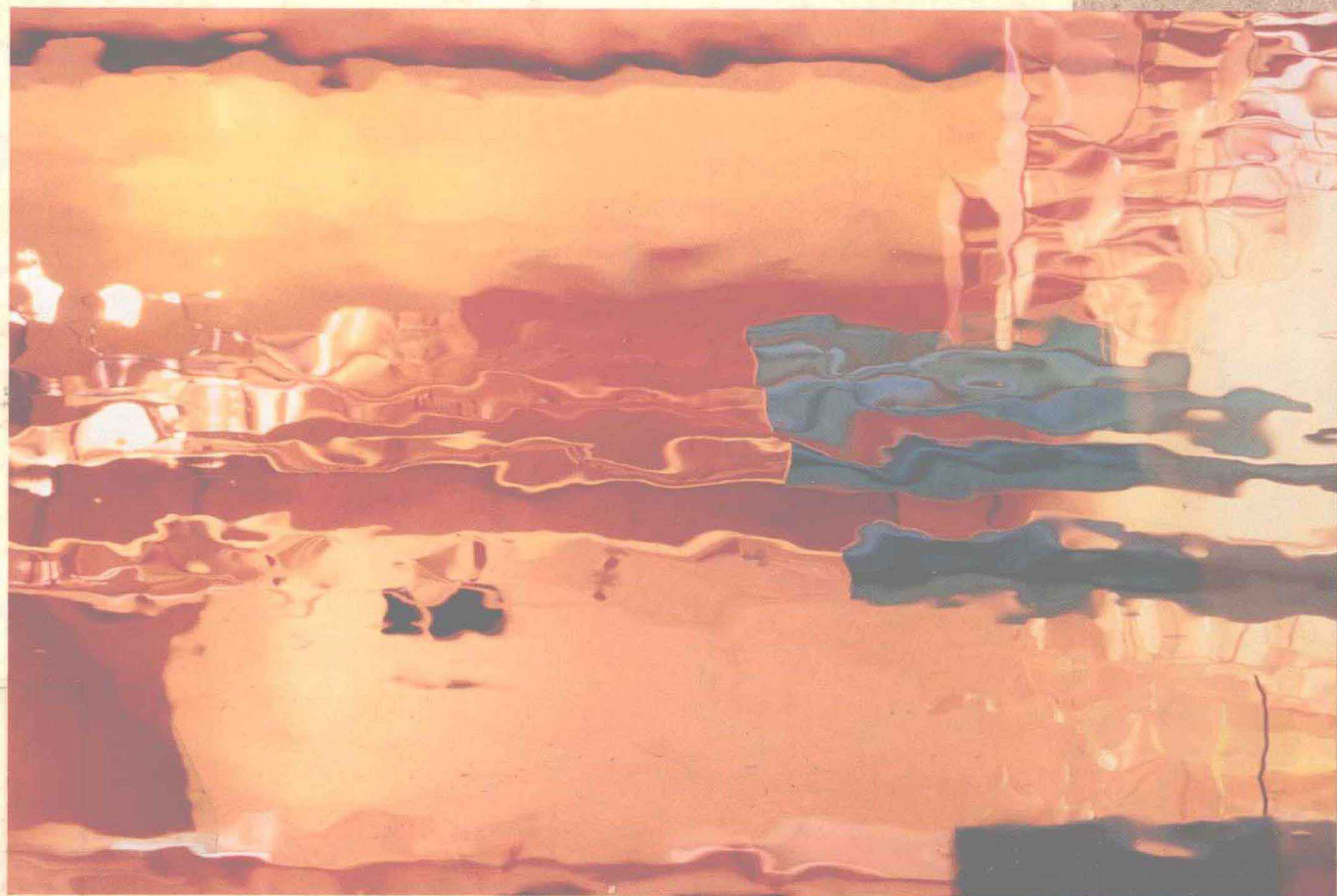


INTERMEDIATE ALGEBRA

WITH EARLY
FUNCTIONS

S E C O N D E D I T I O N

James W. Hall



INTERMEDIATE ALGEBRA WITH EARLY FUNCTIONS SECOND EDITION

James W. Hall
Parkland College



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INTERMEDIATE ALGEBRA WITH EARLY FUNCTIONS

Preface

Intermediate Algebra with Early Functions, Second Edition, is intended to prepare students for a course in college algebra, finite mathematics, or statistics or for other further study in mathematics. It will also equip students for employment in a world where the importance of quantitative reasoning skills is continually increasing. The text features the introduction of graphs and linear functions in Chapter 2; this early introduction of linear functions ensures that fresh material is presented to the student. Coverage of functions and graphing continues throughout the text. See the Table of Contents for an overview of how the coverage is thoroughly integrated.

The text's organization allows for the appropriate use of graphics calculators throughout. The main emphasis is on making mathematical concepts the message, with the graphics calculator used as the messenger wherever it is relevant. This early and graduated use of graphics calculators will provide important background for other courses. This book is designed to work both in classes that fully incorporate the graphics calculator and in those where the instructor uses it occasionally (if only for demonstration purposes). Where appropriate in examples that utilize the graphics calculator, the text illustrates keystrokes for the TI-82 graphics calculator as a model for the student. However, any graphics calculator can be substituted.

Presentation of new ideas in early chapters, appropriate use of modern technology, and inclusion of more real-life applications are all features of this edition designed to produce improvement both in student attitudes and in student performance.

The fundamental organization of this edition builds on the successful presentation of the first edition. New material is introduced clearly and concisely. Examples give the student both a clear mathematical model of the given problem and detailed side-bar explanations of this model. Student aids are abundant and are integrated with the concepts being taught. The exercises contain adequate drill on the basics, as well as material to help students grow mathematically and construct their own bridges between skills and concepts.

Careful pedagogy is employed to ensure that the sections flow and are appropriate for a single lecture. For instance, the general case for the distance formula is developed side by side with a special case. Throughout the text, concepts are related to ideas the students have seen before; then these concepts are developed to a level that will enable students to apply them easily.

FEATURES

New

- *Early Introduction to Functions and Graphs* Early introduction of functions and graphing allows the appropriate use of graphics calculators throughout the book. It also serves to present fresh material to the student who has already completed a Beginning Algebra course. Early in the text many graphs are approximated by broken-line graphs. Thus students can approximate the graphs of a variety of functions without doing anything more complicated than connecting two points with a line segment. This introductory approach opens the door to graphing functions without confronting students with a difficult discussion.
- *Appropriate Use of Technology* Use of scientific and graphics calculators is illustrated wherever appropriate. The emphasis is on the mathematical concepts, with the technology included when it serves a purpose.
- *Emphasis on Estimation Skills* Skills in estimating and checking for the reasonableness of answers are emphasized through exercises designed specifically for this purpose. The appropriate use of technology should be accompanied by a corresponding concern for what is reasonable. The number of exercises on estimation skills has been increased in this edition.
- *Focus on Problem Solving* Consistent with NCTM recommendations, the text focuses on problem solving. There is an early introduction to translating word statements into algebraic statements, and this approach is reinforced throughout the book. Word problems are worked by first forming a **word equation**, which is then translated into an algebraic equation. The use of general principles and tables is emphasized to help the student see the connections that exist between different problems.

New

- *Chapter-Opening Applications* Each chapter opens with an application carefully developed to present the chapter topics in interesting and motivational situations using real-life data provided by industry experts. Students generally work harder when they perceive the material as relevant and important. These chapter openers illustrate the relevance of the mathematics in the chapter and also show possible career opportunities in mathematics.

New

- *Active Applications* These collaborative learning projects, which follow up on selected chapter-opening applications, provide opportunities for students to practice working cooperatively.

New

- *Mathematical Notes* Students should understand that the mathematics they are studying was developed by many civilizations over a long period of time. The Mathematical Notes show where much of the notation we use today came from. They also place mathematics in a more interesting context.

New

- *Geometric Viewpoints* It is appropriate for students who are first viewing new concepts to meet these concepts geometrically, since many of the algebraic methods that we use today were first discovered and used in geometric form.
- *Multiple Representations* Students really understand mathematical principles when they have internalized them and can interpret them from multiple representations. Thus many exercises in the text ask about the same concept from a variety of perspectives. Students will experience the rule-of-three approach, as they see examples and exercises that present real-life functions in numerical, graphical, and algebraic forms.

New

- *Discussion Questions* Students should be able to organize their mathematical ideas and to express them clearly to others. The practice they will receive when responding to the Discussion Questions will not only improve their understanding of mathematics but also contribute to their total education.

New

- *Challenge Questions* These exercises are designed to increase the interest of some students and to foster a variety of problem-solving skills.
- *Self-Check Exercises* Self-check exercises are interspersed throughout for students to check their progress.

New

- *Section Skill Reinforcers* Each section after Section 1-1 contains five exercises that review key skills from earlier in the text.

New

- *Chapter Reviews, Mastery Tests, and Cumulative Reviews* Each chapter has a set of Review Exercises reviewing the entire chapter and a Mastery Test keyed to the chapter objectives. A new Cumulative Review is located after every third chapter.

New

- *Titling of Examples and Exercises* The examples and application exercises have been titled to facilitate the referencing of material by both students and instructors.

New

- *Full Color* The use of full color enlivens the book for the student and facilitates the emphasis of key features. The palette of colors was carefully selected to enhance the pedagogical features of the text.

AN APPLICATION

Time Out for Calculating?

Many professional athletes and coaches now use sophisticated mathematics, implemented on computers, to gain a competitive edge over their opponents. Baseball managers use computers with statistics programs to determine which pitches batters are poorest at hitting. Marathon runners use computer-based motion analysis to fine tune their strides for maximum efficiency. And in mid-race yacht captains use laptop computers to compute optimal sail configurations, based on changing weather conditions.

But not all mathematical applications in sports require the use of computers. The motion of a ball in flight, such as a basketball shot toward a hoop or a football kicked toward a goalpost, can be described fairly well using a quadratic equation. The same sort of equation can describe the motion of a javelin or shot put. Analyzing such an equation can yield useful information. Suppose, for example, that you are a track-and-field coach looking at films of one of your shot-putters at practice; you are watching for the angle at which the shot put leaves the thrower's hand. Using techniques from calculus, it is possible to derive the angle that gives maximum distance. Intuitively, what do you think that angle would be?

The actual path of a thrown or kicked object can be illustrated by the graph of its quadratic function. The graph provides a means of analyzing certain aspects of the flight of the object, including the hang time of a punted football, given its initial upward velocity.

Applications present chapter topics in interesting situations.

Active Applications, keyed to chapter-opening applications, follow selected chapters.

Active Application

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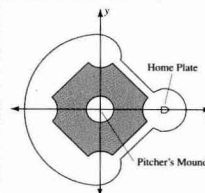
ACTIVE APPLICATION

We will now analyze the motion of a baseball—the familiar curve ball. Place the pitcher's mound at the origin of a coordinate system, and center the front edge of home plate 60 feet away on the positive x -axis. A curve ball thrown by a right-handed pitcher will have a counterclockwise spin, as viewed by the batter, and the pitch will curve toward the first quadrant. A curve ball's motion is actually quite complicated, but the curving path has several reasonable approximations.

1 We can treat the ball's path as a part of a parabola. Suppose the ball leaves the pitcher's hand at $(0, -1)$, initially traveling parallel to the x -axis and reaching home plate over the exact center of its front edge. If the ball's departure point is the vertex of the parabola, what is an equation for the ball's path?

2 If, as many baseball people say, a curve ball hooks more sharply toward the end of its flight than at the beginning, then an ellipse with major axis parallel to the x -axis may be a still better way to describe a curve ball's flight. Suppose the ball travels along

the path $\frac{x^2}{100^2} + \frac{(y-9)^2}{10^2} = 1$. Where will it be when it passes the front edge of home plate? If the ball has to pass the front edge of home plate within $\frac{3}{4}$ ft of its center for a strike, will the pitch be a strike or a ball?

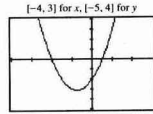


8-5 Quadratic and Rational Inequalities

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EXAMPLE 7 Calculator UsageUse the graph of $y = 2x^2 + 3x - 2$ to solve $2x^2 + 3x - 2 < 0$.**SOLUTION****Keystrokes**

Y= [2] X,T,θ [+] [3] X,T,θ [-] [2] GRAPH

Assume that the window of values has already been set to $[-4, 3]$ for x and $[-5, 4]$ for y .

The solution of $2x^2 + 3x - 2 < 0$ corresponds to the interval for which the graph of $y = 2x^2 + 3x - 2$ is below the x -axis. By inspection or by using the TRACE feature, we can determine that the x -intercepts are -2 and $\frac{1}{2}$. For

$-2 < x < \frac{1}{2}$, the graph is below the x -axis.

Answer $\left(-2, \frac{1}{2}\right)$

Exercises 8-5**A**

In Exercises 1–36 solve each inequality.

- 1 $(x-2)(x+1) < 0$
- 2 $(x+3)(x-1) > 0$
- 3 $v(2-v) \leq 0$
- 4 $-v(v-3) \geq 0$
- 5 $u^2 - 2u \geq 24$
- 6 $4u^2 < 4u + 3$
- 7 $y^2 > 2$
- 8 $y^2 \leq 3$
- 9 $-3x^2 > 17x - 6$
- 10 $-x^2 < 15 - 8x$
- 11 $2x^2 - 3x \geq 2$
- 12 $2x^2 - 5x \leq 3$
- 13 $6y^2 < 20 - 7y$
- 14 $6y^2 \geq 14 - 17y$
- 15 $v^2 + v - 1 \geq 0$
- 16 $v^2 + 2v > 1$
- 17 $(w+1)(w-1)(w-3) > 0$
- 18 $(w+2)(w-1)(w-4) \leq 0$
- 19 $m(m-3)(m+3) \leq 0$
- 20 $m(m-2)(m+4) > 0$
- 21 $(m-2)^2 > 0$
- 22 $(m+1)^2 > 0$

23 $\frac{6}{x-3} < 2$

24 $\frac{6}{x-1} < 2$

25 $\frac{2y-6}{y} < 0$

26 $\frac{2y+4}{y} > 0$

27 $\frac{m-1}{m+2} > 0$

29 $\frac{2x}{x-2} < 6$

30 $\frac{x-2}{x+2} < 3$

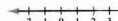
32 $\frac{x-2}{x+2} < 3$

33 $\frac{6}{t-5} \geq t$

35 $\frac{6}{t-5} \geq t$

B

37 Select the inequality with



a. $(x+2)(x+5) > 0$

c. $(x+2)(x+5) < 0$

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Chapter 2 GRAPHS, RELATIONS, AND LINEAR FUNCTIONS

EXAMPLE 10 Solving for the Constant of Variation

If y is inversely proportional to x , transpose the equation of variation to solve for the constant of variation k in terms of x and y and then determine k if $y = 12$ when $x = 4$.

SOLUTION y is inversely proportional to x .

$y = \frac{k}{x}$ Translate the word equation into an algebraic equation.

$xy = \frac{k}{x} \cdot x$ Multiply both sides of the equation by x .

$xy = k$ Then solve for k .

$k = (4)(12)$ Substitute the given values for x and y .

$k = 48$

When y varies directly as x , the constant of variation will determine whether y increases or decreases as x increases. If the constant of variation is positive, as in $y = 2x$, then y increases as x increases. If the constant of variation is negative, as in $y = -2x$, then y decreases as x increases. However, in both of these cases increasing magnitudes of x yield increasing magnitudes of y . This relationship is discussed further in the geometric viewpoint below.

SELF-CHECK

- 1 The pressure exerted on an object submerged in an experimental fluid is directly proportional to the depth at which the object is submerged. The pressure on the object at 4 meters is 9 kilograms per square centimeter. What pressure is exerted at 10 meters?
- 2 The variable a varies jointly as b and c and inversely as d . Write the equation of variation, and then transpose this equation to solve for the constant of variation k .

Examples have titles and side-bar comments that make them easier for students to understand.

Geometric Viewpoints help students visualize algebraic concepts geometrically.

A Geometric Viewpoint: Direct and Inverse Variation

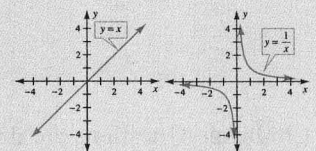
Variables that are in direct and inverse variation have quite distinctive behaviors that can readily be observed from a table of values for the variables. For $y = kx$, a statement of direct variation, increasing magnitudes of the x variable produce increasing magnitudes of the y variable. By contrast, for $y = \frac{k}{x}$, a statement of inverse variation, increasing magnitudes of the x variable produce decreasing magnitudes of the y variable. These behaviors are illustrated in the following tables.

x	1	2	3	4	6	12	24
y	2	4	6	8	12	24	48

(a) As the magnitude of x increases, the magnitude of y increases. In this case, $y = 2x$.

(b) As the magnitude of x increases, the magnitude of y decreases. In this case, $y = \frac{24}{x}$.

The distinctive behaviors of direct and inverse variation can also be readily observed from the graphs of the ordered pairs (x, y) on a rectangular coordinate system. This is illustrated by the graphs of $y = 1 \cdot x$ and $y = \frac{1}{x}$ shown below.



(a) As the magnitude of x increases, the magnitude of y increases.

(b) As the magnitude of x increases, the magnitude of y decreases.

SELF-CHECK ANSWERS

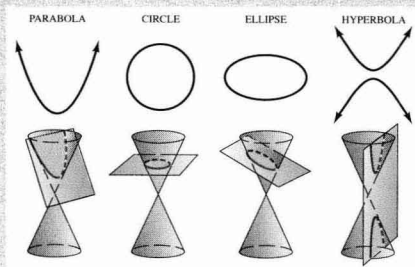
1 22.5 kg/cm² 2 $a = \frac{kbc}{d}$; $k = \frac{ad}{bc}$

CHAPTER 9 OBJECTIVES

- 1 Calculate the distance between two points (Section 9-1).
- 2 Determine the midpoint between two points (Section 9-1).
- 3 Graph a parabola (Section 9-2).
- 4 Determine the maximum or the minimum of a quadratic function (Section 9-2).
- 5 Graph a circle and an ellipse (Section 9-3).
- 6 Graph a hyperbola (Section 9-4).
- 7 Identify the type of conic section from its equation (Section 9-4).

René Descartes developed analytic geometry in 1619 (see Section 2-1). Prior to Descartes, algebra was concerned with numbers and calculations, and geometry was concerned with figures and shapes. By associating points in the plane with ordered pairs of numbers, Descartes merged the power of these areas into analytic geometry. In this chapter we will use algebra to calculate both the distance between two points and the midpoint between two points. The distance and midpoint formulas are important algebraic tools for analyzing geometric shapes.

Some of the geometric shapes that we will examine in this chapter are parabolas, circles, ellipses, and hyperbolas. These shapes are referred to collectively as *conic sections*, because each of these figures can be obtained by intersecting a plane and a cone.



9-1 The Distance and Midpoint Formulas

SECTION OBJECTIVES

- 1 Calculate the distance between two points.
- 2 Determine the midpoint between two points.

An important measurement along a straight line is the distance between two points. To develop the formula for the distance between two points, we will first consider the horizontal and vertical changes between these points and then use

Section Objectives are listed at the beginning of each section.

Challenge Questions are designed to foster problem-solving skills.

Section Skill Reinforcers review key skills from previous sections.

Chapter Objectives, keyed to sections, begin each chapter.

Exercises in Calculator Usage and Estimation Skills are featured in most sections, as are Discussion Questions.

7-1 Rational Exponents

365

C

In Exercises 59–61 simplify each expression. Assume that x and y represent positive real numbers and that m is a natural number.

$$59. x^{m/3}y^{m/2} \quad 60. \frac{16x^{m/2}}{2x^{m/3}} \quad 61. (x^{m/3}y^{m/2})^n$$

$$62. \text{Factor } x^{3/2} + 3x^{1/2} - 4x^{1/2} \text{ by first factoring out } x^{1/2}.$$

$$63. \text{Factor } x^{3/2} - 25x^{-1/2} \text{ by first factoring out } x^{-1/2}.$$

64 Complete the following table for $y = x^{1/2}$. Then use these points to draw a line graph of $y = x^{1/2}$.

x	0	0.25	0.81	1.00	1.44	2.25	4	9
y								

65 Complete the following table for $y = x^{1/3}$. Then use these points to draw a line graph of $y = x^{1/3}$.

x	0	0.027	0.125	1	8
y					

CALCULATOR USAGE (66–70)

In Exercises 66–70 use a calculator with a power key labeled x^y or $\frac{\square}{\square}$ to approximate each number to five significant digits.

$$66. 37^{1/5} \quad 67. 73^{1/4} \quad 68. 12^{2/3} \quad 69. 128^{2/7}$$

70 The third power of the fifth root of 86

71 Give an example of a real number x for which $x^{1/2}$ is defined but $x^{-1/2}$ is undefined.

DISCUSSION QUESTIONS (72 AND 73)

72 Explain why $x^{1/2}$ is defined to be \sqrt{x} .

73 Give an example of a real number x for which $(x^{1/2})^{1/2} \neq x$. Discuss why this does not violate the power rule which states $(x^a)^b = x^{ab}$.

CHALLENGE QUESTION

- Which is larger: $(2^3)^2$ or $2^{(3^2)}$?
- Which is larger: $(3^3)^2$ or $3^{(3^2)}$?
- Which is larger: $2^{(3^2)}$ or $4^{(3^2)}$?

- 41 $3n^{5/11}(2n^{1/11} - 5n^{6/11} - 9)$
- 42 $4n^{-5/3}(3n^{1/3} - 7n^{8/3} + 2n^{7/3})$
- 43 $(a^{1/2} + 3)(a^{1/2} - 3)$
- 44 $(2a^{1/2} - 3b^{1/2})(2a^{1/2} + 3b^{1/2})$
- 45 $(b^{3/5} - c^{3/5})(b^{3/5} + c^{3/5})$
- 46 $(b^{3/5} + c^{3/5})^2$
- 47 $(b^{3/5} - c^{3/5})(b^{3/5} - c^{3/5})$
- 48 $(x^{1/2} - x^{-1/2})^2$
- 49 $(x^{-1/2} + x^{1/2})^2$
- 50 $(x^{2/3} + y)(x^{-2/3} - x)$
- 51 $(y^{1/3} + 2)(y^{2/3} - 2y^{1/3} + 4)$
- 52 $(3y^{1/3} - 5)(9y^{2/3} + 15y^{1/3} + 25)$
- 53 $[(3^{1/3} + 5^{1/3})(3^{2/3} - 15^{1/3} + 5^{2/3})]^{3/3}$
- 54 $[(14^{1/3} - 5^{1/3})(14^{2/3} + 70^{1/3} + 5^{2/3})]^{3/2}$

ESTIMATION SKILLS (55–58)

- 55 The best mental estimate of $145^{1/2}$ is _____.
a. 73 b. 72 c. 14 d. 13 e. 12
- 56 The best mental estimate of $170^{1/2}$ is _____.
a. 96 b. 97 c. 14 d. 13 e. 12
- 57 The best mental estimate of $1003^{1/3}$ is _____.
a. 333 b. 300 c. 133 d. 100
- 58 The best mental estimate of $124^{1/3}$ is _____.
a. 42 b. 43 c. 41 d. 5 e. 10

SECTION SKILL REINFORCERS

- 1 Which is a rational number: $\sqrt{9}$ or $\sqrt{10}$?
- 2 Which is an irrational number: $\sqrt{63}$ or $\sqrt{64}$?
- 3 List one rational number between $\sqrt{5}$ and $\sqrt{6}$.
- 4 Simplify $|-7| + |7|$.
- 5 Simplify $|23| - |-23|$.

Key Concepts are summarized at the end of each chapter.

A Mastery Test, keyed to chapter objectives, ends each chapter.

Key Concepts for Chapter 8

- The standard form of a quadratic equation in x is $ax^2 + bx + c = 0$, where a , b , and c represent real constants and $a \neq 0$.
- A quadratic equation has either two distinct solutions or a solution of multiplicity two. These solutions may be either real or imaginary.
- Methods of solving quadratic equations:
 - Factoring
 - Extraction of roots
 - Completing the square
 - The quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- Nature of the solutions of a quadratic equation if a , b , and c are rational constants and $a \neq 0$:

Discriminant, $b^2 - 4ac$	Nature of the Solutions
Positive and a perfect square	Two distinct rational solutions

Review Exercises for Chapter 8

In Exercises 1–22 solve each equation by the most appropriate method.

- $y^2 = 144$
- $x = 9w - 20$
- $x^2 - 4x + 2 = 0$
- $(y - 3)^2 = 36$
- $10m^2 = 21m + 10$
- $2y^2 = 6y - 9$
- $-9v^2 + 24v = 16$
- $6(x - 3)(x + 5) = 26x$
- $y^4 = 81$
- $z^4 = 14z^2 + 32$
- $(m^2 - 3m)^2 - 44(m^2 - 3m) + 160 = 0$
- $(5x^2 + 1) - 22\sqrt{5x^2 + 1} - 21 = 0$
- $\left(\frac{2w-1}{w-2}\right)^2 + 2\left(\frac{2w-1}{w-2}\right) = 3$
- $15m^{-2} = 17m^{-1} + 4$
- $(n + 5)(2n - 3)(3n - 10) = 0$
- $y^3 - 8 = 0$
- $\sqrt{x+12} - x = 0$
- $\sqrt{2x-1} = x - 2$
- $m - 3 = \frac{4}{m}$
- $\frac{x}{2x-9} = \frac{x+2}{x-2}$
- $v^{2/3} - 26v^{1/3} = 27$
- $\frac{5y-1}{3y+5} - \frac{4y+1}{2y-3} = \frac{18}{6y^2+y-15}$

Review Exercises for each chapter review current and previous concepts.

A Cumulative Review is placed at the end of every third chapter.

Review Exercises for Chapter 8

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Discriminant, $b^2 - 4ac$

Positive and not a perfect square
Zero
Negative

Nature of the Solutions

Two distinct irrational solutions
A rational solution of multiplicity two
Two imaginary solutions that are complex conjugates

Mastery Test for Chapter 8

453

- Construct a quadratic equation in x that has the given solutions.

a. $\frac{3}{4}$ and 5

b. $\frac{1+\sqrt{3}}{2}$ and $\frac{1-\sqrt{3}}{2}$

c. $2 - 5i$ and $2 + 5i$

- Construct a cubic (third-degree) equation in x that has solutions 0, 4, and 7.

- Error Analysis** Examine the student's work shown below, and correct all of the errors that you find.

$$\begin{aligned} (x-2)(2x+3) &= 2x-6 \\ 2x^2-x-6 &= 2x-6 \\ 2x^2-x &= 2x \\ 2x-1 &= 2 \\ 2x &= 3 \\ x &= \frac{3}{2} \end{aligned}$$

Mastery Test for Chapter 8

Exercise numbers correspond to Section Objective numbers.

- Solve each of these quadratic equations by extraction of roots.

a. $v^2 = 19$

c. $(2x - 3)^2 = 36$

- Solve each the square.

a. $m^2 + 4$

c. $-4x^2 - 2$

- Solve each dratic form

a. $6x^2 - 1$

c. $3v^2 + 1$

- Use the dis

- Solve each

a. $x^4 - 34$

c. $\left(\frac{v}{v-2}\right)^2 = 3$

- Solve each of these equations.

a. $\sqrt{x+42} + x = 0$

b. $\sqrt{x+4} = x+1$

Cumulative Review of Chapters 7–9

The limited purpose of this review is to help you gauge your mastery of Chapters 7, 8, and 9. It is not meant to examine each detail from these chapters, nor is it meant to focus on specific sections that may be emphasized at any one particular school.

In Exercises 1–20 perform the indicated operations, and express the answer in simplest form.

1 $\left(\frac{8}{125}\right)^{1/3}$

2 $(36)^{-3/2}$

3 $\sqrt[3]{1,000,000} - \sqrt[3]{1,000,000}$

4 $(\sqrt{5} + \sqrt{2})^2$

5 $\frac{14}{\sqrt{7} + \sqrt{5}}$

6 $3\sqrt{8} - 5\sqrt{18}$

7 $(3x^{2/3}y^{1/3})(5x^{1/3}y^{-2/3})$

8 $\frac{12x^{3/4}y^{1/4}}{6x^{2/3}y^{-2/3}}$

9 $(16x^{3/4}y^{1/4})^{3/4}$

10 $\frac{(x^3y^2)^{1/4}}{(xyz)^{1/2}}$

11 $\sqrt{x^3y^3}$

12 $\sqrt{x^3y^3}$

13 $5(3 - 7i) + 2(4 - 2i)$

14 $(3 - 7i)(4 + 2i)$

15 $\frac{\sqrt{3x} + \sqrt{5y}}{\sqrt{3x} - \sqrt{5y}}$

16 $\frac{3 + 5i}{3 - 5i}$

17 $\sqrt{-36} - \sqrt{-16}$

18 $\frac{130}{4 + 7i}$

19 $\frac{x^3 - y^3}{6x^2 - 6y^2} \cdot \frac{2x^2 + 2xy + 2y^2}{9xy}$

20 $\frac{2z + 11}{z^2 + z - 6} + \frac{2}{z + 3} - \frac{3}{z - 2}$

In Exercises 21–30 solve each equation.

21 $(2x - 3)(x + 4) = 0$

22 $6v^2 + 11v - 10 = 0$

23 $(2x - 3)(x + 4) = -12$

24 $2w^3 - 8w = 0$

25 $\sqrt{4u - 6} = 8$

26 $\sqrt[3]{4m + 12} = 2$

27 $\sqrt{5x + 6} = x$

28 $\frac{12}{x + 2} = \frac{6}{x - 1}$

29 $\frac{4}{m^2 + 2m - 3} - \frac{3}{m + 2} = \frac{1}{m - 1}$

30 $x^4 = 29x^2 - 100$

31 Solve $x^2 + 3xy - 10y^2 = 0$ for x .

32 Construct a quadratic equation in x with solutions -3 and $\frac{4}{5}$.

- Length of a Rafter** Find the length in feet of the rafter r shown in the figure. The lengths of the two braces are $r - 2$ and $r - 9$.

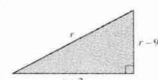


Figure for Exercise 33

- Average Speed** An automobile completed a 480-kilometer trip. If the average rate had been increased by 10 kilometers per hour, the trip would have taken 2 hours less than if the average rate had been decreased by 10 kilometers per hour. What was the average rate for this trip?
- Solve $x^2 - 6x - 8 = 0$.
- Solve $\frac{x^2 - x - 20}{x - 2} < 0$.
- Calculate the distance between $(-2, -2)$ and $(3, 10)$.
- Determine the midpoint between $(-2, 5)$ and $(6, -7)$.
- Calculate the slope of the line through $(-1, -8)$ and $(5, 4)$.
- Write the equation of a line through $(3, 7)$ and perpendicular to $y = -\frac{1}{5}x + 3$.
- Write the equation of the perpendicular bisector of the line segment connecting $(1, -2)$ and $(5, 4)$.
- Write the value of the discriminant of $2x^2 + 4x + 3 = 0$, and determine the nature of the solutions of this equation.
- Average Cost** The average cost of producing x units of a radio is given by $C(x) = x^2 - 85x + 1850$. Determine the minimum average cost.
- Dog Food Mixture** A mixture of dog food is created by mixing two sources. Source A contains 12% protein and 40% carbohydrates, and source B contains 25% protein and 30% carbohydrates. How many grams of each source should be mixed to obtain a supplement containing 272 grams of protein and 480 grams of carbohydrates?
- Speed of an Airplane** Two planes with the same air speed depart 1 hour apart and travel in opposite directions. The plane that departs first flies directly into a 50-mile-per-hour wind, and the second plane flies with this wind. After a period of time radar indicates that the first plane has traveled 375 miles and the second plane has traveled 450 miles. Determine the air speed of each plane.
- Determine the vertex of the parabola $y = 2(x - 3)^2 + 4$.
- Determine the center of the circle $x^2 + y^2 + 8x + 10y + 40 = 0$.
- Determine the x - and y -intercepts of the ellipse $\frac{x^2}{100} + \frac{y^2}{49} = 1$.

SUPPLEMENTS TO ACCOMPANY THE TEXT

For Instructors:

- *Instructor's Edition* contains answers to all exercises in a section at the end of the book.
- *Instructor's Manual* has answers to all exercises and suggested procedures, where appropriate, for Challenge Questions.
- *Test Bank with Transparency Masters* contains all questions and answers from the computerized test bank, three ready-to-use tests (two open-ended and one multiple choice) for each chapter, two final examinations, and a set of transparency masters.
- *Computer Testing Software* is available both for the IBM and compatibles and for the Macintosh. These computerized test banks contain multiple-choice and open-ended questions and allow the user to edit, rearrange, and add to the question bank. *EXPTest* runs on Windows or DOS, and *Exam-Builder* runs on the Macintosh.

For Students:


- *Student Solutions Manual* contains a complete worked-out solution for every other odd problem.
- *MathQuest Tutorial Software* is an interactive, text-specific tutorial which runs on both Windows and Macintosh platforms. The program poses fill-in and multiple-choice questions. If a student answers a question incorrectly, the program will first respond with hints; if the student answers incorrectly a second time, the program will supply a step-by-step solution. Scorekeeping capabilities enable students to monitor their progress. *DOS Tutorial Software* with similar capabilities is also available.
- *Videotape Series* features professional math instructors and reviews key topics in the text. These tutorial tapes, produced by Educational Video Resources, are free to adopters for use in math labs.
- *Video Guidebook* provides exercises that link the content of the text to the videos. For each video that accompanies the text, a three-part lesson ("Pretest," "While You Watch," and "Posttest") engages the student in active learning. All answers are provided, making this worktext especially helpful for independent learners.

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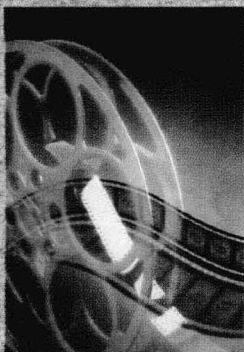
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