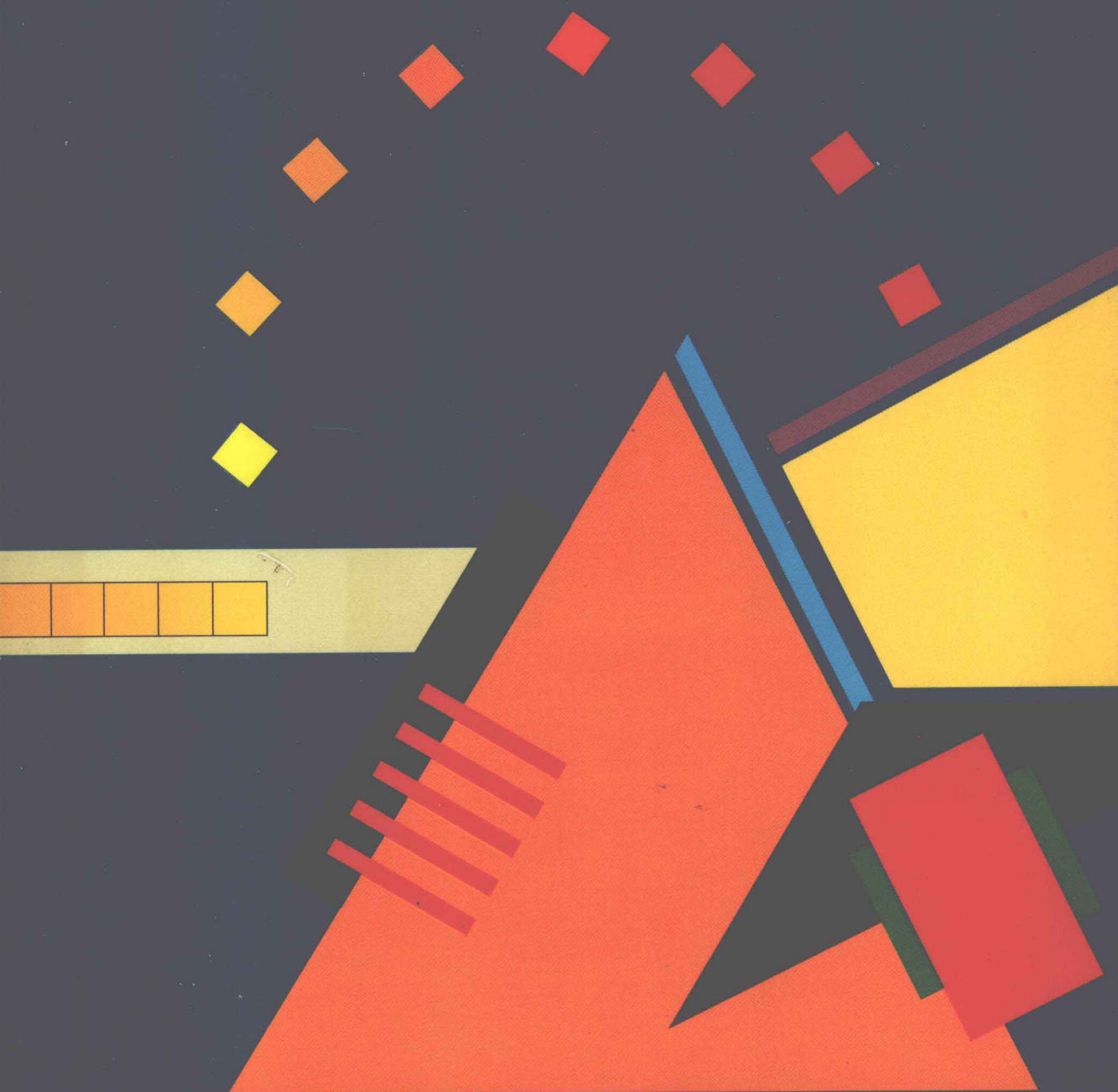


ANNOTATED INSTRUCTOR'S EDITION

FUNDAMENTALS OF MATHEMATICS

FIFTH EDITION

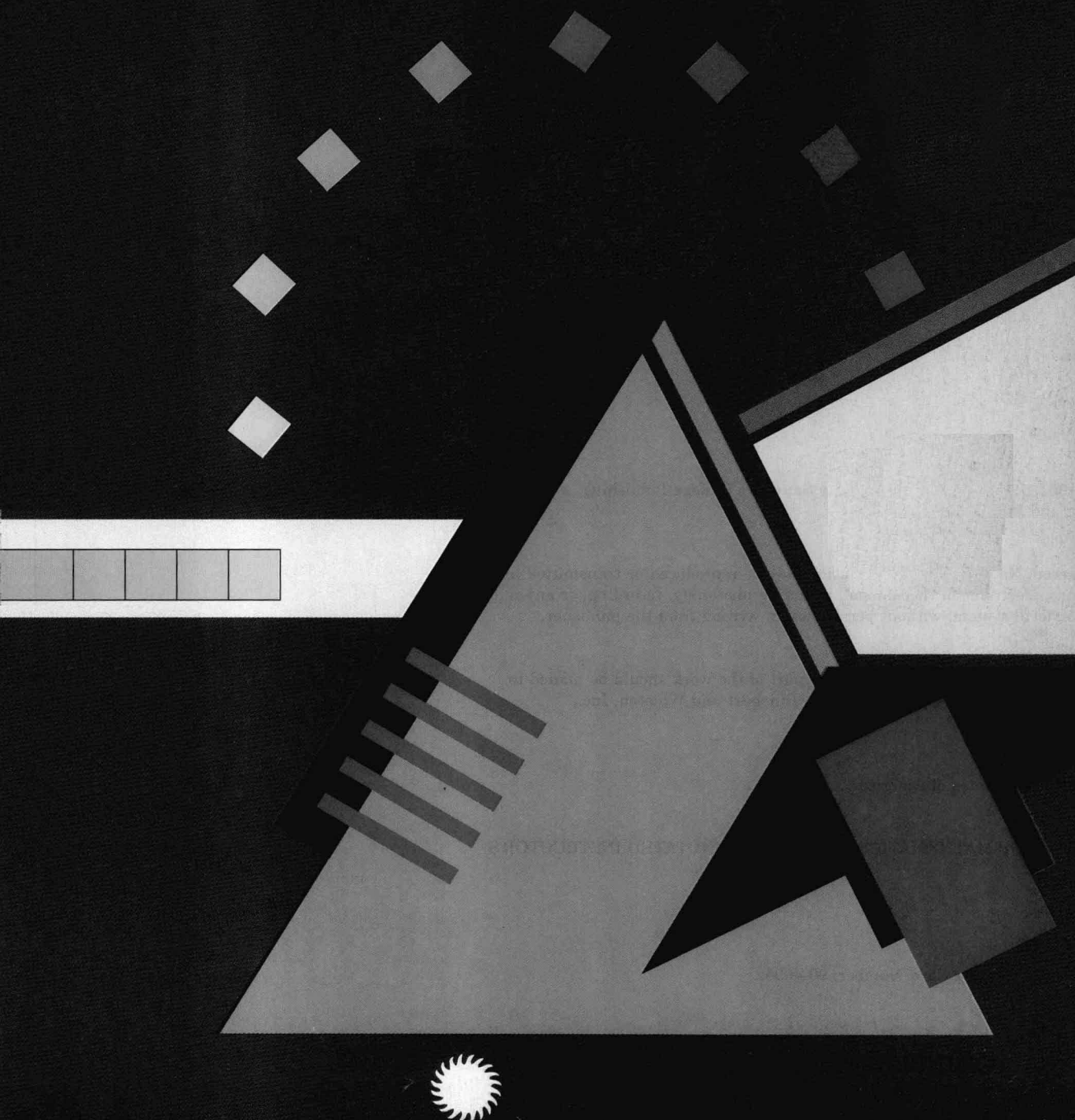


Barker ■ Rogers ■ Van Dyke

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Preface

The fifth edition of *Fundamentals of Mathematics* provides a write-in text for students at the college level who need a review of the basic skills of arithmetic in order to fulfill competency requirements, prepare for business mathematics, achieve adequate scores on placement exams, or complete the prerequisites for elementary algebra.

Special Features The fifth edition contains the following new features:

- All of the exercises (including Pre-Tests, True-False Concept Reviews, Post-Tests, and end-of-section exercises) can be torn out and handed in for grading without disturbing text.
- A True-False Concept Review has been added to the end of each chapter as a check on student understanding of the language, properties, and concepts of arithmetic.
- Pre-Tests and Post-Tests are now keyed to sections of the text as well as to objectives.
- Four-color pedagogical system is used to highlight the various pedagogical features throughout the text. Multiple colors are useful, for example, to distinguish between different portions of the figure being discussed. The complete color system is described in more detail on pages xxii and xxiii.
- The exercises have been revised to include 25 to 30% new problems.
- Answers to Warm Ups in the Model Problem-Solving section will now appear at the bottom of the page so that students can check their answers more readily.
- For the instructor's convenience, there is an Annotated Instructor's Edition, which provides answers to all of the exercises in red, right next to the problem, so that the instructor can readily locate them.
- Expanded and clarified *Strategy* comments.
- More fully worked examples in each section.
- Caution comments, highlighted in red, alert students to common errors and help them avoid pitfalls.

The fifth edition has also added coverage of the following topics:

- Section 6.10 (Draw and Interpret Graphs) gives the student an understanding of how “pictorial” displays of data are constructed and how data is retrieved from these displays. Emphasis is on data commonly found in business and everyday life.
- Section 6.11 (Read and Interpret Tables) takes displayed data and has the student apply newly acquired arithmetic skills to interpret and extend the data.

- Section 7.9 (Reasoning) has been added to expose the student to the types of reasoning used on a daily basis and to prepare for a formal study of geometry.
- Particular attention has been paid to the testing requirements for various states (e.g., ELM, TASP, CLAST, etc.). Please see pages xv–xvi for additional information on how this text meets requirements for these schools.
- Appendix V (Plane Geometry Supplement) has been added to provide a concise coverage of some topics of Euclidean geometry. These topics include angles, triangles, congruent triangles, parallel lines, similar triangles, square roots, and the Pythagorean Theorem. This supplement provides the student with a good foundation for later mathematics classes.

Format The write-in text gives the student space to practice arithmetic skills with ready reference to step-by-step directions and worked examples. Beginning with section-by-section objectives, each section is a complete treatment of the particular topic and contains the following features: Objectives, Application, Vocabulary, How and Why, Model Problem-Solving, and Exercises. The chapter begins with a Pre-Test to determine which objectives the student needs to study and ends with a Post-Test that may serve as either a chapter review or a chapter evaluation; both the Pre-Test and the Post-Test are referenced to the section number and objective so the student can easily refer to a specific section for assistance. A True-False Concept Review in each chapter helps to reinforce student understanding. This format makes it possible for students to work their way through the material in a Math Lab or Learning Center.

In **Chapter 1** we begin with the numeration system including the concepts of place value, word name, expanded form, inequality, and rounding, so the student will have a thorough understanding of the concept of “number” prior to performing operations. The basic operations of addition, subtraction, multiplication, and division of whole numbers are reviewed. An introduction to the solution of equations is presented in Getting Ready for Algebra exercises at the end of Section 1.4 and others throughout the text to prepare the student for the study of algebra. Exponents and powers of ten are examined in preparation for order of operations involving whole numbers and for writing prime factors using exponential notation in Chapter 2. At the end of the chapter, order of operations is presented to expose the student to problems involving multiple operations. This is followed by a section on the idea of average which is applied to real-life situations.

In **Chapter 2** to prepare the student for operations on fractions, the whole number classifications of multiple, divisor, factor, prime, composite, and least common multiple are covered. The section also serves to reinforce the student’s skills with whole numbers with practice in multiplication and division.

In **Chapter 3** the meaning of a fraction is modeled using shaded rectangles. This approach provides a visual presentation to back the mathematical concept. We study operations on both fractions and mixed numbers. Building and reducing fractions are based on the skills acquired in Chapter 2. The least common multiple of Chapter 2 leads here to lowest common denominator for adding fractions. Again the operations are reinforced with a review of order of operations and average incorporating fractions and mixed numbers.

In **Chapter 4** decimals are brought in, employing an approach parallel to that for whole numbers. Coverage includes place value, word names, expanded form, inequalities, and rounding for decimal numbers. The basic operations on decimals comes next. Multiplication and division, using powers of ten, give the student an opportunity to utilize the exponent skills learned in Chapter 1. Both fraction to decimal and decimal to fraction conversions demonstrate the relationship between the two ways of writing a rational number. The fact that

an exact decimal representation is not always possible supports the need for fractions. The chapter ends with the review of order of operations and average using decimals.

In **Chapter 5** ratio and proportion leads to useful applications of the fundamentals of mathematics to practical situations. Here the student is introduced to the formal process of translating from a written statement of facts to a mathematical statement that can be solved. This skill is reinforced in the next two chapters.

In **Chapter 6** percent is developed as a useful way of describing a numerical comparison. Students practice is changing from percent to decimal to fraction so that they can see the relationship of percent to the different numbers and can become skilled at expressing a number in any one of the forms. Solutions of percent problems are covered using either ratios or the formula, $R\%$ of $A = B$. Practical applications are presented showing general applications with a separate section dedicated to business applications. This approach is designed to prepare a student for a business mathematics course. More applications show the use of bar, circle, broken line, and pictorial graphs. Students are given the opportunity to draw conclusions from a visual display. In the last section, tables and charts are used to display data where students extract information and use their mathematical skills to draw conclusions.

In **Chapter 7** both English and metric measurements are formally introduced. Conversion within the systems and between the systems is investigated. The metric system gives a student a skill that can be used in science courses and an appreciation of the measurement system used by the majority of the world's population. Measurement is applied to geometric figures covering perimeter, area of common geometric figures, area of compound figures, and volume. The chapter ends with a discussion of reasoning in preparation for later studies in mathematics or formal logic.

In **Chapter 8** the number system is expanded to include signed numbers. Operations on signed numbers include absolute value, opposites, addition, subtraction, multiplication, and division. This chapter, together with sections in prior chapters on Getting Ready for Algebra, serves to bridge the gap to the student's first study of algebra.

PRE-TEST

Each chapter begins with a Pre-Test to help the student determine which areas require the most attention. Questions are keyed to both the section number and objective to allow the student to refer to that portion of the text for assistance. If the instructor wishes, the Pre-Tests can be torn out and handed in as a classroom assignment.

OBJECTIVES

In each chapter, objectives are identified in the beginning of each section; the student may take the chapter Pre-Test to determine which of the objectives require the most study. In the classroom the instructor can use the Pre-Test to determine which objectives should be emphasized for that particular group of students. The individual student or class can then work on problem objectives and take follow-up exams when ready.

APPLICATION

This section contains a posed problem that is a practical application of the section objectives; the student will be able to solve the problem after reading the How and Why and Model Problem-Solving sections. The solution to the application, an integral part of the worked-out Examples, follows the Examples and serves as additional reinforcement of the concepts presented; the application is also reinforced in the Exercises with similar problems. Including

these applications serves as a bridge between the mathematics classroom and the fields of business, shop mathematics, health science, consumer mathematics, and other fields.

VOCABULARY

As in previous editions, this section provides the student with definitions or examples of words that have not been previously used in the text.

HOW AND WHY

This section explains the concepts presented in the objective and application while developing the necessary methods of solution. Throughout the text the explanations are primarily intuitive. Procedures and rules (methods of solution) are highlighted by bold type and color screens for quick reference and easy review. The explanation in this section, paired with the Model Problem-Solving section that follows, provides an immediate linking of theory and practice.

MODEL PROBLEM-SOLVING

Examples This section uses examples to illustrate the concepts explained in the How and Why section. Each example has a strategy column; as each example is worked out, there is a step-by-step explanation that expands on the procedures and the thinking necessary to work the example. The examples also illustrate common shortcuts. Where applicable, the strategy includes caution comments about errors and pitfalls, highlighted in red for the student.

Warm Ups Each example is paired with a Warm Up problem of the same type and level of difficulty, which reinforces the procedures used to solve the example. These Warm Ups are useful to check the student's understanding of the material before advancing to a more difficult example.

Some examples contain problems solved by using a calculator. These examples, set off with a calculator symbol, demonstrate how to use a calculator and signal to the student that these problems are suited for calculator practice. However, the use of the calculator is left to the discretion of the instructor and/or the student. Nowhere is the use of a calculator required, and all sections of the text can be studied without a calculator.

Here is an example of the presentation used in the text:

MODEL PROBLEM-SOLVING

Examples

Strategy

- a. Find the quotient correct to the nearest thousandth: $0.47891 \div 0.072$

$$0.072 \overline{)0.47891}$$

$$\begin{array}{r} 6.6515 \\ 72 \overline{)478.9100} \\ \underline{432} \\ 469 \\ \underline{432} \\ 371 \\ \underline{360} \\ 110 \\ \underline{72} \\ 380 \\ \underline{360} \\ 20 \end{array}$$

Move both decimals 3 places to the right; that is, multiply both by 1000.

Since we will round to the thousandth, we carry the division to one place past the thousandths, that is, to four places.

Hence, $0.47891 \div 0.072 \approx 6.652$.

Warm Up a. Find the quotient correct to the nearest thousandth: $0.75593 \div 0.043$

b. Calculator Example

$78.1936 \div 8.705 = ?$ Round to the nearest thousandth.



ENTER	DISPLAY
78.1936	78.1936
\div	78.1936
8.705	8.705
=	8.9826077

Enter 78.1936.

Press the “ \div ” key.

Enter 8.705.

Press the “=” key.

The quotient is 8.983 to the nearest thousandth.

Warm Up b. $103.843 \div 4.088 = ?$ Round to the nearest thousandth.

Answers to the Warm Ups appear at the bottom of each page.

EXERCISES

The fifth edition of *Fundamentals of Mathematics* continues to organize the exercises in order of difficulty. As before, “A” indicates that the problems are relatively easy; the “A” problems have been increased in number and can be used as class or “oral” exercises. The “B” problems are more difficult and involve computation with larger numbers. The “C” problems in most instances offer a challenge for the more advanced students and may, at the discretion of the instructor, provide calculator drill for the students. “D” problems follow up the featured application of the section, provide practical application of the skill, and call upon the student to set up the computation.

Maintain Your Skills This section immediately follows the “D” problems in the exercises. The function of this portion of the exercises is to review material previously covered. The exercises in each Maintain Your Skills section have been referenced to the sections reviewed. All of the exercises can be torn out and handed in as classroom assignments without disturbing the text.

▲▲ Getting Ready for Algebra The purpose of this section is to show students that they can use basic skills in an elementary algebra setting; this section was favorably received in the fourth edition. In those sections of Chapters 1, 3, 4, and 8 where operations lend themselves to solving simple equations, this topic is included in the exercises immediately following the *Maintain Your Skills* section. Preceded by a logo of two solid triangles so the student always knows it is the algebra section, Getting Ready for Algebra is completely separate and contains an explanation section, a model problem-solving section, and its own exercises. If the instructor deems this section inappropriate, it can easily be omitted at the instructor’s discretion without loss of continuity.

In all of the exercises, the problems are paired so that the set of odd-numbered problems is equivalent in type and difficulty to the set of even-numbered problems. Answers to the odd-numbered exercises, as well as answers to all the Pre-Tests, Post-Tests, and True-False Concept Reviews are provided in the back of the book.

**TRUE-FALSE
CONCEPT REVIEW**

Appearing toward the end of each chapter, this test helps remind the student of the new concepts before the student proceeds to the Post-Test. Answers to all

of the questions in the True-False Concept Review appear in the back of the book.

POST-TEST

Each chapter concludes with a Post-Test as a final review of student comprehension. Questions on the Post-Test are referenced to a section number and objective so the student can easily refer back to the text for assistance. Answers to all of the questions in the Post-Test appear in the back of the book.

TIMETABLE

The text can be used in a variety of classroom situations, depending upon the needs of the students. Two such possibilities are:

1. A one-quarter or one-semester course given as a review of basic arithmetic. Such a course would cover Chapters 1 through 6, with Chapter 7 optional.
2. A one-quarter or one-semester course given as a review before beginning basic algebra. This course would cover Chapters 1 through 6 and Chapter 8, with Chapter 7 optional.

Since each chapter is relatively independent of the others, an instructor may select chapters that meet the student's career goals.

ANCILLARY ITEMS

Users of *Fundamentals of Mathematics* will receive an extensive set of ancillary items that can substantially assist the instructor in the presentation of the course as well as motivate the students. These items include:

Instructor's Manual The printed manual contains course outlines, lecture suggestions, a conversion grid of problems from the fourth to fifth editions, recommendations for using the entire ancillary package, as well as the following:

- Worked-out solutions to all Exercises
- Supplementary Exercises for each chapter
- Answers to Supplementary Exercises

Prepared Tests with Diagnostic Test This set of tests consists of six tests for each of the eight chapters and provides answers to all of the questions. Half of the tests have multiple choice questions and half are open-ended questions. In addition to the tests for each chapter, there are two final examinations with all of the answers, as well as a Diagnostic Test with suggestions for the best way to use it.

Computerized Test Bank This bank of over 2000 questions contains problems for every objective in the text. The software can generate many customized tests with both open-ended and multiple-choice questions; the instructor is able to edit the questions as well as add new questions. The software solves each problem and prints the answer in a grading key on a separate sheet. The Computerized Test Bank is available for Apple II and IBM microcomputers.

Printed Test Bank This test bank was generated from the Computerized Test Bank and bound as another source of tests. All of the questions in the test bank are included; perforated pages allow the instructor to create tests without using a computer.

MathCue Interactive Software This program disk contains practice problems for every section of the worktext. Using an interactive approach, the software provides students with an alternate way to learn the material and, at

the same time, gives the student individualized attention. The program will automatically advance to the next level of difficulty once the student has successfully solved a few problems; the student may also ask to see the solution to check the process used. The software is keyed to the worktext and will refer the student to the appropriate section of the text if an incorrect answer is input. A useful tool to check skills and to identify and correct any difficulties in finding solutions, this software is available for the Apple II and IBM PC microcomputers.

MathCue Solution Finder Software Available for IBM, this software allows students to input their own questions through the use of an expert system, a branch of artificial intelligence. Students may check their answers or receive help as if they were working with a tutor. The software will refer the student to the appropriate section of the text and will record the number of problems entered and correct answers given.

Videotapes A complete set of videotapes (17 hours) is available to give added assistance or to serve as a quick review of the book. The tapes use a newscaster format to review problem-solving methods and guide students through practice problems; students can stop the tape to work the problems and begin it again to check their solutions. Keyed to the text and providing coverage of every section of the book, these tapes are provided as another approach to mastery of the given topic.

Student Solutions Manual This guide contains worked-out solutions to one quarter of the problems in the exercise sets (every other odd problem) to help the student learn and practice the techniques used in solving problems.

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The authors appreciate the unfailing patience and continuing support of their wives, Mary Barker, Elinore Rogers, and Carol Van Dyke, who made the completion of this work possible. Thanks go to Sue O'Rielly of Portland Community College for her help revising the exercises. We also thank our colleagues for their help and suggestions for the improved fifth edition.

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Jack Barker
Jim Rogers
Jim Van Dyke

ELM Mathematical Skills

The following table lists the California ELM MATHEMATICAL SKILLS and where coverage of these skills can be found in the text. Skills not covered in this text can be found in Basic Algebra, 3rd Edition, or Intermediate Algebra, 3rd Edition. Location of skills are indicated by chapter.section or chapter.

Skill	Location in Text
Whole numbers and their operations	Ch. 1
Fractions and their operations	Ch. 3
Decimals and their operations	Ch. 4
Exponentiation and square roots	1.7, 2.2, 2.5 Appendix* V
Fraction-decimal conversion	4.3, 4.11
Applications (averages, percents, word problems)	1.9, 3.14, 4.12, 6.8, 6.9, In applications throughout the text
Ratio, proportion and variance	Ch. 5
Reading data from graphs and charts	6.10, 6.11
Perimeter and area of triangles, squares, rectangles and parallelograms	7.5, 7.6, 7.7
Circumference and area of circles	7.5, 7.6, 7.7
Volumes of cubes, cylinders, rectangular solids, and spheres	7.8
Sum of interior angles of a triangle	Appendix V
Properties of isosceles and equilateral triangles	Appendix V
Properties of similar and congruent triangles	Appendix V
Pythagorean theorem and special triangles	Appendix V
Parallel and perpendicular lines	Appendix V

TASP Mathematics Skills

The following table lists the Texas TASP MATHEMATICS SKILLS and where coverage of these skills can be found in the text. Skills not covered in this text can be found in Basic Algebra, 3rd Edition, or Intermediate Algebra, 3rd Edition. Location of skills are indicated by chapter.section or chapter.

Skill	Location in Text
Use number concepts and computation skills.	Ch. 1, Ch. 2, Ch. 3, Ch. 4, Ch. 6, Ch. 8
Solve word problems involving integers, fractions, or decimals (including percents, ratios, and proportions).	Ch. 3, Ch. 4, Ch. 5
Solve one- and two-variable equations.	Ch. 6 1.4, 1.6, 3.6, 3.13, 4.7, 4.10, 4.12, 8.6
Solve problems involving geometric figures.	Ch. 7, Appendix V
Apply reasoning skills.	7.9, Appendix V

CLAST Mathematical Skills

The following table lists the Florida CLAST MATHEMATICAL SKILLS and where coverage of these skills can be found in the text. Skills not covered in this text can be found in Basic Algebra, 3rd Edition, or Intermediate Algebra, 3rd Edition. Location of skills are indicated by chapter section or chapter.

Skill	Location in Text
1A1a—Adds and subtracts rational numbers	3.9, 3.10, 3.11, 3.12, 3.13
1A1b—Multiplies and divides rational numbers	3.4, 3.5, 3.6
1A2a—Adds and subtracts rational numbers in decimal form	4.6, 4.7
1A2b—Multiplies and divides rational numbers in decimal form	4.8, 4.9, 4.10, 4.11
1A3 —Calculates percent increase and percent decrease	6.8, 6.9
2A1 —Recognizes the meaning of exponents	1.7, 2.2, 2.5
2A2 —Recognizes the role of the base number in determining place value in the base-ten numeration system and in systems that are patterned after it	1.1, 1.2, 4.1, 4.2
2A3 —Identifies equivalent forms of positive rational numbers involving decimals, percents, and fractions	6.2, 6.3, 6.4, 6.5 6.6
2A4 —Determines the order-relation between magnitudes	1.2, 3.8, 4.4
4A1 —Solves real-world problems which do not require the use of variables and which do require the use of percent	Ch. 1, Ch. 2, Ch. 3, Ch. 4, Ch. 5
4A2 —Solves real-world problems which do not require the use of variables and which do require the use of percent	6.8, 6.9
4A3 —Solves problems that involve the structure and logic of arithmetic	In applications throughout text
1B1 —Rounds measurements to the nearest given unit of the measuring device	4.5
1B2a—Calculates distances	7.5
1B2b—Calculates areas	7.6, 7.7
1B2c—Calculates volumes	7.8
2B1 —Identifies relationships between angle measures	Appendix V
2B2 —Classifies simple plane figures by recognizing their properties	Ch. 7, Appendix II
2B3 —Recognizes similar triangles and their properties	Appendix V
3B1 —Infers formulas for measuring geometric figures	Ch. 7
3B2 —Identifies applicable formulas for computing measures of geometric figures	Ch. 7
4B1 —Solves real-world problems involving perimeters, areas, and volumes of geometric figures	7.5, 7.6, 7.7, 7.8
4B2 —Solves real-world problems involving the Pythagorean property	Appendix V
1C1a—Adds and subtracts real numbers	8.2, 8.3
1C1b—Multiplies and divides real numbers	8.4, 8.5
1C2 —Applies the order-of-operations agreement to computations involving numbers and variables	8.6
1C4 —Solves linear equations and inequalities	1.4, 1.6, 3.6, 3.13, 4.7, 4.10, 4.12
1C5 —Uses given formulas to compute results when geometric measurements are not involved	In applications throughout text
2C3 —Recognizes statements and conditions of proportionality and variation	Ch. 5
1D1 —Identifies information contained in bar, line, and circle graphs	6.10
4D1 —Interprets real-world data from tables and charts	6.11
4E1 —Draws logical conclusions when facts warrant them	7.9



Student Preface

“It looks so easy when you do it, but when I get home . . .” is a popular lament of many students studying mathematics.

Taking our cue from a saying that is current in mathematical circles today—“Mathematics is not a spectator sport”—we believe that the only way to learn mathematics is to get involved with the subject. It is useful for you to read the text and go to class or lab, but you really learn math when you work problems (or better yet, help explain it to one of your classmates outside of class).

Here are some steps that will help you to get involved:

1. Work the Pre-Test in the beginning of the chapter. The answers to the Pre-Test are in the back of the book.
2. Read the section objectives. Note that the application problem that follows is a real-life illustration of how the objectives are used.
3. Read the Vocabulary and How and Why sections once or twice to get a general idea of the topic. Then read the How and Why section more slowly, looking for definitions and rules. Definitions, procedures, and rules are highlighted by various color screens for quick reference and easy review. See chart on pages xxii and xxiii for more detail.
4. Now read the Model Problem-Solving section. A good procedure is to cover up the worked-out solution, work the problem by yourself, and then uncover the solution. Compare your solution to the one in the text, noting the step-by-step explanation in the strategy column. Then work the Warm Up problem that follows to reinforce what you have learned. You can check your answer to the Warm Up problem by looking at the bottom of the page.
5. Read the solution to the Application that appeared earlier in the section. You should now understand how the problem was solved and be ready to go on to the Exercises. If you are not sure how the Application Solution was worked out, reread the How and Why and Model Problem-Solving sections.
6. Now work the Exercises at the end of the section. The Group A problems can usually be done mentally. Group B problems will probably require paper and pencil. Group C problems are more difficult; you may find that a calculator will save some time here. Group D problems follow up the application in each section. The application solution immediately preceding the Exercise section is a useful guide for these problems. Group E problems should not be skipped. They are for review and will help you practice earlier procedures so you do not become “rusty.”

Some sections have problems immediately following Group E called “▲▲ Getting Ready for Algebra.” This section is included where the skills you have learned can be applied in an elementary algebra setting. This section is preceded by a logo of two solid triangles and contains its own

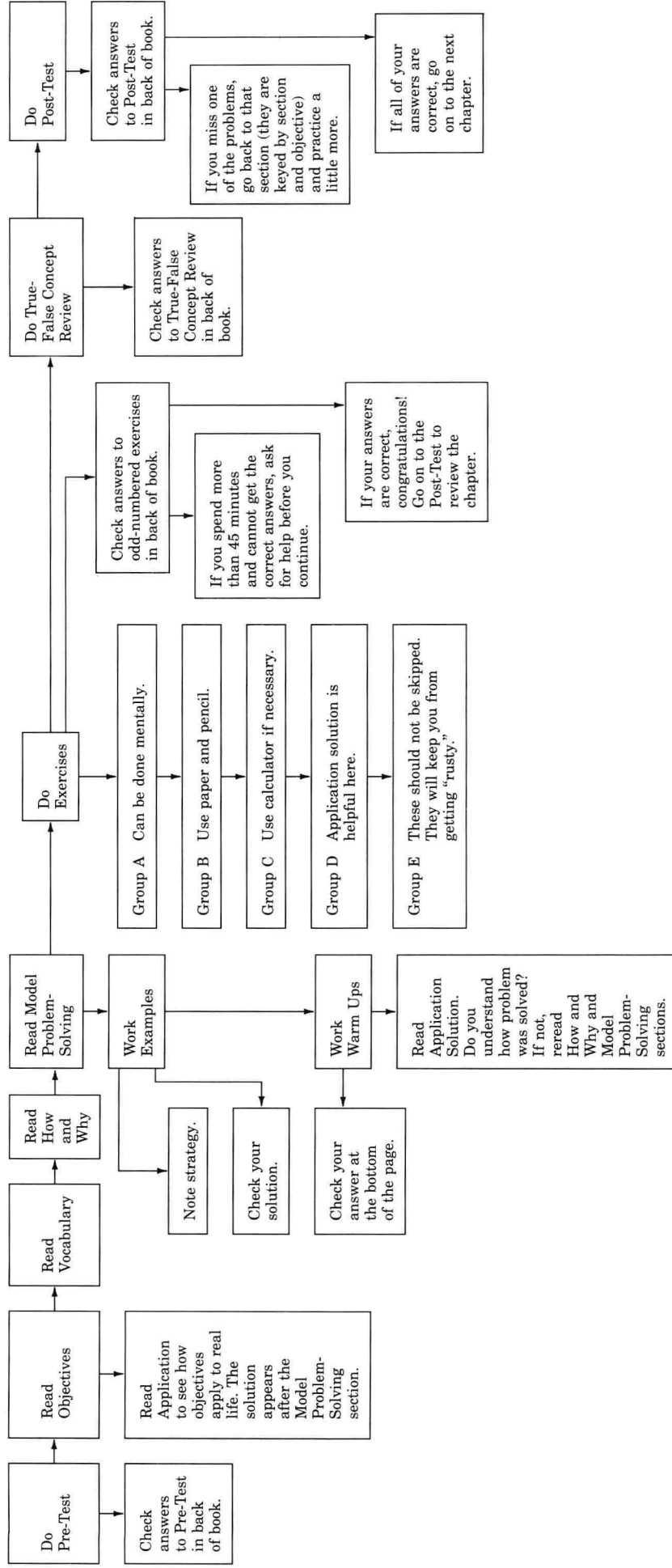
explanation section, model problem-solving section, and exercises. Whenever you see these triangles, you will know you're in the algebra section.

The answers to the odd-numbered exercises are provided in the back of the book so you can check your progress. If you do not get the correct answers after 45 minutes of study, stop and get help before you continue.

7. Work the True-False Concept Review. You should understand the basic concepts before proceeding to the Post-Test.
8. Work the Post-Test at the end of the chapter to review all of the concepts you have learned. The answers to each Post-Test are included in the back of the book. If you miss one of the Post-Test problems, go back to that section (the section number and objective are shown in parentheses at the beginning of each question) and practice a little more.

The chart on the facing page illustrates these steps. If you follow these steps and ask questions when you don't understand, you will have an excellent chance for success in this course. But remember, you must get involved because math is not a spectator sport.

Jack Barker
Jim Rogers
Jim Van Dyke





Pedagogical Use of Color

The various colors in the text figures are used to improve clarity and understanding. Any figures with three-dimensional representations are shown in various colors to make them as realistic as possible. Color is used in those figures where different portions are being highlighted and discussed.

In addition to the use of color in the figures, the pedagogical system in the text has been enhanced with color as well. We have used the following colors to distinguish the various pedagogical features:

PROPERTY

PROCEDURE

CAUTION

RULE