PREALGEBRA
FOR COLLEGE STUDENTS

JOHN R. KENNEDY ■ TERRY R. GREEN

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This book is dedicated to our parents
Elizabeth and John and Dorothy and Charles

PREFACE

Prealgebra for College Students prepares students for a first course in algebra and is designed for a one-quarter or one-semester course. It provides thorough coverage of the skills and concepts that are necessary to build a strong foundation for elementary algebra.

We introduce signed numbers before fractions and decimals, thus allowing manipulations with signs to be integrated with fractions, decimals, and grouping symbols. Throughout the text students are given problems that place additional emphasis on the use of the grouping symbols and the order of operations, thereby helping them develop sequencing skills for solving problems with several simplified steps.

The contexts of the word problems have been carefully selected to be of interest to a wide variety of students. Most of the problems are based on real-life situations that describe facts pertaining to mathematical quantities. The topics have been selected from the fields of accounting and banking, computers, consumer interests, education, the environment, health and nutrition, sports, technology, transportation, and even politics. Topics also encompass the traditional sciences of astronomy, chemistry, and physics.

Many of the word problems require critical reading and critical thinking. Students will find problems that require them to translate verbal descriptions of mathematical quantities into mathematical expressions. We also challenge students to work backwards: translating mathematical expressions into words, phrases, and sentences. We emphasize problem solving throughout the book.

In Chapter 7 on solving equations we present a six-step method for solving word problems:

1. Identify and describe the unknown and assign it a variable name.
2. Use the variable to write one or more expressions that describe other quantities in the problem.
3. Write a statement in English that summarizes the equivalence between two quantities and write an equation using the expressions from step 2.
4. Solve the equation.
5. Check the solution and determine if the answer is reasonable.
6. Write a short sentence explaining the answer.

PEDAGOGICAL FEATURES

Practice for Success

Each section begins with a statement of the objectives for that section. Within each section are numerous examples of the kinds of problems found in the exercises at the end of the section. We recommend that students first try the *Practice for Success* problems that precede each exercise set before they begin the exercises. The purpose of the Practice for Success problems is to test students' knowledge and skill level before they try the exercises. If a student has difficulty correctly completing these preliminary problems, we recommend he or she reread the material for that section and study the examples more closely. The answers to the Practice for Success problems appear at the end of each section.

Looking Back

Looking Back problems remind students of techniques and major ideas that were presented earlier and thus provide a form of review. We encourage instructors to make a point of assigning most of the Looking Back problems along with the other standard problems from the section. Because many of the Looking Back problems ask conceptual types of questions, dealing with definitions and the meanings of terms and requiring critical writing and thinking skills, they are intended to help solidify understanding.

Chapter Review Problems

Chapter Review Problems appear at the end of each chapter and contain only material that appears within the given chapter. Answers to the odd-numbered exercises are provided at the back of the book.

Chapter Practice Tests

A *Chapter Practice Test* appears at the end of each chapter and consists of approximately 25 problems. A *Practice Final Exam* is included at the end of Chapter 8. Answers to all of the test questions appear at the end of the book.

Tables

Four sets of reference tables appear at the end of the book:

Table of Prime Factors and Squares and Square Roots is a computational aid.

Table of Common Fractions and Decimal Equivalents shows the decimal equivalents of fractions that are multiples of sixty-fourths.

Table of Common Measurements provides common measurements, such as the number of yards in a mile.

Table of Geometric Formulas provides figures and formulas for the more common two- and three-dimensional figures that concern perimeter, area, and volume.

Glossaries

In addition to the reference tables, two special glossaries are at the end of the book:

Glossary of Special Symbols and Abbreviations contains special notations and abbreviations that may be unfamiliar.

Glossary of Significant Terms provides a short form of a mathematics dictionary, containing the major concepts and terms presented in the book.

For convenience, the Special Symbols and Abbreviations and the Table of Common Measurements are reproduced inside the front and back covers of the book.

Special Markings, Numbering, and Calculator Use

Major concepts and definitions are boxed for easy reference; the end of each example is marked with a square bullet symbol; and a standard numbering system is used to identify numbered sections, figures, and tables within a chapter. The first number indicates the chapter and the second, the sequence within the chapter—for example, 3.2 indicates Chapter 3 and Section, Figure, or Table 2 within Chapter 3.

This text does not explicitly mark problems as either requiring or recommending the use of a calculator. We expect that part of a student's math education should provide practice in deciding when calculator use is appropriate. We encourage students to use a calculator for several of the sections in Chapter 4, which deal with decimals, and for financial formulas introduced in Section 6.5.

SUPPLEMENTS

The *Instructor's Manual* discusses the purpose and objectives of each chapter and contains a suggested course schedule. It contains four forms of a test for each of the chapters (1 through 8), four forms of the final exam, and answers to all even-numbered exercises.

The *Student Study Guide* contains sets of review problems that provide long-term reinforcement. Solutions to all of the problems are included in this supplement.

EXPTest, a computerized test bank for IBM-PCs and compatibles, contains over *875* test questions. The package also allows the instructor to view and edit the tests by adding or deleting questions. Both the existing and new test questions can be modified. Any number of student tests can be printed and created in multiple forms for larger class sections or individual use. The included graphics importation feature lets the instructor display and print graphs, diagrams, and maps with the tests. EXPTest is accompanied by easy-to-follow documentation and a quick-start guide. A demonstration disk is available for review.

EXAM BUILDER, a computerized test bank for the Macintosh, is a simple testing program that allows instructors to create, view, and edit tests. Questions can be stored by objective so that tests can be created

using multiple choice, true/false, fill-in-the-blank, essay, and matching formats. Questions can also be scrambled to avoid duplicate testing. A demonstration disk is available for review.

Problem-generating software, consisting of programs that can be used to generate or check problems, is available to instructors through the authors. Further information can be obtained by contacting the authors: John Kennedy and Terry Green, Department of Mathematics, Santa Monica College, 1900 Pico Blvd, Santa Monica, CA 90405.

A *Developmental Mathematics Review Videotape Series,* created by Hope Florence, College of Charleston, and covering the review of arithmetic (one tape), topics in elementary algebra (three tapes), and topics in intermediate algebra (one tape), is available to adopters of this text. The videotape series includes specialized worksheets that give students the chance to work additional exercises.

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CHAPTER ONE

WHOLE NUMBERS

In this introductory chapter we review topics related to **whole numbers**, which represent a starting point for learning about the kinds of numbers used in algebra. Whole numbers can be used to represent many different quantities such as money, distance, time, temperature, and so on.

The first few topics in this chapter include place value, rounding whole numbers, writing numbers in expanded forms, and the four fundamental operations. Then we introduce the concept of prime numbers and discuss how these numbers form the fundamental building blocks of the whole number system. Next we introduce applications of prime numbers and bases and exponents to find least common multiples and greatest common factors. In preparation for algebra, we then investigate the order of operations and the use of grouping symbols and how they relate to expressions consisting of several mixed operations. The chapter concludes by discussing some of the fundamental algebraic properties of numbers.

1.1 PLACE VALUE

OBJECTIVES

- □ To identify the place value of a digit
- □ To write whole numbers in expanded form
- □ To convert whole numbers in standard form to words
- □ To convert whole numbers in words to standard form
- □ To round whole numbers

The set of whole numbers starts at 0 and continues forever and is represented by writing $\{0, 1, 2, \ldots\}$. The ellipsis dots, . . . , indicate that a particular sequence of numbers continues indefinitely. Numbers in the **decimal number system**, otherwise known as the "base 10" number system, are written using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The value of a digit within a number is determined by the position of that digit; for example, the numbers 12 and 21 have the same digits, but they do not represent the same numerical value.

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