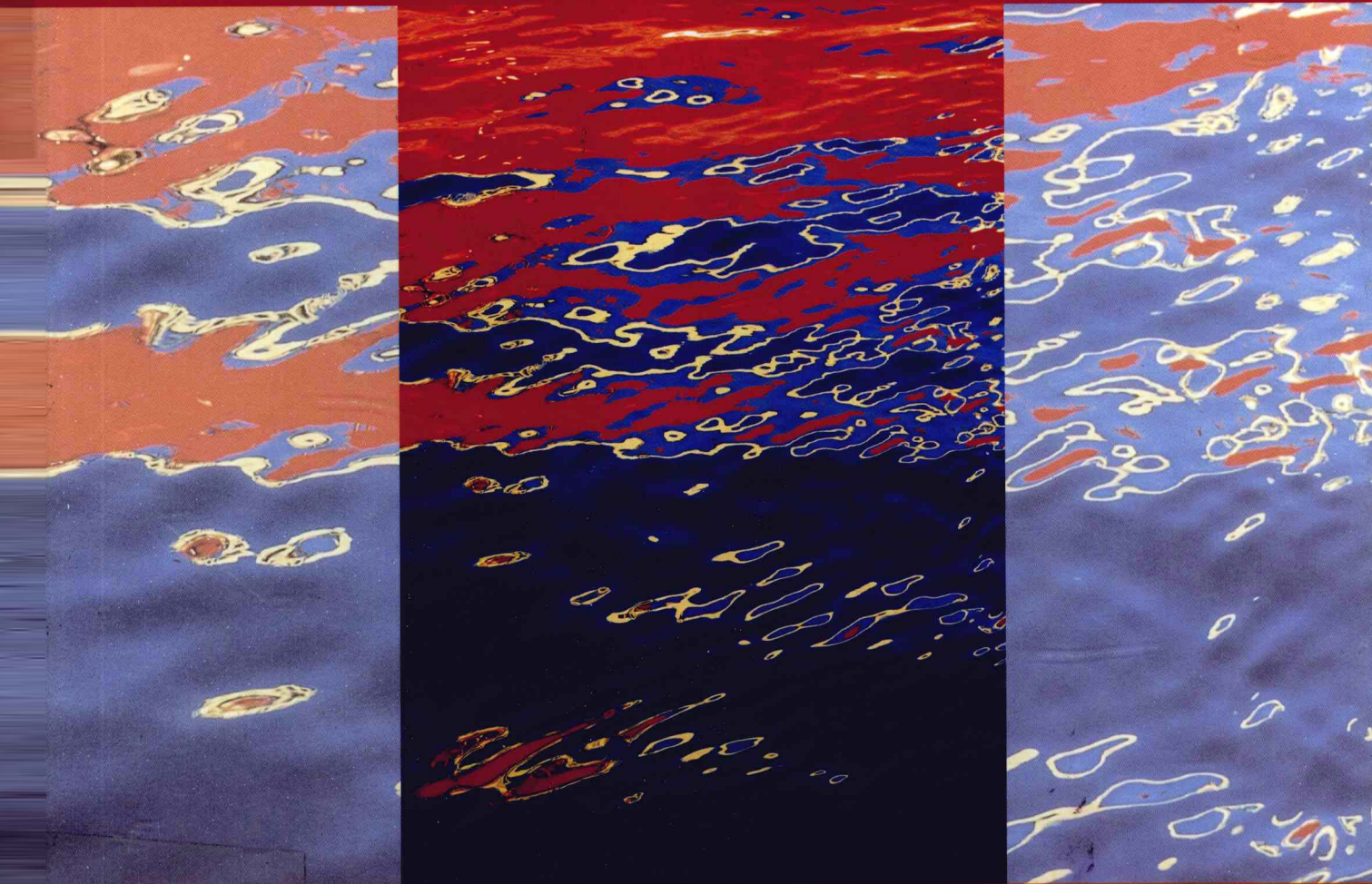


contemporary college algebra and trigonometry

a graphing approach



thomas w. hungerford



Contemporary College Algebra and Trigonometry

A Graphing Approach

Thomas W. Hungerford
Cleveland State University

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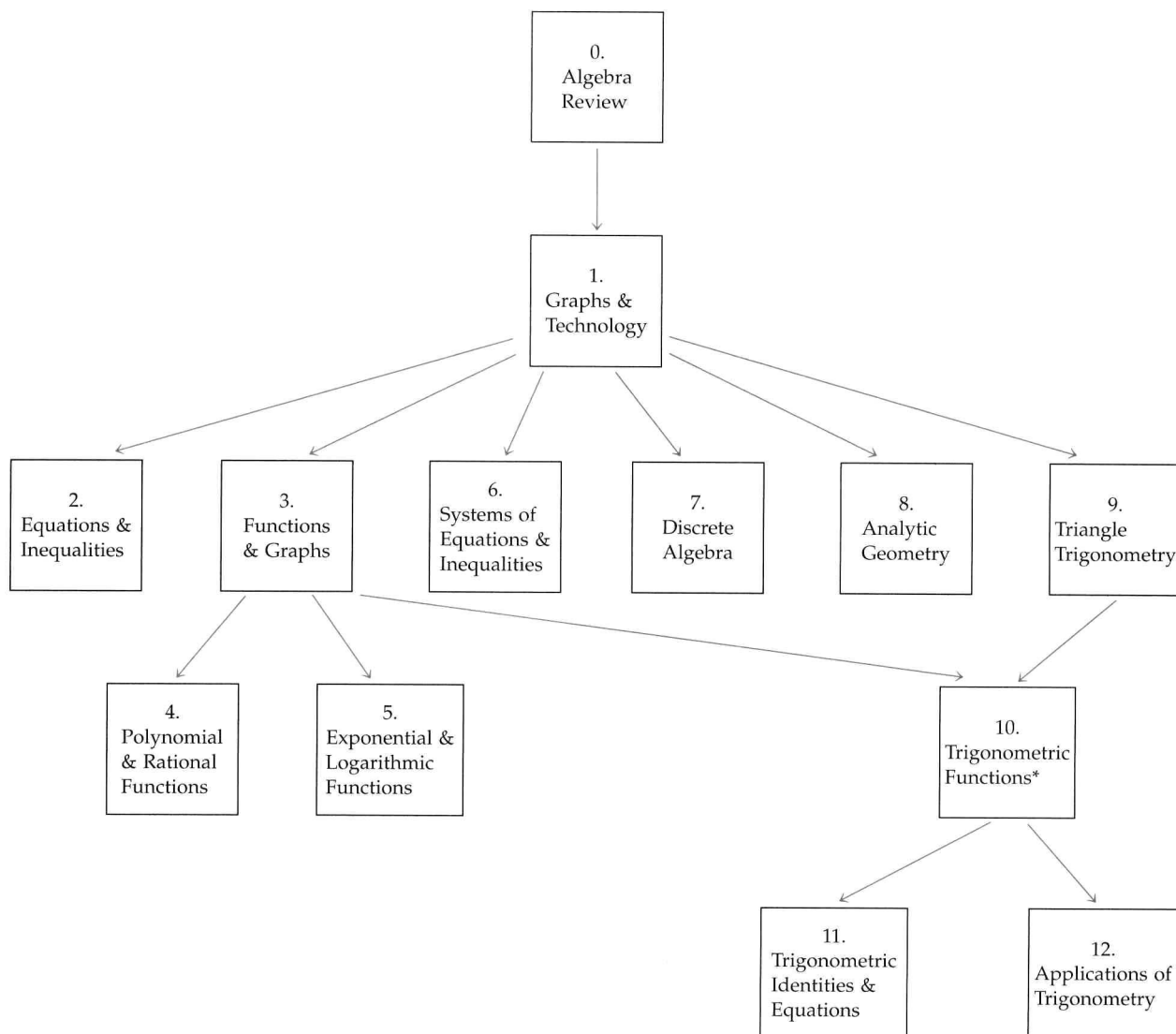
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Interdependence of Chapters



*Chapter 10 may be covered before Chapter 9, as explained on the facing page.

Technology Tips To avoid much clutter, only a limited number of calculators are specifically mentioned in the Technology Tips. However, unless noted otherwise,

Technology Tips for the TI-83 also apply to the TI-82;

Technology Tips for the TI-86 also apply to the TI-85;

Technology Tips for the TI-89 also apply to the TI-92;

Technology Tips for the Casio 9850 also apply to the Casio 9970.

There are no Tips specifically for HP-48 and HP-49 calculators since they use operating systems entirely different from those of other calculators.

Supplements

Instructors who adopt this text may receive, free of charge, the following items:

Electronic Companion to Precalculus This dynamic and interactive CD-ROM, which is packaged with the text, covers the key concepts using multiple representations.

Instructor's Resource Manual This manual comprises two unique parts. The first part contains detailed solutions to all the exercises and end-of-chapter Review Questions to assist the instructor in the classroom and in grading assignments. Solutions to the Discovery Projects at the end of each chapter are also included. The second part of the manual ties in with the *Math in Practice: An Applied Video Companion* CD-ROM that is packaged with the manual. This innovative CD-ROM is designed to show students how and where college algebra topics arise in real life. Lori Palmer of Utah Valley State College has conducted more than 20 engaging interviews with individuals in such fields as aviation, food services, banking, and environmental science to motivate the key concepts from the text. Each vignette is accompanied by two problems to test students' understanding of the underlying mathematical ideas and skills. Printed versions of these problems are included in the manual. Answers to the problems are provided on the disk with detailed solutions within the manual.

Test Bank This manual provides sample problems for each section of the text. On average, there are at least 15 sample problems per section. These problems are both free-response and multiple choice and are broken into three levels of difficulty: easy, medium, and hard. From the sample problems, five sample tests per chapter will be created. Tests A, B, and C will be free-response. Tests D and E will be multiple choice. A complete answer section is included.

ESATEST Computerized Test Bank The computerized test bank contains all the problems from the printed test bank and allows instructors to prepare quizzes and examinations quickly and easily. Instructors may also add questions or modify existing ones. ESATEST has gradebook capabilities for recording and tracking students' grades. Instructors have the opportunity to post and administer a test over a network or

on the Web. ESATEST user-friendly printing capability accommodates all printing platforms.

Graphing Calculator Manual This manual comprises three parts. The initial part of the manual is entitled Basic Calculator Topics. This section provides a general understanding of all the capabilities available on a graphing calculator. Calculator Notes and Problems follow, in which narrative, examples, and exercises to develop the concepts in the text in association with your graphing calculator are used. The final section of the manual provides detailed instructions on 10 specific calculators.

Video Series Free to adopters, the videotape package consists of 13 VHS videotapes, one for each chapter in the text. Each tape is one hour long and further develops the concepts of the chapters. On-location footage is utilized to introduce an extended application at the beginning of each tape. This application is explained fully at the end of each tape.

Web Site The Web site (www.brookscole.com/math_d) offers additional resources to both instructors and students in conjunction with the adoption of the text.

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To the Student

This text assumes the use of technology, so you should be aware of the following facts:

Terminology In this text “calculator” means “graphing calculator.” All discussions of calculators, with obvious modifications, apply to graphing software for computers.

Minimal Technology Requirements In order to use this text effectively, you must have either a computer with appropriate software or a calculator at least at the level of a TI-82. Among current models that meet or exceed this minimal requirement are the TI-82 through TI-92, the Sharp 9600, HP-38, HP-39, HP-48, HP-49, and Casio 9850, 9770, and FX2.

The following features of the text will enable you to get the most out of your calculator.

Technology Tips Some of the Technology Tips in the margin tell you the proper menus or keys to be used on specific calculators to carry out procedures mentioned in the text. Other Tips offer general information or helpful advice for performing a particular task on a calculator.

As a general rule, the only calculators mentioned in the Technology Tips are the TI-83, TI-86, TI-89, Sharp 9600, HP-38, and Casio 9850*. However, unless noted otherwise,

Technology Tips for the TI-83 also apply to the TI-82;

Technology Tips for the TI-86 also apply to the TI-85;

Technology Tips for the TI-89 also apply to the TI-92;

Technology Tips for the Casio 9850 also apply to the Casio 9970.

*There are no Tips in the text specifically for HP-48 and HP-49 calculators, which use an entirely different operating system than other calculators.

Calculator Investigations You may not be aware of the full capabilities of your calculator (or some of its limitations). The Calculator Investigations (which appear just before the exercise sets in some of the earlier sections of the book) will help you to become familiar with your calculator and to maximize the mathematical power it provides. Even if your instructor does not assign these investigations, you may want to look through them to be sure you are getting the most you can from your calculator.

With all this talk about calculators, don't lose sight of this crucial fact:

Technology is only a *tool* for doing mathematics.

You can't build a house if you only use a hammer. A hammer is great for pounding nails, but useless for sawing boards. Similarly, a calculator is great for computations and graphing, but it is not the right tool for every mathematical task. To succeed in this course, you must develop and use your algebraic and geometric skills, your reasoning power and common sense, and you must be willing to work.

The key to success is to use all of the resources at your disposal: your instructor, your fellow students, your calculator (and its instruction manual), and this book. Here are some tips for making the most of these resources.

Ask Questions. Remember the words of Hillel:

The bashful do not learn.

There is no such thing as a "dumb question" (assuming, of course, that you have attended class, taken notes, and read the text). Your instructor will welcome questions that arise from a serious effort on your part.

Read the Book. Not just the homework exercises, but the rest of the text as well. There is no way your instructor can possibly cover the essential topics, clarify ambiguities, explain the fine points, and answer all your questions during class time. You simply will not develop the level of understanding you need to succeed in this course and in calculus unless you read the text fully and carefully.

Be an Interactive Reader. You can't read a math book the way you read a novel or history book. You need pencil, paper, and your calculator at hand to work out the statements you don't understand and to make notes of things to ask your fellow students and/or your instructor.

Do the Graphing Explorations. When you come to a box labeled "Graphing Exploration," use your calculator as directed to complete the discussion. Typically, this will involve graphing one or more equations and answering some questions about the graphs. Doing these explorations as they arise will improve your understanding and clarify issues that might otherwise cause difficulties.

Do Your Homework. Remember that

Mathematics is not a spectator sport.

You can't expect to learn mathematics without doing mathematics, any more than you could learn to swim without getting wet. Like

swimming or dancing or reading or any other skill, mathematics takes practice. Homework assignments are where you get the practice that is essential for passing this course and succeeding in calculus.

Supplements

The following items are available at no cost to students.

Electronic Companion to Precalculus This dynamic and interactive CD-ROM, which is packaged with the text, covers the key concepts using multiple representations.

Web Site The Web site (www.brookscole.com/math_d) offers additional resources to both instructors and students in conjunction with the adoption of the text.

Students using *Contemporary College Algebra and Trigonometry* may purchase the following supplements.

Student Resource Manual This manual comprises two parts. The first part contains detailed solutions to all the odd-numbered exercises and end-of-chapter Review Questions. Solutions to the Discovery Projects at the end of each chapter are also included. The second part of the manual ties in with the *Math in Practice: An Applied Video Companion CD-ROM* that is packaged with the manual. This innovative CD-ROM is designed to show students how and where college algebra topics arise in real life. Lori Palmer of Utah Valley State College has conducted more than 20 engaging interviews with individuals in such fields as aviation, food services, banking, and environmental science to motivate the key concepts from the text. Each vignette is accompanied by two problems written by Carolyn Hamilton, also of Utah Valley State College, to test students' understanding of the underlying mathematical ideas and skills. Printed versions of these problems are included in the manual. Answers to the problems are provided on the disk and in the manual.

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ESATUTOR This computer software package contains hundreds of problems and answers that correspond with every section of the text. Students can complete a pretest to evaluate their level of understanding of the concepts in each chapter. Additionally, students can complete post-tests to ensure they have grasped the primary learning objectives. The software comes with a built-in graphing calculator. Students interested in purchasing this software package should refer to the marketing material inside the back cover of this text.

Core Concept Video This single videotape contains the most important topics covered in the full video series that is given to each school that uses *Contemporary College Algebra and Trigonometry*. This take-home tutorial can be used as a preview of what is to be covered in class, as an aid to completing homework assignments, or as a tool to review for a test.

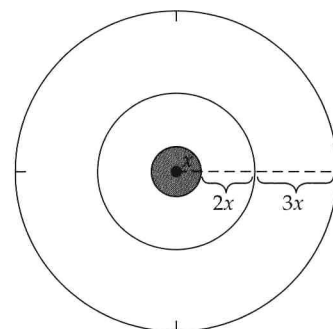
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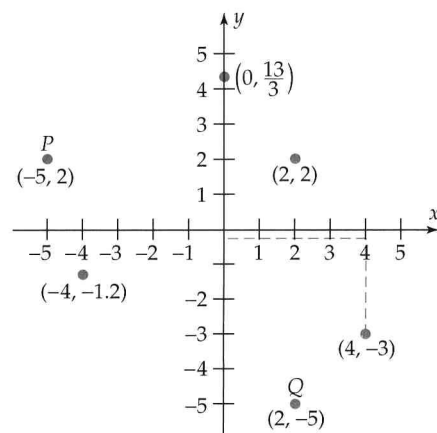
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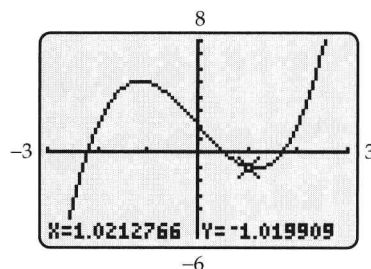
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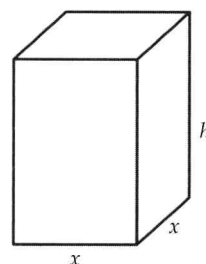
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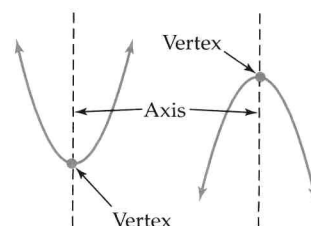
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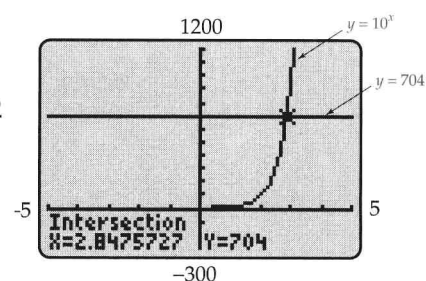
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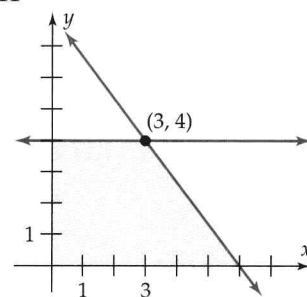
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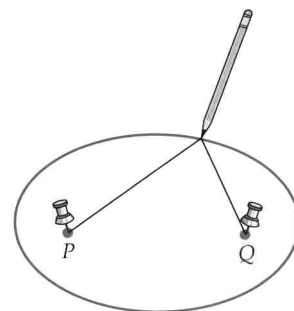
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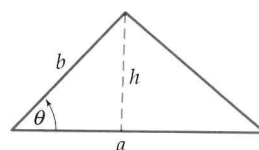
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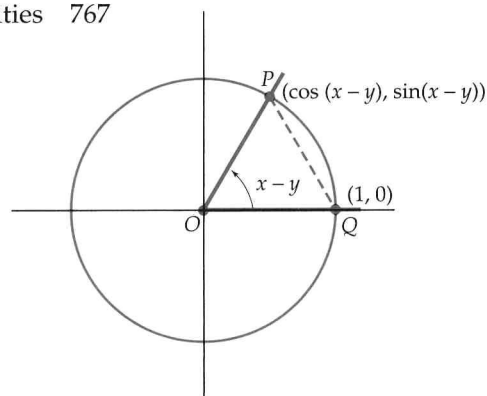
sin(2.5)	.5984721441
cos(-6)	.9601702867
tan(15)	-.8559934009

*Replaces Section 10.2 for those who cover Chapter 10 before Chapter 9.

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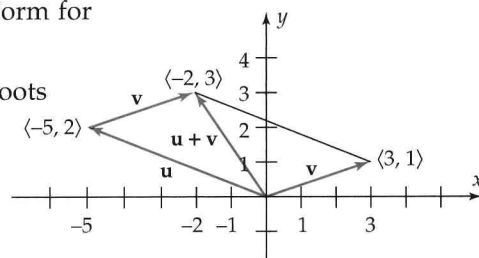
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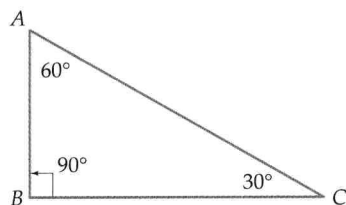
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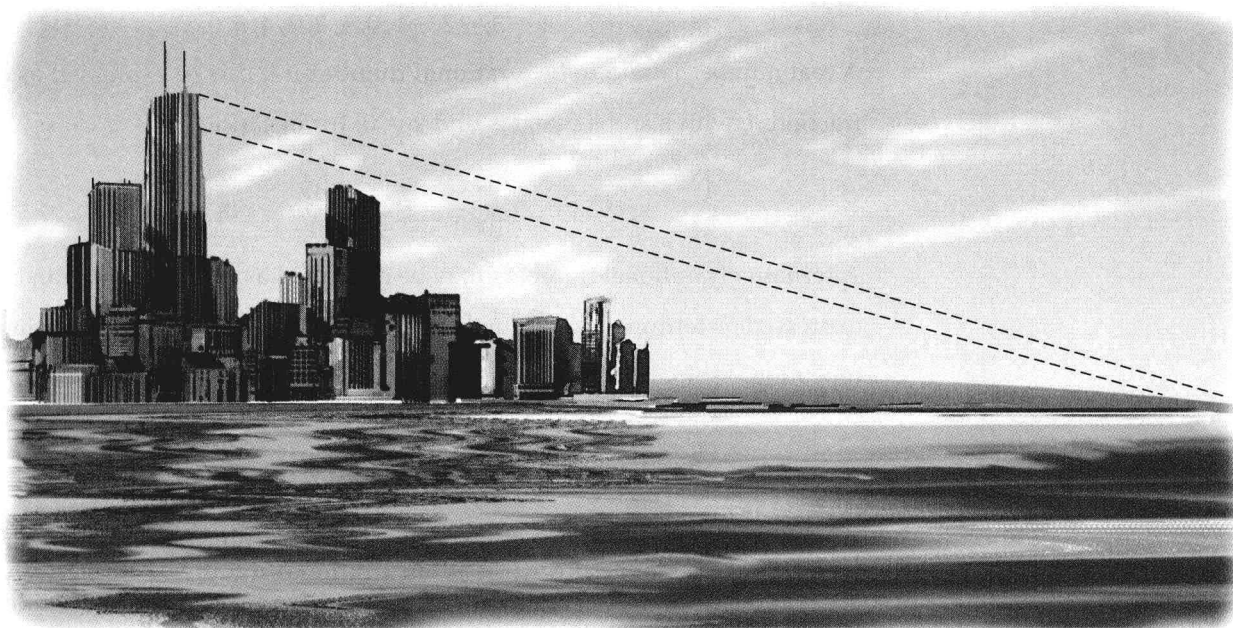
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Algebra Review

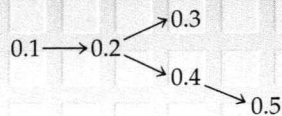
On a clear day, can you see forever?



If you are at the top of the Sears Tower in Chicago, how far can you see? In earlier centuries, the lookout on a sailing ship was posted on the highest mast because he could see farther from there than from the deck. How much farther? These questions, and similar ones, can be answered (at least approximately) by using basic algebra and geometry. See Example 9 on page 22 and Exercise 74 on page 24.



Interdependence of Sections



Chapter Outline

- 0.1 The Real Number System
- 0.1.A Excursion: Decimal Representation of Real Numbers
- 0.2 Integral Exponents
- 0.3 Roots, Radicals, and Rational Exponents
- 0.4 Polynomials
- 0.5 Fractional Expressions

This chapter reviews the essential facts about real numbers, exponents, and the basic rules of algebra that are needed in this course and later ones. Well-prepared students may be able to skim over much of this material, but if you haven't used your algebraic skills for a while, you should review this chapter thoroughly. Your success in the rest of the course depends on your ability to use the fundamental algebraic tools presented here.

0.1

The Real Number System

You have been using **real numbers** most of your life. They include the **natural numbers** (or **positive integers**): 1, 2, 3, 4, ... and the **integers**:

$$\dots, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, \dots$$

A real number is said to be a **rational number** if it can be expressed as a fraction $\frac{r}{s}$, with r and s integers and $s \neq 0$; for instance

$$\frac{1}{2}, \quad -.983 = -\frac{983}{1000}, \quad 47 = \frac{47}{1}, \quad 8\frac{3}{5} = \frac{43}{5}.$$

Alternatively, rational numbers may be described as numbers that can be expressed as terminating decimals, such as $.25 = \frac{1}{4}$, or as nonterminating repeating decimals in which a single digit or a block of digits repeats forever, such as

$$\frac{5}{3} = 1.66666\dots \quad \text{or} \quad \frac{58}{333} = .174174174\dots$$

A real number that cannot be expressed as a fraction with integer numerator and denominator is called an **irrational number**. Alternatively, an irrational number is one that can be expressed as a nonterminating, nonrepeating decimal (no block of digits repeats forever). For example,