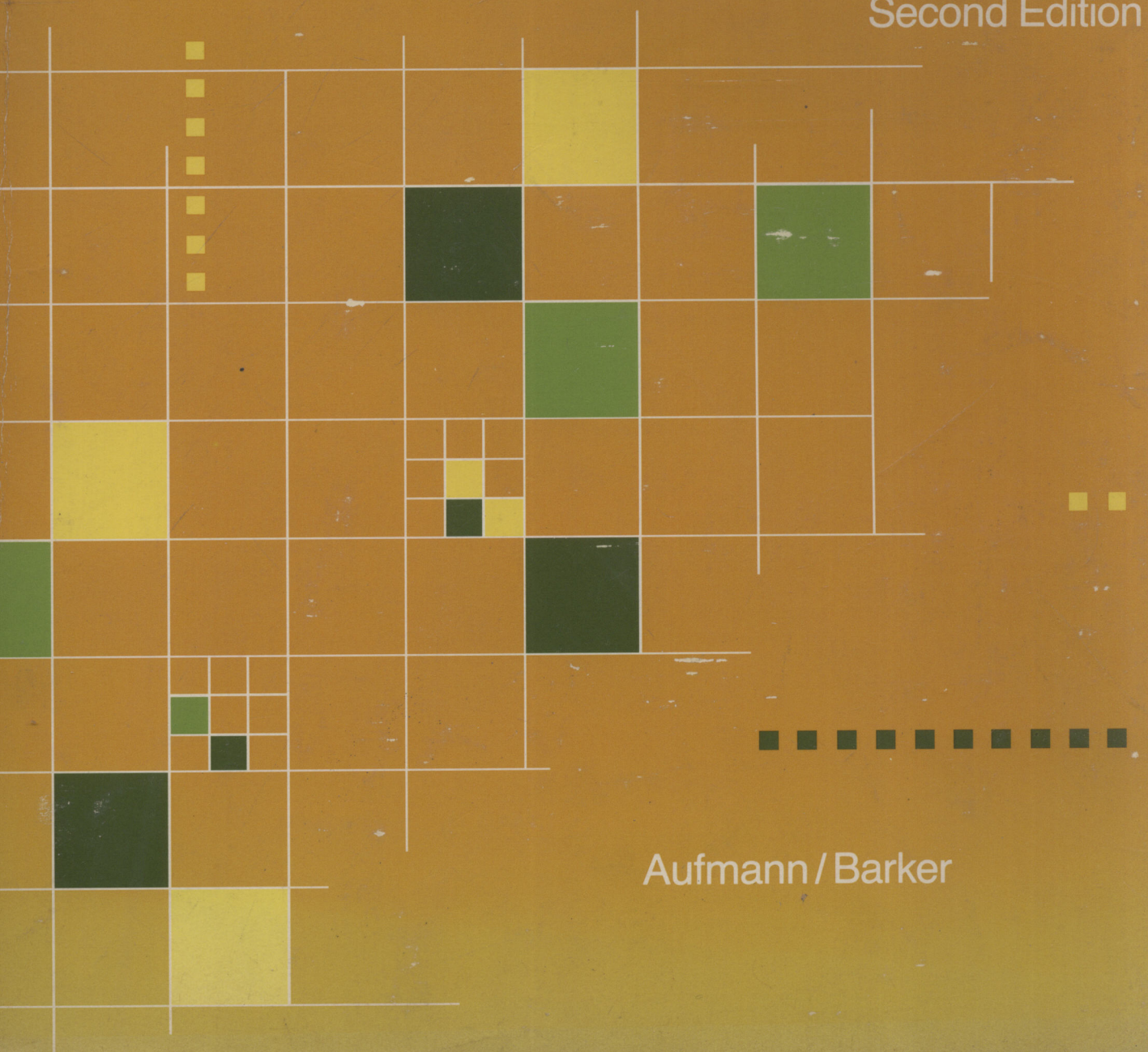


# Intermediate Algebra

An Applied Approach

Second Edition



Aufmann / Barker



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# Intermediate Algebra

AN APPLIED APPROACH

Second Edition

**Richard N. Aufmann** □ **Vernon C. Barker**

Palomar College    California



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## Overview

### Purpose

INTERMEDIATE ALGEBRA: AN APPLIED APPROACH, SECOND EDITION is a newly developed text which covers all the topics considered essential in a second-year algebra course, emphasizing applications of algebra throughout. The text has been specifically developed to meet not only the needs of the traditional college student, but also the needs of the mature student whose mathematical proficiency may have declined during years away from formal schooling.

### Contents

INTERMEDIATE ALGEBRA: AN APPLIED APPROACH is the third in a series of three texts by the authors:

BASIC COLLEGE MATHEMATICS: AN APPLIED APPROACH, THIRD EDITION  
INTRODUCTORY ALGEBRA: AN APPLIED APPROACH, SECOND EDITION  
INTERMEDIATE ALGEBRA: AN APPLIED APPROACH, SECOND EDITION

The first book, BASIC COLLEGE MATHEMATICS: AN APPLIED APPROACH, provides a comprehensive coverage of computational skills and their applications. INTRODUCTORY ALGEBRA: AN APPLIED APPROACH contains a complete development of the basic skills and applications typically found in a first-year algebra course. INTERMEDIATE ALGEBRA: AN APPLIED APPROACH covers the essentials of second-year algebra as well as certain more advanced pre-calculus topics. Since the three texts share several important pedagogical and organizational features, they may be used sequentially to reap the benefits of a smoothly-integrated series of learning materials. However, because the three texts have been written so that the content of each is independent of the other two, any one book in the series may be used independently of the other two.

### Organization

INTERMEDIATE ALGEBRA: AN APPLIED APPROACH is organized into 12 chapters. Each chapter is divided into a varying number of sections, and each section contains several related objectives. Any one objective contains the exposition of a single skill or application. The exercise sets found at the end of each section are grouped by objective to establish a simple matching between exposition and related practice problems. The Review/Test found at the end of each chapter is also organized by objective, in order to define a clear correspondence between exposition and related testing.

### Features

INTERMEDIATE ALGEBRA: AN APPLIED APPROACH is built around the three proven and effective teaching strategies which are characteristic of the entire series. First, an **applied approach** generates an awareness of the value of algebra as a practical tool. Second, an **interactive approach** encourages the student to practice each skill while it is being presented, thus avoiding needless confusion later when working practice assignments. Third, an **objective-specific approach** helps the student or the Instructor manage instruction, improving both the efficiency and the effectiveness of the instruction. These three strategies are described pictorially on the next three pages.

### New Features

This new edition is primarily a refinement and enhancement of the previous edition and contains the same organizational features and pedagogical approach that have made it so successful. Features new to this edition include **chapter summaries**, which call out the "Key Words" and "Essential Rules" in each chapter and assist students preparing for class testing; **cumulative chapter tests**, which help students evaluate their mastery of math skills; special **calculator and computer enrichment topics**, which provide students with valuable instruction and practice in using calculators or computer applications to solve selected types of exercises; and **historical notes**, which briefly examine mathematically-oriented topics of interest.



# An Applied Approach

The traditional approach to teaching or reviewing algebra, which places major emphasis on problems requiring only manipulation of numbers and variables, is lacking in that it fails to teach the practical value of algebra. By contrast, **INTERMEDIATE ALGEBRA: AN APPLIED APPROACH** places a heavy stress on applications. Where applicable, the last objective of any section is an applications objective in which the skills covered in the section are used in the solution of practical problems. Frequently, an entire section of a chapter is devoted to applications. Also, almost all of Chapter 2 and portions of several other chapters are devoted to certain standard types of applications. This carefully-integrated applied approach generates awareness on the student's part of the value of algebra as a real-life tool.

An entire section of a chapter is frequently devoted to applications of algebra.

A strategy which the student may use in solving application problems is stated and explained for each major type of problem. This strategy is used in the solution of the worked examples which follow the exposition.

## SECTION 4 Application Problems in Two Variables

### 4.1 Objective To solve rate-of-wind or current problems

Motion problems which involve an object moving with or against a wind or current normally require two variables to solve.

A motorboat traveling with the current can go 24 mi in 2 h. Against the current it takes 3 h to go the same distance. Find the rate of the motorboat in calm water and the rate of the current.

#### STRATEGY FOR SOLVING RATE-OF-WIND OR CURRENT PROBLEMS

▷ Choose one variable to represent the rate of the object in calm conditions and a second variable to represent the rate of the wind or current. Using these variables, express the rate of the object with and against the wind or current. Use the equation  $rt = d$  to write expressions for the distance traveled by the object. The results can be recorded in a table.

Rate of the boat in calm water:  $x$   
Rate of the current:  $y$

	Rate	•	Time	=	Distance
With the current	$x + y$	•	2	=	$2(x + y)$
Against the current	$x - y$	•	3	=	$3(x - y)$

▷ Determine how the expressions for distance are related.

The distance traveled with the current is 24 mi.  
The distance traveled against the current is 24 mi.

$$\begin{aligned} 2(x + y) &= 24 \\ 3(x - y) &= 24 \end{aligned}$$

Solve the system of equations.

$$\begin{aligned} 2(x + y) &= 24 & \frac{1}{2} \cdot 2(x + y) &= \frac{1}{2} \cdot 24 & x + y &= 12 \\ 3(x - y) &= 24 & \frac{1}{3} \cdot 3(x - y) &= \frac{1}{3} \cdot 24 & x - y &= 8 \\ & & & & 2x &= 20 \\ & & & & x &= 10 \\ \text{Replace } x \text{ by } 10 \text{ in the equation } x + y &= 12. & & & x + y &= 12 \\ \text{Solve for } y. & & & & 10 + y &= 12 \\ & & & & y &= 2 \end{aligned}$$

The rate of the boat in calm water is 10 mph.  
The rate of the current is 2 mph.

## An Interactive Approach

Instructors have long realized the need for a text which requires the student to use a skill *as it is being taught*. INTERMEDIATE ALGEBRA: AN APPLIED APPROACH uses an interactive technique which meets this need. Every objective, including the one pictured below, contains at least one pair of examples in which one example is worked. The second example in the pair is not worked so that the student may “interact” with the text by solving it. In order to provide immediate feedback, complete solutions to these examples are provided in the Answer Section. The benefit of this interactive strategy is that the student can check that a new skill has been learned in advance of attempting a homework assignment.

A simple and concise explanatory passage begins each skill objective.

Paired examples follow the explanatory passage.

The interactive key is the second example in each pair. It has not been worked so that the students may test their understanding of the skill by solving it, referring to the worked example at the left if necessary.

Reference to the Answer Section allows the student to check solutions immediately.

467

Chapter 11 / Exponential and Logarithmic Functions

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### SECTION 1 The Exponential and Logarithmic Functions

---

**1.1 Objective**

To evaluate an exponential function

---

A function of the form  $f(x) = b^x$  is an **exponential function** where  $b$  is a positive real number not equal to 1. The number  $b$  is the **base** of the exponential function.

Evaluate the function  $f(x) = 2^x$  at  $x = 3$ .

$$f(3) = 2^3 = 8$$

Evaluate the function  $f(x) = 3^x$  at  $x = -2$ .

$$f(-2) = 3^{-2} = \frac{1}{3^2} = \frac{1}{9}$$

Evaluate the function  $f(x) = (-4)^x$  at  $x = \frac{1}{2}$ .

$$f\left(\frac{1}{2}\right) = (-4)^{\frac{1}{2}} = \sqrt{-4} = 2i$$

The value is a complex number. For this reason, the base of an exponential function is required to be a positive real number.

Evaluate the function  $f(x) = 4^x$  at  $x = \sqrt{2}$ .

Using a calculator, the value of this function can be found to the desired degree of accuracy by using approximations for  $\sqrt{2}$ .

$f(\sqrt{2}) \approx f(1.41)$	$\approx 4^{1.41}$	$\approx 7.06$
$f(\sqrt{2}) \approx f(1.414)$	$\approx 4^{1.414}$	$\approx 7.101$
$f(\sqrt{2}) \approx f(1.4142)$	$\approx 4^{1.4142}$	$\approx 7.1029$
$f(\sqrt{2}) \approx f(1.41421)$	$\approx 4^{1.41421}$	$\approx 7.10296$

**Example 1** Evaluate the function  $f(x) = \left(\frac{1}{2}\right)^x$  at  $x = 2$  and  $x = -3$ .

**Solution**

$$f(x) = \left(\frac{1}{2}\right)^x$$

$$f(2) = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

$$f(-3) = \left(\frac{1}{2}\right)^{-3} = 2^3 = 8$$

**Example 2** Evaluate the function  $f(x) = \left(\frac{2}{3}\right)^x$  at  $x = 3$  and  $x = -2$ .

**Your solution** →

**Example 3** Evaluate the function  $f(x) = 2^{3x-1}$  at  $x = 1$  and  $x = -1$ .

**Solution**

$$f(x) = 2^{3x-1}$$

$$f(1) = 2^{3(1)-1} = 2^2 = 4$$

$$f(-1) = 2^{3(-1)-1} = 2^{-4} = \frac{1}{2^4} = \frac{1}{16}$$

**Example 4** Evaluate the function  $f(x) = 2^{2x+1}$  at  $x = 0$  and  $x = -2$ .

**Your solution** →

Solutions on p. A76

# An Objective-Specific Approach

Many texts in mathematics are not organized in a manner which facilitates management of learning. Typically, students are left entirely to their own devices to wander through a maze of apparently unrelated lessons, practice sets, and tests. **INTERMEDIATE ALGEBRA: AN APPLIED APPROACH** solves this problem by organizing all lessons, practice sets, and tests around a carefully-constructed hierarchy of 143 objectives. The advantage of this objective-by-objective organization is that it enables the student who is uncertain at any step in the learning process to refer easily to the original presentation of a skill in order to review the skill or application involved.

A numbered objective statement names the skill taught in each lesson.

Chapter 5 / Rational Expressions 187

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## SECTION 1 Simplifying Rational Expressions

---

**1.1 Objective** To simplify a rational expression

---

A fraction in which the numerator or denominator is a polynomial is called a **rational expression**. Examples of rational expressions are shown at the right.

$\frac{2}{a}, \quad \frac{x^2 + y}{2x + 3}, \quad \frac{x^2 + 2x - 4}{x^4 - 2x}$

End-of-section Exercise Sets are referenced by number to objectives.

Chapter 5 / Rational Expressions 193

---

## 1.1 Exercises

---

Simplify.

1.  $\frac{4 - 8x}{4}$

2.  $\frac{8y + 2}{2}$

3.  $\frac{6x^2 - 2x}{2x}$

4.  $\frac{3y - 12y^2}{3y}$

5.  $\frac{8x^2(x - 3)}{4x(x - 3)}$

6.  $\frac{16y^4(y + 8)}{12y^3(y + 8)}$

The Review/Test at the end of each chapter is also referenced by number to objectives.

Chapter 5 / Rational Expressions 231

---

## Review/Test

---

**SECTION 1**

**1.1a** Simplify:  $\frac{8x^2 - 12x}{4x^3 - 2x^2 - 6x}$

**1.2** Simplify:  
 $(4x^3 - x - 10) \div (2x - 3)$

**1.1b** Simplify:  $\frac{4x^2 + 4x - 3}{4 - 16x^2}$

**1.3** Simplify:  
 $\frac{3x^4 + 2x^3 - 4x^2 + 6x - 8}{x + 2}$



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## Instructor's Computerized Test Generator

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### For the Instructor



Reference for  
Computerized  
Test Generator

The INSTRUCTOR'S COMPUTERIZED TEST GENERATOR is a test-making tool designed to produce an infinite variety of both multiple-choice and free-response objective-referenced tests for each chapter of the text. (Cumulative Tests and Final Exams may also be created.)

The INSTRUCTOR'S COMPUTERIZED TEST GENERATOR is *educationally sound*. The data base consists of 1823 customized test items that are organized around the same hierarchy of objectives that organize the lessons of the text. Thus, the "generator" is an instructional management tool that makes it possible to determine which objectives have been mastered and which objectives require the recycling of instruction for any individual student. The tests *directly* support the text!

As an aid to the Instructor, the Instructor's Annotated Edition (IAE) is cross-referenced to the appropriate disk in the INSTRUCTOR'S COMPUTERIZED TEST GENERATOR by virtue of a computer-referencing logo and annotation which is to be found at the end of the Historical Note for each chapter. (See example upper left.)

While there are other computer-based test generators available, the INSTRUCTOR'S COMPUTERIZED TEST GENERATOR for the Aufmann/Barker program clearly distinguishes itself as technically *superior*. Printouts of complex math symbolisms as well as graphic representations are faithful to the text and are of exceptionally high quality.

The INSTRUCTOR'S COMPUTERIZED TEST GENERATOR is currently available for the Apple® II family of microcomputers.

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## The Computer Tutor™

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### For the Student



Reference for  
Computer  
Tutor™

The COMPUTER TUTOR™ is an "interactive" instructional-delivery vehicle designed for student use. The objectives which organize the "tutor" are the same as those of the text. Thus, each lesson of the "tutor" directly supports a corresponding lesson in the text. Each lesson in the Student Text (as well as its replica in the Instructor's Annotated Edition) is now cross-referenced to the COMPUTER TUTOR™ by virtue of a computer-referencing logo which is found adjacent to the lesson objective. The COMPUTER TUTOR™ lessons, in turn, are cross-referenced to the corresponding text lessons.

The COMPUTER TUTOR™ can prove to be a useful adjunct to basal-text instruction for a variety of reasons:

- An individual student might require help with *initial instruction* because of class absence.
- An individual student might require the *recycling of instruction* because testing has revealed lack of mastery on a given skill or concept the first time around.
- An individual student might require *review instruction* as they prepare for competency exams or as they prepare for enrollment in higher-level courses.

The COMPUTER TUTOR™ is not only educationally sound (for the reasons listed above) but it is also technically well-executed. A special type face has been especially created for this screen-only program to enhance readability, and complex math symbolisms and graphics are particularly well-executed.

The COMPUTER TUTOR™ is currently available for the Apple® II family of microcomputers.

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## Other Ancillaries

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### Instructor's Annotated Edition

In order to facilitate the Instructor's grading of exercise sets and Review/Tests, the ancillary package of INTERMEDIATE ALGEBRA: AN APPLIED APPROACH includes an Instructor's Annotated Edition (IAE). The IAE is an exact replica of the student text except that the answer to every problem in the text has been printed in red directly adjacent to the problem. An uncommon item in college mathematics packages, the IAE can serve as an invaluable timesaver to the Instructor.

### Solutions Manual

The ancillary package which accompanies INTERMEDIATE ALGEBRA: AN APPLIED APPROACH includes a Solutions Manual which contains the *complete solution for every exercise in the text*. At the Instructor's discretion, students may be granted access to the Solutions Manual. Use of the Solutions Manual allows the student to check the answers *and* the solution to every exercise. In the event that an answer is found to be incorrect, the student's solution may be compared to the solution found in the Solutions Manual in order to find the exact nature of the error. Students who are permitted use of the Solutions Manual are often able to help themselves, reducing the demand on the Instructor's time for tutorial help.

### Alternate Testing Program

Instructors frequently request testing materials which are not available to the student. For this reason, the ancillary package for INTERMEDIATE ALGEBRA: AN APPLIED APPROACH includes *two* printed Alternate Testing Booklets. In each booklet, the first half is a battery of free-response tests, one for each chapter. After every third chapter test, there is a cumulative test which covers three chapters. The first half of the booklet ends with a Final Exam covering all twelve chapters in free-response form. The second half of each booklet is identical to the first except that the tests are multiple choice instead of free response. Thus, the Instructor has four printed tests (in two formats) for every chapter including cumulative tests and final exams. All tests are on easy-to-copy, permission-to-reproduce pages.

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