

SECOND EDITION

INTERMEDIATE  
ALGEBRA  
A Modern Approach

Keedy-Bittinger

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# **INTERMEDIATE ALGEBRA**

## **A MODERN APPROACH**

**SECOND EDITION**



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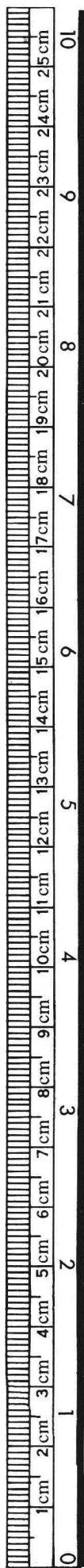
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Centimeters (cm); 1 millimeter =  $\frac{1}{10}$  centimeter



# **TABLES OF MEASURES** (see pages 529–541 for more on the metric system)

## **LENGTH**

1 kilometer (km)	=	1000 meters (m)
1 hectometer (hm)	=	100 meters
1 dekameter (dam)	=	10 meters
1 decimeter (dm)	=	0.1 meter
1 centimeter (cm)	=	0.01 meter
1 millimeter (mm)	=	0.001 meter

## **MASS OR WEIGHT**

1 kilogram (kg)	=	1000 grams (g)
1 hectogram (hg)	=	100 grams
1 dekagram (dag)	=	10 grams
1 decigram (dg)	=	0.1 gram
1 centigram (cg)	=	0.01 gram
1 milligram (mg)	=	0.001 gram
1 metric ton (MT or t)	=	1000 kilograms

## **AREA**

1 hectare (ha)	=	100 are (a), or 10,000 sq m (m <sup>2</sup> )
1 are (a)	=	100 sq m (m <sup>2</sup> )
1 centare (ca)	=	0.01 are, or 1 m <sup>2</sup>

The word “are” is pronounced “AIR.”

## **VOLUME**

1000 cubic centimeters (cc or cm <sup>3</sup> )	=	1 liter (ℓ)
1 cubic centimeter (cc)	=	1 milliliter (mℓ)
1 mℓ of water weighs		1 g
1 stere	=	1 cubic meter

## **METRIC-AMERICAN CONVERSIONS** (Approximate)

### **LENGTH**

1 m	=	39.37 in. = 3.3 ft
1 in.	=	2.54 cm
1 km	=	0.62 mi
1 mi	=	1.6 km
1 cm	=	$\frac{3}{8}$ in.

### **MASS OR WEIGHT**

1 kg	=	2.2 lb
1 MT	=	1.1 tons
1 lb	=	454 g
1 oz	=	28 g
1 g	=	weight of a raisin, or weight of a paperclip

### **AREA**

1 hectare	=	2.47 acres
1 are	=	120 sq yd

### **VOLUME**

1 liter	=	1.057 qt = 2.1 pt
1 cup	=	240 mℓ
1 ounce (liquid)	=	30 mℓ
1 gallon	=	3.78 liters
1 tablespoon	=	15 mℓ
1 teaspoon	=	5 mℓ

## **Some Familiarization Exercises**

- Measure yourself in centimeters.  
Height = \_\_\_\_\_ centimeters  
Chest/ \_\_\_\_\_ centimeters  
Bust = \_\_\_\_\_ centimeters  
Waist = \_\_\_\_\_ centimeters  
Hips = \_\_\_\_\_ centimeters
- Measure your weight in kilograms.  
Weight = \_\_\_\_\_ kilograms
- Measure this book in centimeters.  
Length = \_\_\_\_\_ centimeters  
Width = \_\_\_\_\_ centimeters  
Thickness = \_\_\_\_\_ centimeters
- Measure the weight of this book in grams.  
Weight of book = \_\_\_\_\_ grams

# **INTERMEDIATE ALGEBRA**

## **A MODERN APPROACH**

**SECOND EDITION**

# PREFACE TO SECOND EDITION

---

The users of the first edition have been so enthusiastic in their response and so helpful in offering constructive criticism, the authors first wish to say "thank you."

## WHAT'S NEW IN THE SECOND EDITION?

**Suggestions from Users.** In various places errors have been corrected, changes in wording have been made, boldface type has been used, and exercises have been added, deleted, or changed. Chapter 2 in the first edition, which was rather long, has been divided into two chapters. There is also a new, more detailed index, and the headings of chapters, sections, exercise sets, and answers have been redesigned to make them easier to use.

**The Metric System.** To aid transition to the metric system, we have used metric units in approximately 50% of the applied problems. Students do not need to know what the metric units are in order to solve the problems, but if they wish they can take a "short course" on the metric system using the newly-added Appendix B: "The Metric System," and the familiarization material on the inside front cover.

## SUGGESTIONS FOR USING THIS BOOK

In the preface to the first edition, it was pointed out that there are many ways in which this book can be used, and flexibility in that regard is one of the book's important features. The book has been very effective in lecture, math lab, and independent study situations.

Worth special mention is a teaching method developed by some users that works well in classes of all sizes, notably large ones. The instructor does not lecture, but makes assignments which students do on their own, including working exercise sets. The following class period the instructor spends answering questions. Students have an additional day or two to polish their homework before handing it in. In the meantime, they are working on the next assignment. This method has the advantage of providing individualization while at the same time keeping the class together and working as a group. It also minimizes the number of instructor man-hours required.

## SUPPLEMENTS THAT ACCOMPANY THE SECOND EDITION

In order to further enhance flexibility in using this book, the following (optional) supplements are now available:

- *Audio-Tape Cassettes* are available for use in audio-tutorial or math lab situations.
- *An Instructor's Manual* contains commentary and a sample course syllabus.
- *A Test Booklet* contains five alternate forms of each chapter test and the final examination, with answers spaced for easy grading.
- *An Answer Booklet* contains the answers to all of the exercises.
- *A Student's Solutions Booklet* contains worked out solutions to all of the margin exercises.

## ACKNOWLEDGEMENTS

The authors especially wish to thank Donald Evans, Betty Crawshaw, Dave Buckley, and Don Knorr of Polk Community College for their detailed and helpful suggestions for revision. Thanks also to Richard Spangler, Tacoma Community College; Matt Hassett and Paul Livermore, Arizona State University; Richard Thompson, Arizona University; Wilson Brumley, Colorado State University; Lucille Park, Pima Community College; Murphy Johnson, Arnie Stephensen, and Charles Little, Northern Arizona University; and Howard Beckwith, California State University, Long Beach, for their recommendations. In addition to Professor Hassett, Wayne McDaniel and Cynthia Siegal, University of Missouri, St. Louis; Carl Diekhans, Treasure Valley Community College; and Milton Legg, Moorhead State College, helped develop scripts for the audio-tape cassettes, for which we are grateful.

January 1975

M.L.K.  
M.L.B.



## PREFACE TO FIRST EDITION

---

The scope of this book is intermediate algebra. It is intended for use by students who have just finished a course in introductory algebra and also for students who have studied algebra at some earlier time but still need a course which starts "at the beginning," yet gets quickly into the topics of intermediate algebra. There is strong emphasis on the development of algebraic skills, but the "whys" of algebra also receive significant attention—more than is usual in developmental courses. The emphasis on understanding is what we feel makes this a modern book. We have not cluttered things with set notation and other distractions which many call modern, but do not really contribute to the student's skill or understanding. In this book as well as its companion volumes, the authors bring to bear not only their own experience in teaching remedial courses but also the suggestions and recommendations of instructors in scores of two-year colleges across the country.

One of the principal and distinguishing features of the book is its design and format. Each page has an outer margin, which is used for materials of several types. For each lesson the objectives are stated in behavioral terms at the top of the page. These can easily be seen by the student and they tell him clearly what is expected of him in terms of performance. We hope that this will help answer the question all-too-often heard, "What material are we responsible for?" The most important items in the margins, however, are the sample, or developmental, exercises. These are placed with the text development so that the student can become involved actively in the development of the topic and gain some practice on exercises of the type he will be expected to do as homework for the lesson. The text refers the student to these exercises in the margins at the appropriate places.

There are many ways in which this book can be used. Flexibility in this regard is indeed one of its important features. The instructor who wishes to use it as he would an ordinary textbook can do so very easily. All he need do is ignore, and have students ignore, the exercises in the margins. If an instructor wishes to use the lecture method primarily, but would like to bring some student-centered activity into the class, he can very easily do so. He would merely stop lecturing and have the students do the exercises in the margins at the appropriate times. On the other hand, the book is well suited for use in a learning laboratory situation. Because of its design, it can be used by a student with minimal instructor guidance. Yet it retains the flavor of the ordinary textbook, without the often deadly quality of the programmed text. This book contains some other features not usually found in a college textbook. There are tests at the ends of chapters, in addition to a final examination. Besides these, there is a pretest which can be used diagnostically, for placement. The exercise sheets which the student removes from the book are designed for quick and easy grading or scoring. The answers in the *Instructor's Manual* are arranged so that they match the spacing on the exercise sheets. The *Manual* also contains alternative forms of the chapter tests and the final examination. The book contains a great number of exercises (about 4000), and the authors have attempted to use language sparingly, so that the student has a maximal chance to learn the mathematics by reading it.

The material herein is suitable for a semester or quarter course for most students needing intermediate algebra in college. This is the third in a series of books written in the same style. The two which precede it are *Arithmetic: A Modern Approach* and *Introductory Algebra: A Modern Approach*.

The authors wish to thank the numerous people who helped make this book what it is. These include the many instructors in two-year colleges with whom they visited and who made many helpful suggestions. Professors Jerry Ball of Chabot College, Ralph Mansfield of Chicago City College, Loop Campus, and Mathew Graber of New York City Community College made many helpful suggestions for improving the manuscript, and the staff of the Addison-Wesley Publishing Company has prodded and encouraged us most appropriately. Last, but not least, we thank our wives for their patience and helpful encouragement.

January, 1971

M. L. K.  
M. L. B.

## PRETEST

The purpose of this test is to help identify weak points. When you have completed the test, read the test analysis on the answer page at the end of the book. The answers are given along with page numbers to indicate where you need to study. Remove the test from the book and begin.

## ANSWERS

1.

2.

3.

4.

5.

6.

7.

8.

9.

See graph.

## Chapter 1

1. Simplify.  $|-28|$

2. Evaluate  $\frac{ab + ac}{bc}$  when  $a = -2$ ,  $b = 3$ ,  
 $c = -4$ .

3. Remove parentheses and simplify.  
 $-2[7x - 3(5 - 4x)] - 9x$

4. Simplify.  $\frac{42y^7x^6z^{-5}}{21y^8x^4z^2}$

## Chapter 2

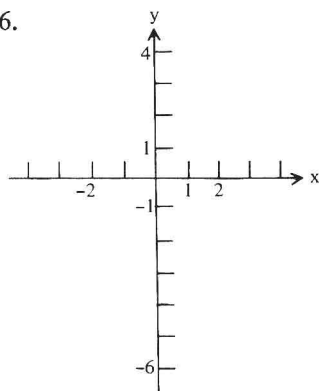
5. Solve.  $3(x + 5) - 7x = 2(x - 4)$

6. The sum of two consecutive odd integers is 40. What are the integers?

7. Solve  $A = \pi(H - h)$ , for  $H$ .

8. Find an equation of the line containing the point  $(-1, 3)$  and parallel to the line whose equation is  $2x + 7y = 10$ .

9. Graph  $4x - y = 6$ .





ANSWERS

10.

See graph.

11.

12.

13.

14.

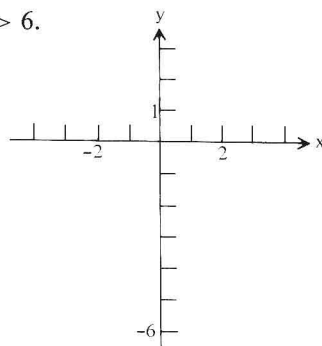
15.

16.

17.

Chapter 3

10. Graph  $4x - y > 6$ .



11. Solve  $|x - 1| > 2$ .

Chapter 4

Evaluate.

12.  $\begin{vmatrix} 7 & 10 \\ 9 & 8 \end{vmatrix}$

13.  $\begin{vmatrix} 1 & 2 & 0 \\ 3 & -1 & -2 \\ 4 & -3 & -4 \end{vmatrix}$

14. Solve  $2x + 3y = 11$   
 $3x + 2y = 9$

15. Solve.  $x + y - z = -3$   
 $x + y + z = 1$   
 $x - y + 2z = 7$

16. Car A leaves a city traveling at a speed of 36 mph. Car B leaves the same city  $\frac{1}{2}$  hr later traveling 48 mph in the same direction as Car A. How long does it take Car B to overtake Car A?

17. Rick Rapp weighs 150 lb and is sitting 9 ft from Gil Gruv on a see-saw. Gil weighs 120 lb. The see-saw is balanced. How far is each from the fulcrum?

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

ANSWERS

**Chapter 5****18.** Add.

$4x^3 - 3x^2 - 5x - 1$  and  $-4x^2 - x - 8$

**19.** Subtract.

$(a^3 + 5a^2 - ab) - (-ab^3 + 3a^3 + 4a^2 - a)$

**18.****19.**

Multiply.

**20.**  $(7x + 5)(x - 4)$

**21.**  $(4a - b^3)^2$

**20.****21.**

Factor.

**22.**  $x^3 + 13x^2 + 12x$

**23.**  $8x^3 - 1$

**24.**  $a^2 - 2ab + b^2 - 16$

**22.****23.****25.** Solve for  $x$ .

$a^2x + bx = a - b$

**26.** Given a function described by  $f(x) = x^2 - x$ , find  $f(2 - a)$ .**24.****25.****26.****27.****Chapter 6****27.** One mixture of saltwater is 20% salt. Another is 50% salt. How many gallons of each should be used to make 6 gallons of saltwater which is 40% salt?

ANSWERS

28.

---

29.

---

30.

---

31.

---

32.

---

33.

---

28. The speed of a boat in still water is 12 mph. The boat travels 3 miles upstream in the same time that it takes to travel 5 miles downstream. What is the speed of the stream?

29. Man A and Man B, working together, can complete a certain job in 2 hours. Man B can do the same job alone twice as fast as Man A can do the job working alone. How long would it take Man B to do the job alone?

Perform the following operations and simplify.

30.  $\frac{1}{x^2 - y^2} + \frac{1}{x + y} - \frac{1}{x - y}$

31.  $\frac{a^3 + b^3}{5} \cdot \frac{5}{a + b}$

32.  $\frac{x^2 - 7x + 12}{x - 2} \div \frac{3x - 12}{x^2 - 4x + 4}$

33.  $\frac{\frac{1}{a^2} - \frac{1}{b^2}}{\frac{1}{a} - \frac{1}{b}}$

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

ANSWERS \_\_\_\_\_

34. Solve.

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

34. \_\_\_\_\_

36. Use synthetic division to find the quotient and remainder.

$$(x^3 - 4x^2 - 5) \div (x + 3)$$

35. \_\_\_\_\_

36. \_\_\_\_\_

**Chapter 7**

37. Divide. Write scientific notation for the answer.

$$\frac{2.21 \times 10^5}{6.5 \times 10^8}$$

38. Multiply and simplify.

$$\sqrt{5ab} \cdot \sqrt{10a^3}$$

39. Divide and simplify.

$$\frac{\sqrt[3]{a}}{\sqrt[3]{5b^2}}$$

37. \_\_\_\_\_

38. \_\_\_\_\_

39. \_\_\_\_\_

40. Rationalize the numerator.

$$\frac{\sqrt{5} - 1}{3}$$

41. Write a single radical expression.

$$\frac{\sqrt{(a+b)^3}}{\sqrt[4]{(a+b)^5}}$$

40. \_\_\_\_\_

41. \_\_\_\_\_

ANSWERS

42.

\_\_\_\_\_

43.

\_\_\_\_\_

44.

\_\_\_\_\_

45.

\_\_\_\_\_

46.

\_\_\_\_\_

47.

\_\_\_\_\_

48.

\_\_\_\_\_

42. Solve.

$$\sqrt[4]{3y+7} = 2$$

43. Multiply these complex numbers.

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

Chapter 8

Solve.

44.  $8x^2 + 24 = 0$

45.  $4x^2 = 20x - 23$

46. Write a quadratic equation whose solutions are  $2\sqrt{5}$  and  $-2\sqrt{5}$ .

47. Solve.  $x - 9\sqrt{x} + 20 = 0$

48. In a right triangle the length of one leg is 1 yd longer than the length of the other leg. The length of the hypotenuse is 29 yd. Find the lengths of the legs.

# CONTENTS

	Pretest		
Chapter 1	Real Numbers and Their Properties		
1.1	Real Numbers and Algebra	3	
1.2	Properties of Addition and Subtraction	7	
1.3	Properties of Multiplication and Division	11	
1.4	The Distributive Laws and Their Use	16	
1.5	Multiplying by $-1$ and Simplifying	19	
1.6	Exponents	22	
1.7	Order and Properties of Absolute Value	27	
	Exercise Set 1.1	29	
	Exercise Set 1.2	31	
	Exercise Set 1.3	33	
	Exercise Set 1.4	35	
	Exercise Set 1.5	37	
	Exercise Set 1.6	39	
	Exercise Set 1.7	43	
	Chapter 1 Test	45	
Chapter 2	Linear Equations		
2.1	Solving Equations	49	
2.2	Applied Problems	56	
2.3	Formulas	59	
2.4	Graphs of Equations	60	
2.5	Linear Equations	66	
2.6	Slope	69	
2.7	More Equations of Lines	73	
2.8	Parallel and Perpendicular Lines	76	
	Exercise Set 2.1	79	
	Exercise Set 2.2	83	
	Exercise Set 2.3	85	
	Exercise Set 2.4	87	
	Exercise Set 2.5	89	
	Exercise Set 2.6	91	
	Exercise Set 2.7	93	
	Exercise Set 2.8	95	
	Chapter 2 Test	97	
Chapter 3	Inequalities		
3.1	Solving Inequalities; the Addition Principle	101	
3.2	Solving Inequalities; the Multiplication Principle	106	
3.3	Equations and Inequalities with Absolute Value	108	
3.4	Inequalities in Two Variables —Graphs on a Plane	111	
	Exercise Set 3.1	115	
	Exercise Set 3.2	117	
	Exercise Set 3.3	119	
	Exercise Set 3.4	121	
	Chapter 3 Test	123	
Chapter 4	Systems of Equations		
4.1	Systems of Equations in Two Variables	125	
4.2	Other Methods for Solving Systems of Equations	129	
4.3	Systems of Equations in Three Variables	133	
4.4	Using Second Order Determinants, Cramer's Rule (Optional)	136	
4.5	Applied Problems	139	
4.6	Lever or Torque Problems (Optional)	143	
4.7	Three-by-Three Determinants (Optional)	146	
4.8	Using Third Order Determinants, Cramer's Rule (Optional)	148	
4.9	Applied Problems	151	
	Exercise Set 4.1	153	
	Exercise Set 4.2	155	
	Exercise Set 4.3	159	
	Exercise Set 4.4	163	
	Exercise Set 4.5	165	
	Exercise Set 4.6	167	
	Exercise Set 4.7	169	
	Exercise Set 4.8	173	
	Exercise Set 4.9	175	
	Chapter 4 Test	177	
Chapter 5	Polynomials and Functions		
5.1	Some Properties of Polynomials	181	
5.2	Calculations with Polynomials	185	
5.3	Multiplication of Polynomials	188	
5.4	Special Products of Polynomials	191	
5.5	Factoring	194	
5.6	Factoring Trinomials	197	
5.7	Completing the Square	201	
5.8	Factoring Sums or Differences of Two Cubes	203	

5.9	Factoring: a General Strategy . . . . .	205			
5.10	Solving Equations . . . . .	206			
5.11	Formulas . . . . .	208			
5.12	Solving Equations by Factoring . . . . .	209			
5.13	Functions . . . . .	211			
5.14	Function Notation and Graphs of Functions . . . . .	214			
5.15	More About Functions . . . . .	216			
	Exercise Set 5.1 . . . . .	219			
	Exercise Set 5.2 . . . . .	221			
	Exercise Set 5.3 . . . . .	223			
	Exercise Set 5.4 . . . . .	225			
	Exercise Set 5.5 . . . . .	229			
	Exercise Set 5.6 . . . . .	231			
	Exercise Set 5.7 . . . . .	233			
	Exercise Set 5.8 . . . . .	235			
	Exercise Set 5.9 . . . . .	237			
	Exercise Set 5.10 . . . . .	239			
	Exercise Set 5.11 . . . . .	241			
	Exercise Set 5.12 . . . . .	243			
	Exercise Set 5.13 . . . . .	245			
	Exercise Set 5.14 . . . . .	247			
	Exercise Set 5.15 . . . . .	249			
	Chapter 5 Test . . . . .	251			
<b>Chapter 6</b>	<b>Fractional Expressions and Equations</b>				
6.1	Multiplying and Simplifying Fractional Expressions . . . . .	255			
6.2	Division and Reciprocals . . . . .	258			
6.3	Least Common Multiples . . . . .	259			
6.4	Addition . . . . .	261			
6.5	Subtraction . . . . .	263			
6.6	Complex Fractional Expressions . . . . .	265			
6.7	Division of Polynomials . . . . .	267			
6.8	Synthetic Division . . . . .	270			
6.9	Solving Fractional Equations . . . . .	272			
6.10	Formulas . . . . .	274			
6.11	Applied Problems . . . . .	275			
6.12	Variation . . . . .	279			
	Exercise Set 6.1 . . . . .	283			
	Exercise Set 6.2 . . . . .	287			
	Exercise Set 6.3 . . . . .	289			
	Exercise Set 6.4 . . . . .	291			
	Exercise Set 6.5 . . . . .	293			
	Exercise Set 6.6 . . . . .	295			
	Exercise Set 6.7 . . . . .	297			
	Exercise Set 6.8 . . . . .	299			
	Exercise Set 6.9 . . . . .	301			
	Exercise Set 6.10 . . . . .	305			
	Exercise Set 6.11 . . . . .	307			
	Exercise Set 6.12 . . . . .	311			
	Chapter 6 Test . . . . .	313			
<b>Chapter 7</b>	<b>Exponents, Powers, and Roots</b>				
7.1	Properties of Integer Exponents . . . . .	317			
7.2	Scientific Notation . . . . .	319			
7.3	Radicals . . . . .	322			
7.4	Multiplying and Simplifying with Radicals . . . . .	325			
7.5	Simplifying and Dividing with Radicals . .	329			
7.6	Addition and Subtraction Involving Radicals . . . . .	332			
7.7	More Multiplication Involving Radicals . .	333			
7.8	Rationalizing Denominators or Numerators . . . . .	334			
7.9	Rational Numbers as Exponents . . . . .	338			
7.10	Solving Radical Equations . . . . .	341			
7.11	The Complex Numbers . . . . .	344			
7.12	More on the Complex Numbers . . . . .	347			
	Exercise Set 7.1 . . . . .	349			
	Exercise Set 7.2 . . . . .	351			
	Exercise Set 7.3 . . . . .	353			
	Exercise Set 7.4 . . . . .	355			
	Exercise Set 7.5 . . . . .	359			
	Exercise Set 7.6 . . . . .	361			
	Exercise Set 7.7 . . . . .	363			
	Exercise Set 7.8 . . . . .	365			
	Exercise Set 7.9 . . . . .	369			
	Exercise Set 7.10 . . . . .	371			
	Exercise Set 7.11 . . . . .	373			
	Exercise Set 7.12 . . . . .	375			
	Chapter 7 Test . . . . .	377			
<b>Chapter 8</b>	<b>Quadratic Equations and Functions</b>				
8.1	Quadratic Equations . . . . .	381			
8.2	Fractional Equations . . . . .	385			
8.3	Completing the Square . . . . .	387			
8.4	The Quadratic Formula . . . . .	389			
8.5	More about the Solutions of a Quadratic Equation . . . . .	392			
8.6	Formulas . . . . .	394			
8.7	Equations Quadratic in Form . . . . .	395			
8.8	The Pythagorean Theorem and the Distance Formula . . . . .	397			
8.9	Quadratic Variation . . . . .	401			
8.10	Graphs of Quadratic Functions . . . . .	404			
	Exercise Set 8.1 . . . . .	411			
	Exercise Set 8.2 . . . . .	413			
	Exercise Set 8.3 . . . . .	415			
	Exercise Set 8.4 . . . . .	417			



Exercise Set 8.5	421	10.2	Logarithmic Functions	473
Exercise Set 8.6	423	10.3	Basic Properties of Logarithms	475
Exercise Set 8.7	425	10.4	Common Logarithms	478
Exercise Set 8.8	427	10.5	Linear Interpolation	484
Exercise Set 8.9	431	10.6	Calculations with Common Logarithms	488
Exercise Set 8.10	433	10.7	Exponential and Logarithmic Equations	491
Chapter 8 Test	437	10.8	Change of Base	494
<b>Chapter 9 Equations of Second Degree and Their Graphs</b>		Exercise Set 10.1		495
9.1 Systems of One First Degree and One Second Degree Equation	441	Exercise Set 10.2		497
9.2 Systems of Two Second Degree Equations	444	Exercise Set 10.3		499
9.3 Conic Sections: the Circle and the Ellipse	446	Exercise Set 10.4		501
9.4 Conic Sections: the Hyperbola and the Parabola	450	Exercise Set 10.5		505
9.5 Graphical Solutions	455	Exercise Set 10.6		507
Exercise Set 9.1	457	Exercise Set 10.7		511
Exercise Set 9.2	459	Exercise Set 10.8		513
Exercise Set 9.3	461	Chapter 10 Test		515
Exercise Set 9.4	463	<b>Final Examination</b>		519
Exercise Set 9.5	465	<b>Appendix A Geometric Formulas</b>		528
Chapter 9 Test	467	<b>Appendix B The Metric System</b>		529
<b>Chapter 10 Exponential and Logarithmic Functions</b>		Table 1 Powers, Roots, and Reciprocals		543
10.1 Exponential Functions	469	Table 2 Common Logarithms		544
		<b>Answers</b>		A-1
		<b>Index</b>		I-1

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

ANSWERS

49.

50.

51.

52.

53.

54.

See graph.

49. The stopping distance of a car after the brakes are applied varies directly as the square of the speed  $r$ . If a car traveling 60 mph can stop in 240 ft, how long will it take the same car to stop when it is traveling 90 mph?

50. A rocket is fired into the air. Its height  $h$ , in feet,  $t$  seconds after blastoff is given by

$$h = -16t^2 + 96t + 880.$$

Find its maximum height and when it attains it.

## Chapter 9

51. Solve.

$$3x^2 + y^2 = 7$$

$$y - x = 1$$

52. The length of a rectangle is 1 ft greater than the width. The length of a diagonal is 29 ft. Find its dimensions.

53. Find the center and radius of the circle

$$x^2 + y^2 + 8x - 10y - 8 = 0$$

54. Graph.  $\frac{x^2}{9} - \frac{y^2}{25} = 1$ .

