

Preface

This sixth edition of *College Algebra* maintains our objective of providing a textbook designed for use *by the student*. The book is written in a supportive style and includes abundant pedagogic tools to encourage the student to read the text with care, follow the numerous examples, and tackle the exercises. The skills and confidence the student acquires will enable him or her to succeed in more advanced mathematics courses (calculus in particular) that are required in the study of engineering, the natural sciences, business, and management.

New to This Edition

This edition continues emphasis on incorporating graphing calculators as powerful problem-solving and visualization tools, without sacrificing the emphasis of the authors on traditional approaches. New and updated exercises, as well as attention-grabbing chapter openings and projects, have been added to help instructors and students make connections between algebra and the real world. This edition has gone through extensive copy editing and proofing phases in an effort to further ensure the accuracy of this textbook.

Increased Use of Technology

Because many students now have access to graphing calculators, the new graphing calculator material gives instructors a flexible approach for incorporating this technology into their course design. This material, written by Paul Bedard of St. Clair Community College, provides basic and advanced instructions, as well as numerous exercises. Each *Graphing Calculator Alert* section instructs students how to use their graphing calculator effectively. Each *Power User's Corner* section illustrates the special features of the graphing calculator in more advanced calculations. More than 350 exercises, marked with a special icon, give students a chance to practice using their calculators to explore essential algebra concepts graphically.

Pedagogic Tools

- Concepts are introduced gradually and supported by fully worked examples, figures, and realistic applications to help students build problem-solving skills.
- Many algebraic procedures are described with the aid of a “split screen” that displays, side by side, both the steps of an algorithm and a worked-out example.
- Numerous applied problems from a variety of fields are written by Marilyn Belkin of Villanova University, Nina Edelman of Spring Garden College, and John Santomas of Villanova University.
- A *Progress Check* following many worked-out examples provides an exercise with its answer, enabling the student to test his or her understanding of the material just explained.



- *Warnings* reinforce good mathematical habits by pointing out incorrect practices most commonly found in homework and exams.
- Numerous vignettes have been included throughout the book. These are independent of the text, yet are often related to the mathematical concepts discussed near where the vignettes appear. They are intended to provide some additional interesting material for the student and instructor.
- To help students check their understanding of the concepts, each chapter concludes with a list of terms and symbols and a list of key ideas for review.
- In addition, the *Chapter Review Exercises* and *Review Tests* give students a chance to practice what they have learned. The *Cumulative Review Exercises* at the end of every third chapter provide additional review practice.

Exercises



Abundant, carefully graded exercises provide practice in the mechanical and conceptual aspects of algebra. Exercises requiring the use of a calculator or graphing calculator are indicated by the calculator icons shown to the left. Although some exercises require student skills in graphing as well as graphing calculators, the latter may be disregarded, if desired. Answers to selected odd-numbered exercises, review exercises, review tests, and cumulative exercises appear in an appendix at the back of the book. Worked-out solutions to selected review exercises appear in a separate appendix at the back of the book. The solved *Review Exercises* reassure students that they have mastered the concepts in preparation for the *Review Tests*.

Supplementary Material

Students using *College Algebra*, sixth edition, may purchase the *Student Solutions Manual and Study Guide* by Cheryl Roberts of Northern Virginia Community College. It includes complete solutions to the odd-numbered exercises, to the graphing calculator exercises, and to every exercise in the *Chapter Reviews*, *Progress Checks*, and *Cumulative Review Exercises*. In addition, each chapter of this manual begins with ten additional *Practice Exercises* and ends with a *Chapter Test* containing 20–25 exercises. Solutions to the *Practice Exercises* and answers to the *Chapter Tests* are also included.

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

- The *Instructor's Resource Manual with Test Bank* contains a course syllabus for both texts, with chapter-by-chapter lecture notes referenced with other supplements and chapter-by-chapter test questions. This manual also contains approximately 2500 test questions, including graphing calculator test questions, referenced by chapter and section text.
- The *Instructor's Solutions Manual*, by Cheryl Roberts of Northern Virginia Community College, contains complete solutions to every exercise in the text.

—Michael Levitan
Villanova University

—Bernard Kolman
emeritus, Drexel University

—Arnold Shapiro
emeritus, Temple University

*New to
This Edition!*

BVTLab

For Students

BVTLab the most affordable, comprehensive online lab for college math students, provides the practice questions, learning aids, and communication tools that students need for success.

Practice Questions

Students can work through an expansive set of practice questions online. Questions are all multiple choice or true/false and are graded instantly for immediate feedback.

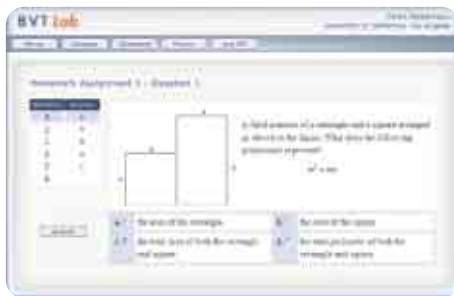


www.BVTLab.com



Worked Solutions

BVTLab includes fully worked solutions for many of the odd-numbered questions from the textbook. An extended set of worked solutions is available with the purchase of the Student Solutions package, available at www.BVTLab.com.



Tutorials

Online video clips, audio files, or animated tutorials—all playable in any web browser—reinforce challenging concepts.

Additional Help

Helpful hints accompany selected questions, and the instructors may provide additional tips specific to their students. An “Ask the Instructor” button is also available on homework assignments and practice questions.

Discussion Forum

An online discussion forum allows students to interact with each other and the instructor to explore challenging concepts and share other resources, while providing an online community for distance learning.

Review

Students can view their grades for all completed work and also review prior homework and quizzes to identify areas that require additional study.

New to This Edition!

For Instructors

BVTLab—a simple, robust, online lab for college math instructors and their students—provides essential teaching, assessment, and communication tools. It is an affordable option for students, with student lab fees costing only \$19.99 for a full-semester course.

Course Set-up

BVTLab has an easy-to-use, intuitive interface that allows instructors to quickly set up their courses and grade books, and replicate them from section to section and semester to semester. Multiple choice and true/false questions can be delivered online as practice questions, homework assignments, quizzes, and tests, each of which draws from a separate bank of questions.



Homework, quizzes, and tests have assigned start and end times; and tests can be proctored in the computer lab, or self-proctored for distance learners. Homework and quizzes offer optional hints and instructor tips. In addition, practice questions can be linked to fully worked solutions and multimedia tutorials.

Instructors can preview and manually select questions assigned to students, or they can use the “quick-pick” feature in **BVTLab** to generate sets of questions.

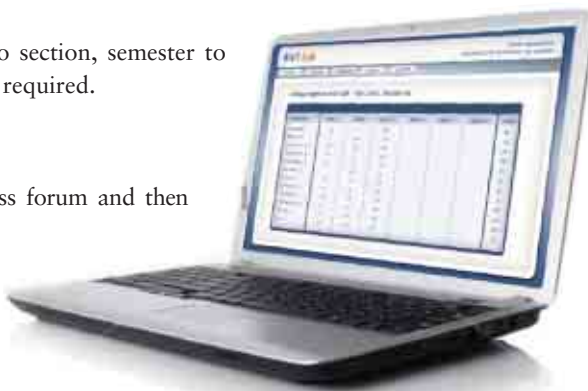
Grade Book

Using an assigned passcode, students register themselves into the grade book. All homework, quizzes, and tests are automatically graded and recorded in the grade book. In addition, instructors can manually enter or modify scores, with provisions for extra credit, attendance, and participation grades.

Grade books can be replicated from section to section, semester to semester, and can be easily edited or modified if required.

Communications Tools

Instructors can post discussion threads to a class forum and then monitor and moderate student replies. Important notifications can also be sent directly to each student via email.



Acknowledgments

The authors and publisher wish to acknowledge the many helpful suggestions from faculty at a variety of institutions who have used the earlier editions of this book. These suggestions have strongly influenced the preparation of this edition. We look forward to continuing to receive comments and suggestions from faculty and students.

We also benefited greatly from the considered opinions of the following mathematicians who read parts or all of the initial draft of the revision:

Daniel D. Anderson	University of Iowa
Paul R. Boltz	Harrisburg Area Community College
Kate Danforth	Corning County College
Iris B. Fetta	Clemson University
Dean Franzen	University of Northern Iowa
Henry Hosek, Jr.	Purdue University–Calumet
Richard Katz	California State University–Los Angeles
Gary S. Kersting	Sacramento City College
Lynne Kotrous	Central Community College–Platte Campus
Jean Lane	Union County College–Cranford
Kurt Lewandowski	Clackamas Community College
Stanley M. Lukawecki	Clemson University
Melissa Richardson	Anne Arundel Community College
Marilyn Schiermeier	North Carolina State University
George L. Szoke	University of Akron
Mohan Tikoo	Southeast Missouri State University
Jan Vandever	South Dakota State University
Carroll Wells	Western Kentucky University
Bostwick F. Wyman	University of Ohio

The accuracy of the solutions to the worked examples and of the answers to the *Progress Checks* and *Exercises* have been verified independently by Sarah Clark of South Dakota State University, Sudhir Goel of Valdosta State College, Norma James of New Mexico State University, Ann Ostberg of Central Community College–Platte Campus, and Paul Bedard, St. Clair Community College. The exercises and answers were checked again independently by

Hugo Sun	California State University–Fresno
Lynne Kotrous	Central Community College–Platte Campus
John Khalilian	University of Alabama–Tuscaloosa
Kerry Wyckoff	Brigham Young University

Although we trust that this process has increased the accuracy of the answer section as much as possible, all errors are our responsibility and we would appreciate hearing about them.

We want to thank Sue Boshers for typing portions of this manuscript. We also wish to express our appreciation to Sarah Clark, Project Editor, and Brae Buhnerkemper, Project Coordinator.

Furthermore, there is no doubt that Marjorie Woodall cheerfully and carefully prepared the index under some very demanding conditions.

Finally, we want to thank Mary Davis, our erudite grammarian, who had many helpful suggestions for the language and punctuation of this text.

—*Michael Levitan*
Villanova University

—*Bernard Kolman*
emeritus, Drexel University

—*Arnold Shapiro*
emeritus, Temple University

To the Student

This book was written for you, and it gives you every possible chance to succeed. We would like to have you think of mathematics as a challenging game—but not as a spectator sport. This leads to our primary rule: *Read this textbook with a pencil and paper handy.* We illustrate every new idea or technique with fully worked-out examples. As you read the text, carefully follow the examples and then do the *Progress Check* boxes. The key to success in a math course is working problems, and the Progress Checks are there to provide immediate practice with the material you have just covered.

Your instructor will assign homework from the extensive selection of exercises that follows each section in the book. By doing many problems, you will develop the necessary skills in algebra, and your confidence will grow. Because algebraic techniques and concepts build on previous results, you cannot afford to skip any of the work.

To help prevent or eliminate improper habits and to help you avoid the errors that we see each term as we grade papers, we have interspersed *Warning* text throughout the book. These point out common errors and emphasize the correct methods to be used.

The material on calculators and graphing calculators will help you do your homework rapidly and with greater accuracy. It will also enable you to solve realistic problems, when the numbers involved are not always “nice.”

There is important review material at the end of each chapter. The *Terms and Symbols* should all be familiar by the time you reach them. If your understanding of a term or symbol is hazy, use this section to find the place in the text where it is introduced, then go back and review the material.

It is possible to become so involved with the details of techniques that you lose track of the broader concepts. The list of *Key Ideas for Review* at the end of each chapter will help you focus on the principal ideas.

The *Review Exercises* at the end of each chapter can be used as part of your preparation for examinations. If you get stuck on an exercise, see if there is a similar example worked out in the text. Alternatively, there may be a similar exercise in the *Review Exercises* numbered in blue. This indicates that a worked-out solution appears in the back of the book. You

are then ready to try the *Review Test*. You will soon pinpoint weak spots and you can go back for further review and more exercises in those areas.

We believe that the eventual payoff of studying mathematics is an improved ability to tackle practical problems in your field of interest. To that end, this book places special emphasis on word problems, which so often trouble students. Algebra is the bridge to all other fields of mathematics, and the mastery of algebra is well worth your effort.

—*Michael Levitan*
Villanova University

—*Bernard Kolman*
emeritus, Drexel University

—*Arnold Shapiro*
emeritus, Temple University

List of Graphing Calculator Topics

The graphing calculator material has been designed to give you a flexible approach to using this technology in your course. The *Graphing Calculator Alert* sections instruct students on using a graphing calculator effectively. The *Power User's Corner* sections illustrate the special features of the graphing calculator in more advanced calculations. The lists below show the locations of these two types of boxes and the topics they cover. The *Instructor's Manual* lists the exercises requiring the use of a graphing calculator and those for which it is optional.

Graphing Calculator Alert Topics

Section	Topic	Page
2.2	Formulas	103
2.3	Quadratic Formula	122
2.5	Inequalities	136
3.1	Viewing Rectangles and Plotting Points	160
3.1	Function Graphs	166
3.1	Circle	170
3.3	Piecewise-Defined Function	191
3.3	Turning Points	195
3.4	Slope of a Line	203
3.4	Vertical Lines	207
4.2	Function Graphs	270
4.5	Complex Numbers	285
6.2	Evaluating e^x	391
6.3	Evaluating e^x with $\ln x$	409
7.1	Solving Equations with Zoom-In	442

Graphing Calculator Power User's Corner Topics

Section	Topic	Page
3.5	Graphing Inverse Functions	228
4.2	Graphing Polynomial Functions	270
4.6	Analyzing Roots	304
4.7	Approximating Roots	309
5.1	Graphing Rational Functions	332
5.2	Graphing Circles	340
5.3	Graphing Parabolas	352
5.4	Graphing Ellipses and Hyperbolas	364
5.5	Graphing General Conic Sections	372
7.5	Solving Systems of Inequalities	481
8.1	Reduced Row Echelon Form	508
9.1	Partial Sums	563