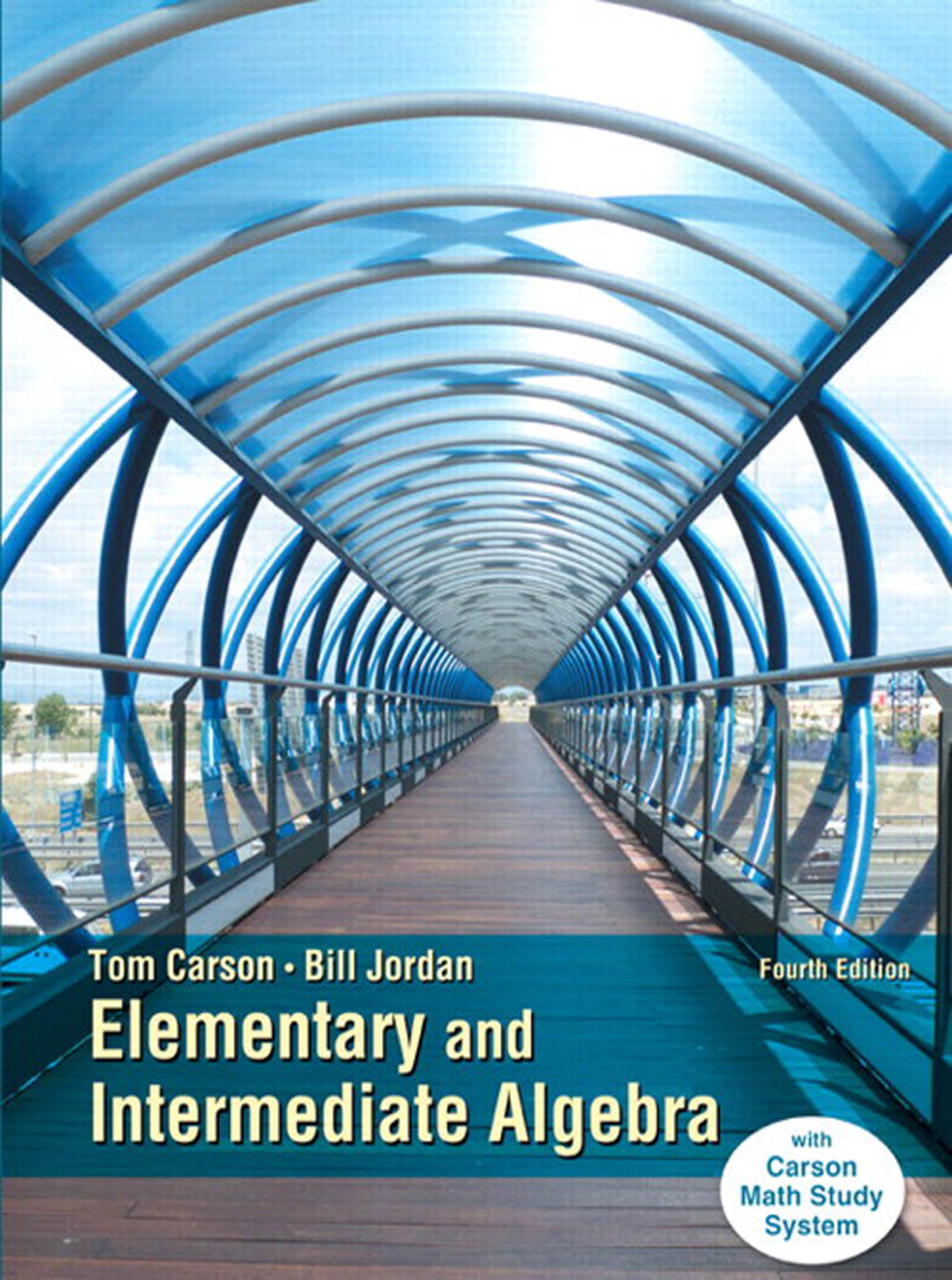

Tom Carson • Bill Jordan
Fourth Edition
Elementary and Intermediate Algebra
with
Carson
Math Study
System

Your Learning Style

To discover what kind of learner you are, complete the Learning Styles Inventory on page xiv (or in MyMathLab). Then in the textbook, watch for the Learning Strategy boxes and the accompanying icons that provide ideas for maximizing your own learning style.

_____ 1. I remember information better if I write it down or draw a picture of it.

_____ 2. I remember things better when I hear them instead of just reading or seeing them.

_____ 3. When I receive something that has to be assembled, I just start doing it. I don't read the directions.

_____ 4. If I am taking a test, I can visualize the page of text or lecture notes where the answer is located.

_____ 5. I would rather have the professor explain a graph, chart, or diagram to me instead of just showing it to me.

_____ 6. When learning new things, I want to do it rather than hear about it.

_____ 7. I would rather have the instructor write the information on the board or overhead instead of just lecturing.

_____ 8. I would rather listen to an audiobook than read the book.

_____ 9. I enjoy making things, putting things together, and working with my hands.

_____ 10. I am able to conceptualize quickly and visualize information.

_____ 11. I learn best by hearing words.

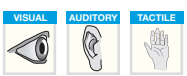
_____ 12. I have been called hyperactive by my parents, spouse, partner, or professor.

_____ 13. I have no trouble reading maps, charts, or diagrams.

_____ 14. I can usually pick up on small such as like bells, crickets, or frogs or on distant sounds such as train whistles.

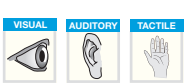
_____ 15. I use my hands and gesture a lot when I speak to others.

Your Learning Strategies



Learning Strategy

Developing a good study system and understanding how you best learn is essential to academic success. Make sure you familiarize your-self with the study system outlined in the To the Student section at the beginning of the text. Also take a moment to complete the Learning Styles Inventory found at the end of that section to discover your personal learning style. In these Learning Strategy boxes, we offer tips and suggestions on how to connect the study system and your learning style to help you be successful in the course.



Learning Strategy

In the To the Student section, we suggest that when taking notes, you use a red pen for definitions and a blue pen for rules and procedures. Notice that we have used those colors in the design of the text to connect with your notes.

Definition **Additive inverses:** Two numbers whose sum in zero.

Examples of additive inverses: 15 and -15 because $15 + (-15) = 0$

-9 and 9 because $-9 + 9 = 0$

0 and 0 because $0 + 0 = 0$

Notice that 0 is its own additive inverse and that for numbers other than 0, the additive inverses have the same absolute value but *opposite* signs.

Rules

The sum of two additive inverse is zero.

The additive inverse of 0 is 0.

The additive inverse of a nonzero number has the same absolute value but opposite sign.

The Carson Math Study System

The Carson Math Study System is designed to help you succeed in your math course. You will discover your own learning style, and you will use study strategies that match the way you learn best. You will also learn how to organize your course materials, manage your time efficiently, and study and review effectively.

Your Math Notebook

Notes

(see pages xvii–xviii)

Section # 9/20

We can simplify an expression by combining like terms.

p. 37 def. Like terms: constant terms or variable terms that have the same variable(s) raised to the same powers.

Ex 1) 2x and 3x are like terms.
Ex 2) 5x and 7y are not like terms.

Homework

(see pages xviii–xxi)

Section # Homework 9/21

#1 – 15 odd

1. $5^2 + 3 \cdot 4 - 7$
$= 25 + 3 \cdot 4 - 7$
$= 25 + 12 - 7$
$= 37 - 7$
$= 30$

Quizzes/Tests

(see page xxv)

Chapter # Quiz 10/10

For 1-4, simplify.

1. $|-8|$ $= 8$ ✓
2. $|9|$ $= 9$ ✓
3. $-15 + 5$ $= -10$ ✓
4. $-8 + -6$ $= -14$ ✓

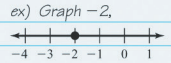
4/4 = 100% Nice work!

Study Materials

(see pages xxii–xxiv)

Chapter # Study Sheets 9/10

To graph a number on a number line, draw a dot on the mark for the number. ex) Graph −2,



The absolute value of a positive number is positive. ex) $|7| = 7$

The absolute value of a negative number is positive. ex) $|-12| = 12$

Fourth Edition

Elementary and Intermediate Algebra

Tom Carson

Bill Jordan

Seminole State College of Florida

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Cover Design: Tamara Newnam
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Library of Congress Cataloging-in-Publication Data

Carson, Tom, 1967–
Elementary & intermediate algebra / Tom Carson, Bill Jordan—Fourth edition.
pages cm.
title: Elementary and intermediate algebra
Includes index.
ISBN-13: 978-0-321-92514-5
ISBN-10: 0-321-92514-9
1. Algebra—Textbooks. I. Jordan, Bill. II. Title. III. Title: Elementary and intermediate algebra.
QA152.3.C374 2015
512.9—dc23 2013009305

1 2 3 4 5 6 7 8 9 10—CRK— 17 16 15 14 13

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www.pearsonhighered.com

ISBN 13: 978-0-321-92514-5
ISBN 10: 0-321-92514-9

Contents

Preface

The *Why* behind Understanding Algebra + The *Carson Math Study System* with *Learning Styles Inventory*

From the Authors

Welcome to the fourth edition of *Elementary and Intermediate Algebra*! Revising our program has been both exciting and rewarding, and it has given us the opportunity to respond to valuable instructor and student feedback. With great pride, we share with you the improvements to this edition, as well as the key features and proven style of our approach.

Elementary and Intermediate Algebra, Fourth Edition, is one title in a series of four that also includes *Prealgebra*, Fourth Edition; *Elementary Algebra*, Fourth Edition; and *Intermediate Algebra*, Fourth Edition. We have designed our program to be versatile enough for use in a variety of teaching and learning formats, including standard lecture, self-paced lab, hybrid, online, and even independent study.

We write in a relaxed, nonthreatening style, taking great care to ensure that students who have struggled with math in the past will be comfortable with our subject matter. Throughout the text, we explain *why* an algebraic process works the way it does, instead of just showing how to follow steps to solve problems. In addition, through problems from science, engineering, accounting, health, the arts, and everyday life, we link algebra to the real world.

Finally, to help students succeed in these courses, we offer the complete Carson Study System that includes a note To the Student, a Learning Styles Inventory, a Math Study System plan for developing a notebook as a personalized organizational and study tool, and integrated Learning Strategies from both the authors and students.

Tom Carson
Bill Jordan

The Carson Math Study System

The Carson Math Study System is designed to help students develop the skills (for example, time management, test prep, and note-taking) that students need to succeed in math, their college careers, and life.

1. **To the Student** (page xiii) focuses on why math is important and what students need to do to succeed in their math courses.
2. Taking the **Learning Styles Inventory** (page xv) will help students assess their particular style of learning and use that knowledge to identify helpful study skills.
3. **The Math Study System** (page xvii) offers students abundant suggestions for developing a class notebook to reflect their personal learning styles, taking effective notes, doing homework, and reviewing for quizzes and tests.
4. Throughout the text, **Learning Strategy** boxes offer advice on implementing the study system effectively based on a student's learning style (pages xv–xvi).

New to this Edition

In response to feedback from instructors and students, the presentation was refined; examples, exercises, Your Turns, and Instructor Notes were added; and real-data applications were updated or replaced with current data and topics. In addition, the order and content of some topics was improved for student comprehension and retention.

Content Changes

Chapter 1 The objectives in Sections 1.3 and 1.4 were condensed. Instead of separate objectives for integers and rational numbers, each section has a single objective for rational numbers.

Chapter 2 The former Chapter 3 on problem solving was streamlined and the topics integrated elsewhere. Former Sections 3.1 and 3.2 on ratios, proportions, and percents were moved to Chapter 2 as Sections 2.6 and 2.7. Former Sections 3.3–3.5 have been integrated into Chapter 4. Those sections involved solving problems with two unknowns using single-variable equations. In the authors' experience, however, students find it easier and more intuitive to solve those problems using systems of equations; so the topic is now covered with systems.

Chapter 3 Graphing linear equations is now covered earlier, in Chapter 3.

Chapter 4 Formerly Chapter 9, the chapter on systems of equations now follows the chapter on graphing linear equations. This keeps all of the discussion of linear equations together in a natural flow. This also introduces problems with two unknowns earlier in the text, using the more intuitive approach. Cramer's Rule has been moved to Appendix F.

Chapter 7 The discussion of LCD and the examples of variation were streamlined and are now covered in a more visual presentation.

Chapter 8 Function operations (formerly in Chapter 8) are now in Chapter 10, and the review section on graphing functions was deleted. The only functions that had not been introduced to this point were absolute value functions. Graphing absolute value functions is now an objective in Section 8.2 rather than in a separate section.

Chapter 9 The development of complex numbers is now more precise.

Chapter 10 Operations on functions are now covered in Section 10.6. The authors did this for two reasons. First, because all of the functions involved are polynomial functions, the topic fits better with the chapter on quadratic equations. Second, by placing this topic at the end of the chapter, it acts as a good transition into composite functions at the beginning of Chapter 11.

New and Revised Features

Student Learning Strategies and helpful tips written by successful students and recent college graduates were added throughout the text. These can be identified by the student's name at the end of the strategy.

The **Chapter Openers** now provide a brief topical overview of the chapter. In the instructor's edition, each opener now includes teaching suggestions for the chapter.

Each section now begins with **Warm-up Exercises** that review material presented previously and are helpful to understanding the concepts in the section.

Section Exercises are now grouped by objective to make it easier for students to connect examples with related exercises. In addition, new **Prep Exercises** help students focus on the terminology, rules, and processes corresponding to the exercises that immediately follow.

The **Chapter Summary and Review** is now interactive, with Review Exercises integrated within the summary to encourage active learning and review. For each key topic, students are prompted to complete the corresponding definitions, rules, and procedures.

Finally, we now offer two versions of MyMathLab: **Standard MyMathLab courses** allow instructors to build the course their way, offering maximum flexibility and control over all aspects of assignment creation. **New Ready-to-Go courses** provide students with all the same great MyMathLab features, but make it easier for instructors to get started.

Key Features

In addition to the new and revised features just described, the following key components round out the comprehensive guided learning approach.

An Algebra Pyramid is used throughout the text to help students see how the topic they are learning relates to the big picture of algebra—focusing particularly on the relationship between constants, variables, expressions, and equations and inequalities (page 3). In the end-of-section Review Exercises, Chapter Review Exercises, and Cumulative Review Exercises, an Algebra Pyramid icon indicates the level of the pyramid that correlates to a particular group of exercises. This helps students determine what actions are appropriate with these exercises (for example, whether to "simplify" or "solve" (pages 74, 75–76, 187–188).

Connection Boxes help students understand how math concepts are related and build on each other (pages 190, 690).

Your Turn Practice Exercises, found after most examples, give students an opportunity to work problems similar to the examples they just saw. This practice step engages students and provides immediate feedback to help them develop confidence in their problem-solving skills (pages 2, 596).

Real, Relevant, and Interesting Applications in the examples and exercises reflect real-world situations in science, engineering, health, finance, the arts, and other areas. These applications illustrate the everyday use of basic algebraic concepts and encourage students to apply mathematical concepts to solve problems (pages 305–306, 559).

Thorough Explanations are key to student understanding. The authors take great care to explain not only *how* to do the math but also *why* the math works the way it does, how concepts are related, and how the math is relevant to students' everyday lives. Knowing all of this gives students a context in which to learn and remember math concepts.

MyMathLab

Ties the Complete Learning Program Together

MyMathLab® Online Course (access code required)

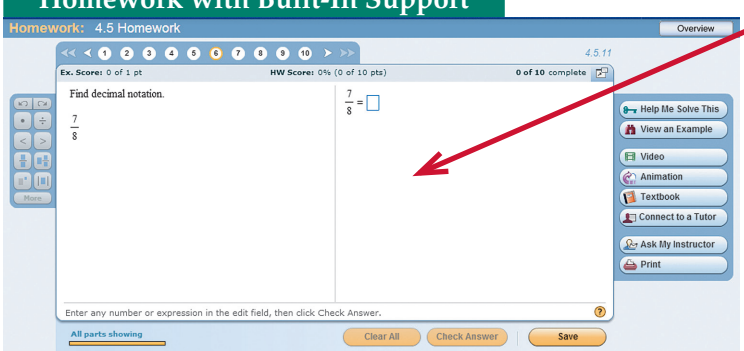
MyMathLab from Pearson is the world's leading online resource in mathematics, integrating interactive homework, assessment, and media in a flexible, easy-to-use format. MyMathLab delivers **proven results** in helping individual students succeed. It provides **engaging experiences** that personalize, stimulate, and measure learning for each student. And it comes from an **experienced partner** with educational expertise and an eye on the future.

MyMathLab® for Developmental Mathematics

Prepared to go wherever you want to take your students.

Personalized Support for Students

Homework with Built-In Support



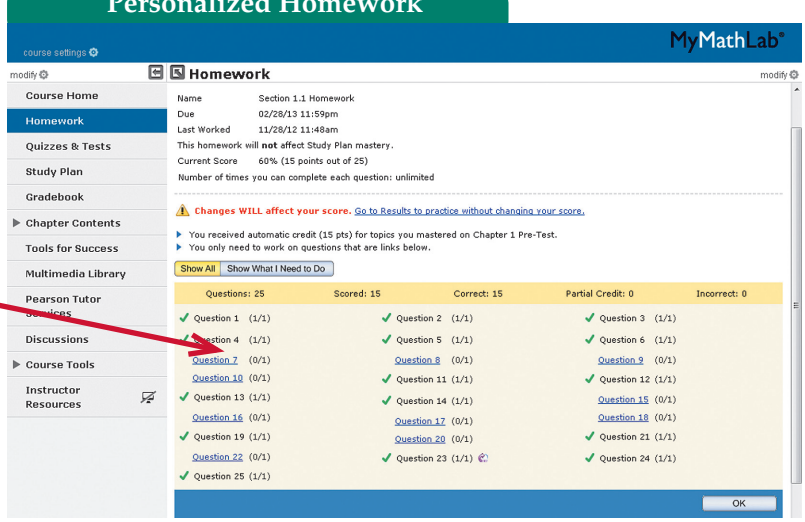
Exercises: The homework and practice exercises in MyMathLab are correlated to the exercises in the textbook, and they regenerate algorithmically to give students unlimited opportunity for practice and mastery. The software offers immediate, helpful feedback when students enter incorrect answers.

Multimedia Learning Aids: Exercises include guided solutions, sample problems, animations, videos, and eText access for extra help at point of use.

Expert Tutoring: Although many students describe the whole of MyMathLab as "like having your own personal tutor," students using MyMathLab do have access to live tutoring from Pearson, from qualified math instructors.

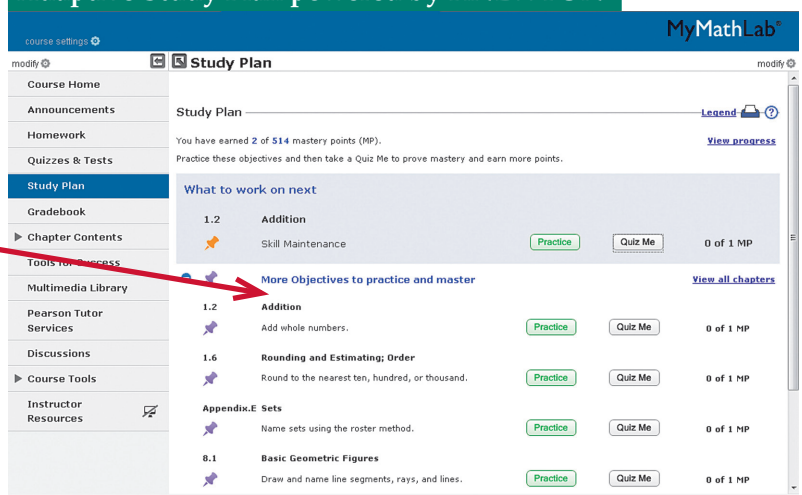
To help students achieve mastery, MyMathLab can generate **personalized homework** based on individual performance on tests or quizzes. Personalized homework allows students to focus on topics they have not yet mastered.

Personalized Homework



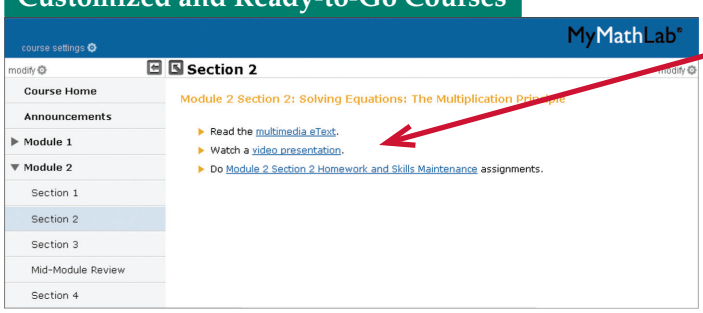
The **Adaptive Study Plan** makes studying more efficient and effective for every student. Performance and activity are assessed continually in real time. The data and analytics are used to provide personalized content—reinforcing concepts that target each student's strengths and weaknesses.

Adaptive Study Plan powered by KNEWTON



Flexible Design, Easy Start-up, and Results for Instructors

Customized and Ready-to-Go Courses

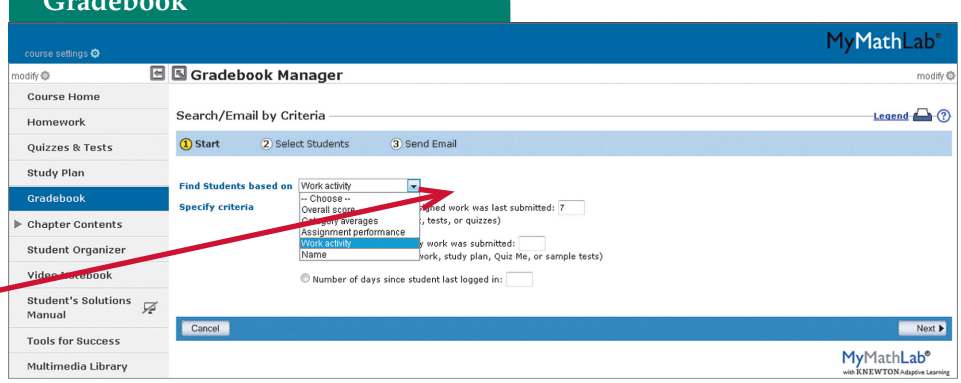


Instructors can modify the left-hand nav and insert their own directions onto course-level landing pages, and a **custom MyMathLab** course can be built to reorganize material and structure the course by chapters, modules, units—whatever the needs may be.

Ready-to-Go courses include pre-assigned homework, quizzes, and tests to make it even easier for instructors to get started.

The **comprehensive online gradebook** automatically tracks students' results on tests, quizzes, homework, and in the study plan. You can use the gradebook to intervene quickly if students have trouble or to provide positive feedback on a job well done. The data within MyMathLab is easily exported to a variety of spreadsheet programs such as Microsoft Excel. Instructors can determine which points of data to export and then analyze the results to determine success.

Gradebook



New features such as **Search/Email by criteria** make the gradebook a powerful tool for instructors. With this feature, instructors can easily communicate with both at-risk and successful students. Instructors can search by score on specific assignments, noncompletion of assignments within a given time frame, last log-in date, or overall score.

Additional Resources in MyMathLab

*In addition to the robust course delivery, the course also include the **full Carson eText, additional Carson Program Features,** and the **entire set of instructor and student resources** in one easy place to access online.*

For Students

Student's Solutions Manual*

ISBN-10: 0-321-92529-7
ISBN-13: 978-03-21-92529-9

- Contains complete solutions to the odd-numbered section exercises and solutions to all of the section-level Review Exercises, Chapter Review Exercises, Practice Tests, and Cumulative Review Exercises.

MyWorkBook for Intermediate Algebra*

ISBN-10: 0-321-92526-2
ISBN-13: 978-0-321-92526-8

MyWorkbook can be packaged with the textbook or with the MyMathLab access kit and includes the following resources for each section of the text:

- Key vocabulary terms and vocabulary practice problems.
- Guided Examples with stepped-out solutions and similar Practice Exercises, keyed to the text by Learning Objective.
- References to textbook Examples and Section Lecture Videos for additional help.
- Additional Exercises with ample space for students to show their work, keyed to the text by Learning Objective.

Video Resources

Within MyMathLab, students can access short lectures for each section of the text, plus Chapter Test Prep Videos, which allow students to watch an instructor work through step-by-step solutions for all of the Chapter Test exercises from the textbook. All videos include optional English and Spanish captions.

*Printed supplements are also available for separate purchase through MyMathLab, MyPearsonStore.com, or other retail outlets. They can also be value-packed with a textbook or MyMathLab code at a discount.

For Instructors

Annotated Instructor's Edition**

ISBN-10: 0-321-92536-X
ISBN-13: 978-0-321-92536-7

- Includes answers to all exercises, including Puzzle Problems and Collaborative Exercises, printed in bright blue near the corresponding problems.
- Useful teaching tips are printed in the margin.
- A ★ icon, found in the AIE only, indicates especially challenging exercises in the exercise sets.

Instructor's Resource Manual with Tests and Mini Lectures** (download only)

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ISBN-13: 978-0321-92524-4

- A mini-lecture for each section of the text, organized by objective, includes key examples and teaching tips.
- Designed to help both new and adjunct faculty with course preparation and classroom management.
- Contains one diagnostic test per chapter; four free-response test forms per chapter, one of which contains higher-level questions; one multiple-choice test per chapter; a midchapter check-up for each chapter; one midterm exam; and two final exams.

Instructor's Solutions Manual** (Download only)

ISBN-10: 0-321-92525-4
ISBN-13: 978-0-321-92525-1

- Contains complete solutions to all even-numbered section exercises, Puzzle Problems, and Collaborative Exercises.

PowerPoint® Lecture Slides** (download only)

Present key concepts and definitions from the text.

TestGen®

TestGen®(www.pearsoned.com/testgen) enables instructors to build, edit, print, and administer tests using a computerized bank of questions developed to cover all the objectives of the text. TestGen is algorithmically based, allowing instructors to create multiple but equivalent versions of the same question or test with the click of a button. Instructors can also modify test bank questions or add new questions. The software and test bank are available for download from Pearson Education's online catalog.

**Also available in print or for download from the Instructor Resource Center (IRC) on www.pearsonhighered.com.

To learn more about how MyMathLab combines proven learning applications with powerful assessment, visit **www.mymathlab.com** or contact your Pearson representative.

Acknowledgments

Many people gave of themselves in so many ways during the development of this text. Mere words cannot contain the fullness of our gratitude. Although the words of thanks that follow may be few, please know that our gratitude is great.

We would like to thank the following people who have given of their time in reviewing this and previous editions of this textbook. Their thoughtful input was vital to the development of the text.

Khadija Ahmed, *Monroe County Community College*
Bruce Armbrust, *Lake Tahoe Community College*
Frank Attanucci, *Scottsdale Community College*
Daniel Bacon, *Massasoit Community College*
Kerry Bailey, *Laramie Community College*
Madelaine Bates, *Bronx Community College*
William Berech, *Arapahoe Community College*
Marta Brito-Villani, *Miami-Dade College*
Denise Brown, *Collin County Community College*
Ronnie Brown, *University of Baltimore*
Debra Bryant, *Tennessee Technological University*
Baruch Cahlon, *Oakland University*
Nancy Carpenter, *Johnson County Community College*
Laurence Chernoff, *Miami-Dade College*
Delaine E. Cochran, *Indiana University Southeast*
Pat Cook, *Weatherford College*
Greg Cripe, *Spokane Falls Community College*
Patrick S. Cross, *University of Oklahoma*
Cheryl B. Davids, *Central Carolina Technical College*
Elias Deeba, *University of Houston–Downtown Campus*
Nelson de la Rosa, *Miami-Dade College*
Stephan DeLong, *Tidewater Community College–Virginia Beach Campus*
Cynthia Ellis, *Indiana University–Purdue University Fort Wayne*
Laura Ferguson, *Weatherford College*
John Garlow, *Tarrant County Junior College*
Kristin Good, *Washtenaw Community College*
Margret Hathaway, *Kansas City Kansas Community College*
Fat Lam, *Gallaudet University*
Ruby Martinez, *San Antonio College*
Diane Martling, *WM Rainey Harper College*
Theresa McChesney, *Johnson County Community College*
Allen Miller, *South Plains College*
Carol Murphy, *Miramar College*
Andrea Payne, *Montana State University Billings*
Joanne Peeples, *El Paso Community College*
Larry Pontaski, *Pueblo Community College*
Jack Sharp, *Floyd College*
Linda Shoesmith, *Scott Community College*
James Smith, *Columbia State Community College*
Chairsty Stewart, *Montana State University Billings*
Mary Lou Townsend, *Wor-Wic Community College*
Imre Tuba, *San Diego State University*
Cindy Vanderlaan, *Indiana University–Purdue University Fort Wayne*
Alexis Venter, *Arapahoe Community College*
James Vicich, *Scottsdale Community College*
Beverly Vredevelt, *Spokane Falls Community College*

Linda J. Wagner, *Indiana University–Purdue University Fort Wayne*
Walter Wang, *Baruch College*
Floyd Wouters, *University of Wisconsin Oshkosh*
Patricia Youngblood, *New Mexico Junior College*
Vivian Zabrocki, *Montana State University Billings*

In addition, we would like to thank the students who provided their successful learning strategies for inclusion in the book. We hope their tips will help other students succeed as well.

Ruben C.
Matt D., *University of West Florida*
Ellyn G., *Stanly Community College*
Jason J., *University of Alabama*
Joel G., *Palo Alto College*
Judah G., *Columbus State Community College*
Lauren H., *University of Central Florida*
Biridiana N.
Stella P., *Virginia Commonwealth University*
Paul S., *Columbus State Community College*
Zheng Alick Z., *University of Southern California*

We would like to extend a heartfelt thank-you to Cathy Cantin, Kerianne Okie, Christine Whitlock, Kari Heen, Tamela Ambush, Michelle Renda, Rachel Ross, Alicia Frankel, Kelly Cross, Aimee Throne, Rebecca Williams, Greg Tobin, and all of the wonderful people at Pearson Arts & Sciences who helped so much in the revision of the text. Special thanks to Janis Cimperman and Paul Lorczak for checking the manuscript and pages for accuracy and to Becky Troutman for researching application problems and preparing the Glossary.

To Erin Donahue and all of the fabulous people at PreMediaGlobal, thank you for your attention to detail and for working so hard to put together the finished pages.

To Melinda McLaughlin and her team at GEX for their work on the solutions manuals, the Instructor's Resource Manual, and the MyWorkBook.

Finally, we'd like to thank our families for their support and encouragement during the process of developing and revising this text.

Tom Carson
Bill Jordan

To the Student

Why Do I Have to Take This Course?

Often, this is one of the first questions students ask when they find out they must take an algebra course. What a great question! But why focus on math alone? What about English, history, psychology, or science? Does anyone really use *every* topic of *every* course in the curriculum? Most jobs do not require that we write essays on Shakespeare, discuss the difference between various psychological theories, or analyze the cell structure of a frog's liver. So what's the point? The issue comes down to recognizing that general education courses are not job training. The purpose of those courses is to stretch and exercise the mind so that the educated person can better communicate, analyze situations, and solve problems, which are all valuable skills in life and any job.

Professional athletes offer a good analogy. They usually have an exercise routine apart from the sport designed to build and improve their body. They may seek a trainer to design exercises intended to improve strength, stamina, or balance and then push them in ways they would not normally push themselves. That trainer may have absolutely no experience with his or her client's sport, but can still be quite effective in designing an exercise program because the trainer is focused on building basic skills useful for any athlete in any sport. Education is similar: it is exercise for the mind. A teacher's job is like that of a physical trainer. A teacher develops exercises intended to improve communication skills, critical- thinking skills, and problem-solving skills. Different courses are like different types of fitness equipment. Some courses may focus more on communication through writing papers and through discussion and debate. Other courses, such as mathematics, focus more on critical thinking and problem solving.

Another similarity is that physical exercise must be challenging for your body to improve. Similarly, mental exercise must be challenging for the mind to improve. Expect course assignments to challenge you and push you mentally in ways you wouldn't push yourself. That's the best way to grow. So as you think about the courses you are taking and the assignments in those courses, remember the bigger picture of what you are developing: your mind. When you are writing papers, responding to questions, analyzing data, and solving problems, you are developing skills important to life and any career out there.

What Do I Need to Do to Succeed?

☑ **Adequate Time** To succeed, you must have adequate time and be willing to use that time to perform whatever is necessary. To determine if you have adequate time, use the following guide.

Step 1. Calculate your work hours per week.
Step 2. Calculate the number of hours in class each week.
Step 3. Calculate the number of hours required for study by doubling the number of hours you spend in class.
Step 4. Add the number of hours from steps 1–3.

Adequate time: If the total number of hours is below 60, then you have adequate time.

Inadequate time: If the total number of hours is 60 or more, then you do not have adequate time. You may be able to hang in there for a while, but eventually, you will find yourself overwhelmed and unable to fulfill all of your obligations. Remember, the above calculations do not consider other likely elements of life such as a commute, family, and recreation. The wise thing to do is cut back on work hours or drop some courses.

Assuming you have adequate time available, choosing to use that time to perform whatever is necessary depends on your attitude, commitment, and self-discipline.

☑ **Positive Attitude** We do not always get to choose our circumstances, but we do get to choose our reaction and behavior. A positive attitude is choosing to be cheerful, hopeful, and encouraging no matter the situation. A benefit of a positive attitude is that it tends to encourage people around you. As a result, they are more likely to want to help you achieve your goal. A negative attitude, on the other hand, tends to discourage people around you. As a result, they are less likely to want to help you. The best way to maintain a positive attitude is to keep life in perspective, recognizing that difficulties and setbacks are temporary.

☑ **Commitment** Commitment means binding yourself to a course of action. Remember, expect difficulties and setbacks, but don't give up. That's why a positive attitude is important; it helps you stay committed in the face of difficulty.

☑ **Self-Discipline** Self-discipline is choosing to do what needs to be done—even when you don't feel like it. In pursuing a goal, it is normal to get distracted or tired. It is at those times that your positive attitude and commitment to the goal help you discipline yourself to stay on task.

Thomas Edison, inventor of the lightbulb, provides an excellent example of all of these principles. Edison tried over 2000 different combinations of materials for the filament before he found a successful combination. When asked about all his failed attempts, Edison replied, "I didn't fail once, I invented the lightbulb. It was just a 2000-step process." He also said, "Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time." In those two quotes, we see a person who obviously had time to try 2000 experiments, had a positive attitude about the setbacks, never gave up, and had the self-discipline to keep working.

Behaviors of Strong Students and Weak Students

The four requirements for success can be translated into behaviors. The following table compares the typical behaviors of strong students with the typical behaviors of weak students.

Strong Students …	Weak Students …
• are relaxed, patient, and work carefully.	• are rushed, impatient, and hurry through work.
• almost always arrive on time and leave the classroom only in an emergency.	• often arrive late and often leave class to "take a break."
• sit as close to the front as possible.	• sit as far away from the front as possible.
• pay attention to instruction.	• ignore instruction, chit-chat, draw, fidget, etc.
• use courteous and respectful language, encourage others, make positive comments, are cheerful and friendly.	• use disrespectful language, discourage others, make negative comments, are grumpy and unfriendly. Examples of unacceptable language include: "I hate this stuff!" (or even worse!) "Are we doing anything important today?" "Can we leave early?"
• ask appropriate questions and answer instructor's questions during class.	• avoid asking questions and rarely answer instructor's questions in class.
• take a lot of notes, have organized notebooks, seek out and use study strategies	• take few notes, have disorganized notebooks, do not use study strategies
• begin assignments promptly and manage time wisely and almost always complete assignments on time.	• procrastinate, manage time poorly, and often complete assignments late.
• label assignments properly and show all work neatly.	• show little or no work and write sloppily.
• read and work ahead.	• rarely read or work ahead.
• contact instructors outside of class for help, and use additional resources such as study guides, solutions manuals, computer aids, videos, and tutorial services.	• avoid contacting instructors outside of class and rarely use additional resources available.

Assuming you have the prerequisites for success and understand the behaviors of a good student, our next step is to develop two major tools for success:

1. **Learning Style:** Complete the Learning Styles Inventory to determine how you tend to learn.
2. **The Study System:** This system describes a way to organize your notebook, take notes, and create study tools to complement your learning style. We've seen students transform their mathematics grades from D's and F's to A's and B's by using the Study System that follows.

Learning Styles Inventory

What Is Your Personal Learning Style?

A learning style is the way in which a person processes new information. Knowing your learning style can help you make choices in the way you focus on and study new material. Below are 15 statements that will help you assess your learning style. After reading each statement, rate your response to the statement using the scale below. There are no right or wrong answers.

3 = Often applies **2** = Sometimes applies **1** = Never or almost never applies

_____ 1. I remember information better if I write it down or draw a picture of it.

_____ 2. I remember things better when I hear them instead of just reading or seeing them.

_____ 3. When I receive something that has to be assembled, I just start doing it. I don't read the directions.

_____ 4. If I am taking a test, I can visualize the page of text or lecture notes where the answer is located.

_____ 5. I would rather have the professor explain a graph, chart, or diagram to me instead of just showing it to me.

_____ 6. When learning new things, I want to do it rather than hear about it.

_____ 7. I would rather have the instructor write the information on the board or overhead instead of just lecturing.

_____ 8. I would rather listen to an audiobook than read the book.

_____ 9. I enjoy making things, putting things together, and working with my hands.

_____ 10. I am able to conceptualize quickly and visualize information.

_____ 11. I learn best by hearing words.

_____ 12. I have been called hyperactive by my parents, spouse, partner, or professor.

_____ 13. I have no trouble reading maps, charts, or diagrams.

_____ 14. I can usually pick up on small sounds such as bells, crickets, frogs or on distant sounds such as train whistles.

_____ 15. I use my hands and gesture a lot when I speak to others.

Write your score for each statement beside the appropriate statement number below. Then add the scores in each column to get a total score for that column.

	Visual	Auditory	Tactile
	1. _____	2. _____	3. _____
	4. _____	5. _____	6. _____
	7. _____	8. _____	9. _____
	10. _____	11. _____	12. _____
	13. _____	14. _____	15. _____
Total:	_____	_____	_____

The largest total of the three columns indicates your dominant learning style.

Visual learners learn best by seeing. If this is your dominant learning style, then you should focus on learning strategies that involve seeing. The color coding in the study system (see page xvii–xviii) will be especially important. The same color coding is used in the text. Draw diagrams, arrows, and pictures in your notes to help you see what is happening. Reading your notes, study sheets, and text repeatedly will be an important strategy.

Auditory learners learn best by hearing. If this is your dominant learning style, then you should use learning strategies that involve hearing. After getting permission from your instructor, bring a recorder to class to record the discussion. When you study your notes, play back the recording. Also, when you learn rules, say the rule over and over. As you work problems, say the rule before you do the problem. You may also find the videotapes to be beneficial because you can hear explanations of problems taken from the text.

Tactile (also known as kinesthetic) learners learn best by touching or doing. If this is your dominant learning style, you should use learning strategies that involve doing. Doing a lot of practice problems will be important. Make use of the Your Turn exercises in the text. These are designed to give you an opportunity to do problems that are similar to the examples as soon as a topic is discussed. Writing out your study sheets and doing your practice tests repeatedly will be important strategies for you.

Note that the study system developed in this text is for all learners. Your learning style will help you decide what aspects and strategies in the study system to focus on, but being predominantly an auditory learner does not mean that you shouldn't read the textbook, do a lot of practice problems, or use the color-coding system in your notes. Auditory learners can benefit from seeing and doing, and tactile learners can benefit from seeing and hearing. In other words, do not use your dominant learning style as a reason for not doing things that are beneficial to the learning process. Also remember that the Learning Strategy boxes presented throughout the text provide tips to help you use your personal learning style to your advantage.

The Carson Math Study System

Organize the notebook into four parts using dividers shown:

Notes (see pages xvii–xviii)

Homework (see pages xviii–xxi)

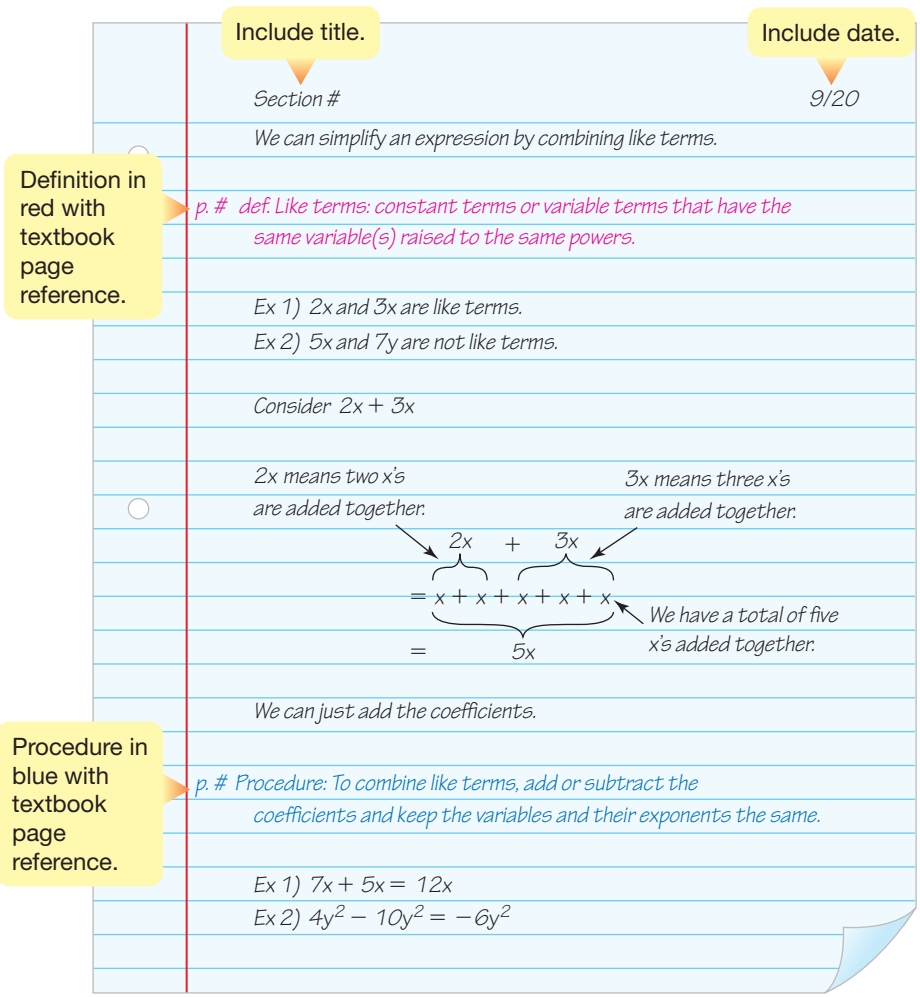
Study Materials
Study sheets (see page xxii)
Practice opportunities (see page xxiii)
Game plans (see page xiv)

Quizzes/Tests (see page xv)

Notes

- Use a color code: **red** for definitions, **blue** for rules or procedures, and **pencil** for all examples and other notes.
- Begin notes for each class on a new page (front and back for that day is okay). Include a topic title or section number and the date on each page.
- Try to write your instructor's spoken explanations along with the things he or she writes on the board.
- Mark examples your instructor emphasizes in some way to give them a higher priority. These problems often appear on quizzes and tests.
- Write warnings your instructor discusses about a particular situation.
- Include common errors that your instructor illustrates, but mark them clearly as errors so that you do not mistake them for correct.
- To speed note taking, eliminate unnecessary words such as *the* and use codes for common words such as + for *and* and ∴ for *therefore*. Also, instead of writing complete definitions, rules, or procedures, write the first few words and place the page reference from the text so that you can copy from the text later.

Sample Notes with Color Code



Homework

This section of the notebook contains all homework. Use the following guidelines whether your assignments are from the textbook, a handout, or a computer program such as MyMathLab or MathXL.

- Use pencil so that mistakes can be erased (scratching through mistakes is messy and should be avoided).
- Label according to your instructor's requirements. Usually, at least include your name, the date, and the assignment title. It is also wise to write the assigned problems at the top as they were given. For example, if your instructor writes "Section 1.5 #1–15 odd," write it that way at the top. Labeling each assignment with this much detail shows that you take the assignment seriously and leaves no doubt about what you interpreted the assignment to be.
- For each problem you solve, write the problem number and show all solution steps neatly.

Why do I need to show work and write all the steps? Isn't the right answer all that's needed?

- Mathematics is not just about getting correct answers. You really learn mathematics when you organize your thoughts and present those thoughts clearly using mathematical language.
- You can arrive at correct answers with incorrect thinking. Showing your work allows your instructor to verify that you are using correct procedures to arrive at your answers.
- Having a labeled, well-organized, and neat hard copy is a good study tool for exams.

What if I submit my answers in MyMathLab or MathXL? Do I still need to show work?

Think of MyMathlab or MathXL as a personal tutor who provides the exercises, offers guided assistance, and checks your answers before you submit the assignment. For the same reasons as those listed above, you should still create a neatly written hard copy of your solutions, even if your instructor does not check the work. Following are some additional reasons to show your work when submitting answers in MyMathlab or MathXL.

- If you have difficulties that are unresolved by the program, you can show your instructor. Without the written work, your instructor cannot see your thinking.
- If you have a correct answer but have difficulty entering that correct answer, you have a record of it and can show your instructor. If correct, your instructor can override the score.

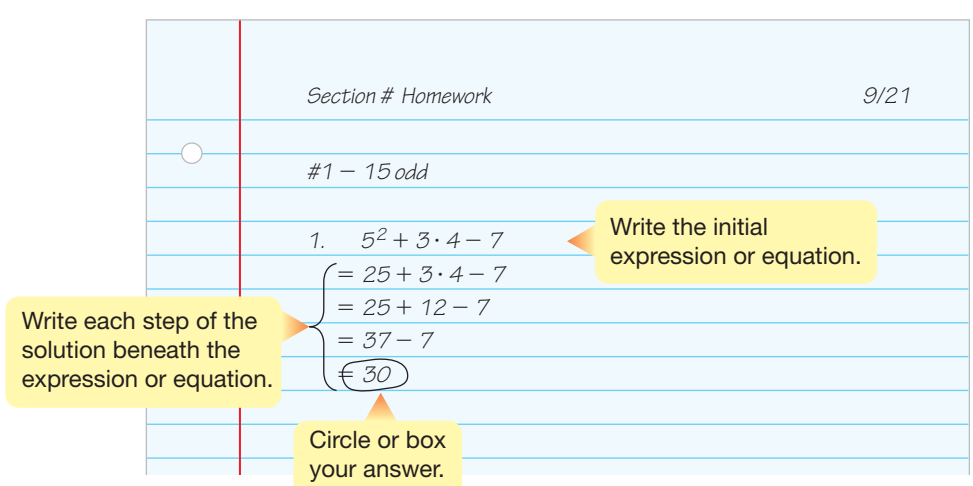
Sample Homework: Simplifying Expressions or Solving Equations

Suppose you are given the following exercise:

For Exercises 1–30 simplify.

1. $5^2 + 3 \cdot 4 - 7$

Your homework should look something like the following:



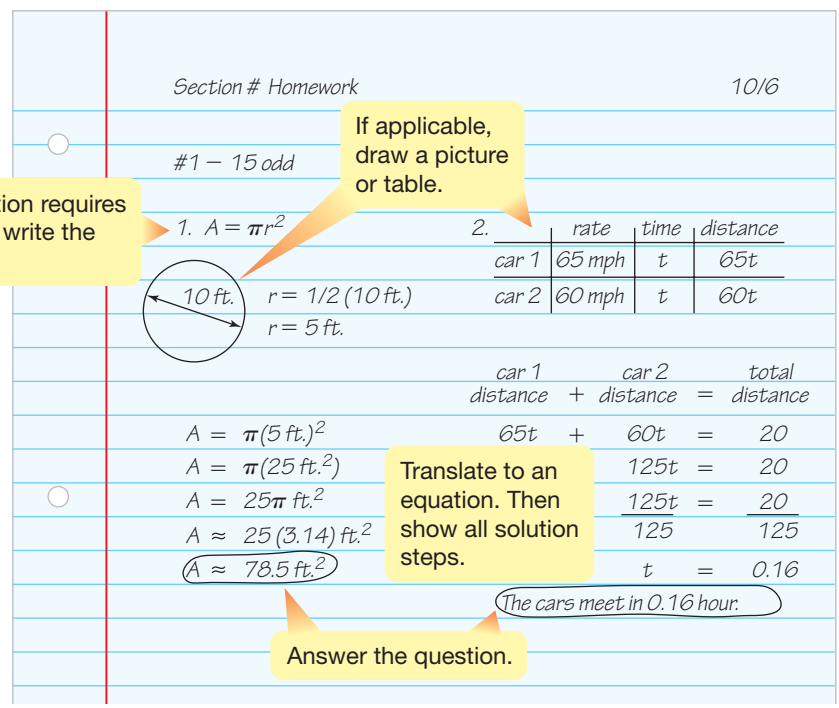
Sample Homework: Solving Application Problems

Example: Suppose you are given the following two problems.

For Exercises 1 and 2, solve.

1. Find the area of a circle with a diameter of 10 feet.
2. Two cars are traveling toward each other on the same highway. One car is traveling 65 miles per hour, and the other is traveling at 60 miles per hour. If the two cars are 20 miles apart, how long will it be until they meet?

Your homework should look something like the following:



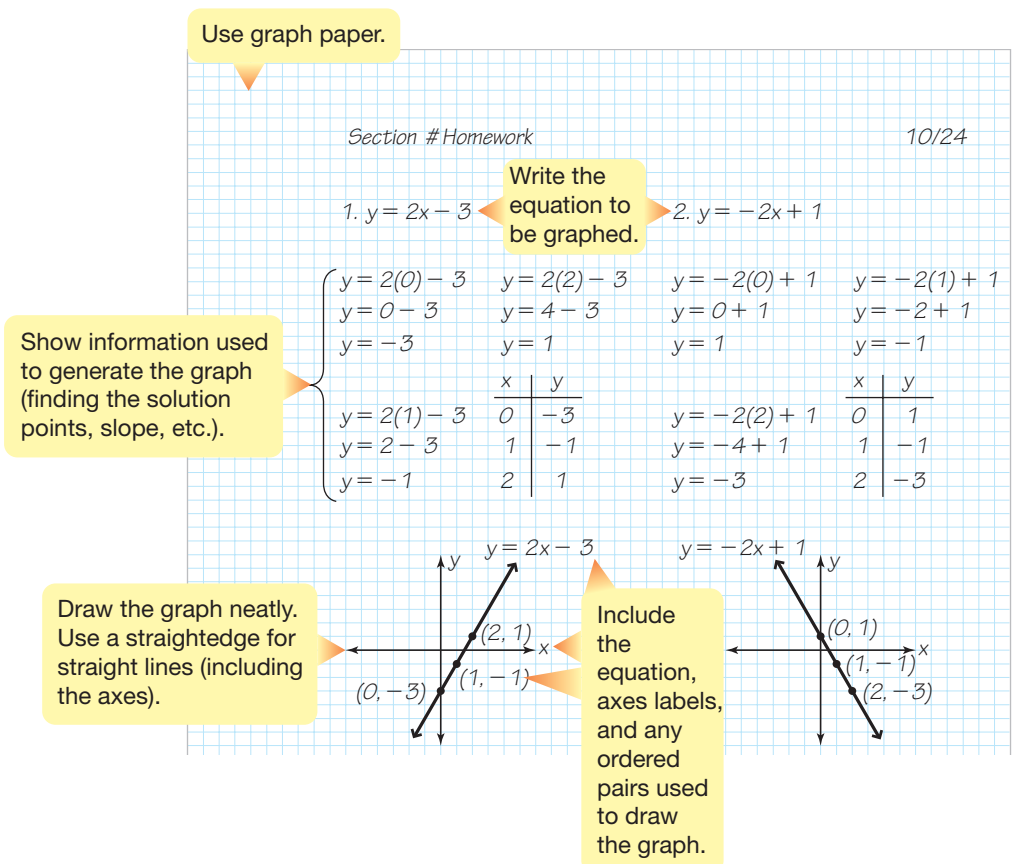
Sample Homework: Graphing

Example: Suppose you are given the following two problems.

For Exercises 1 and 2, graph the equation.

1. $y = 2x - 3$ **2.** $y = -2x + 1$

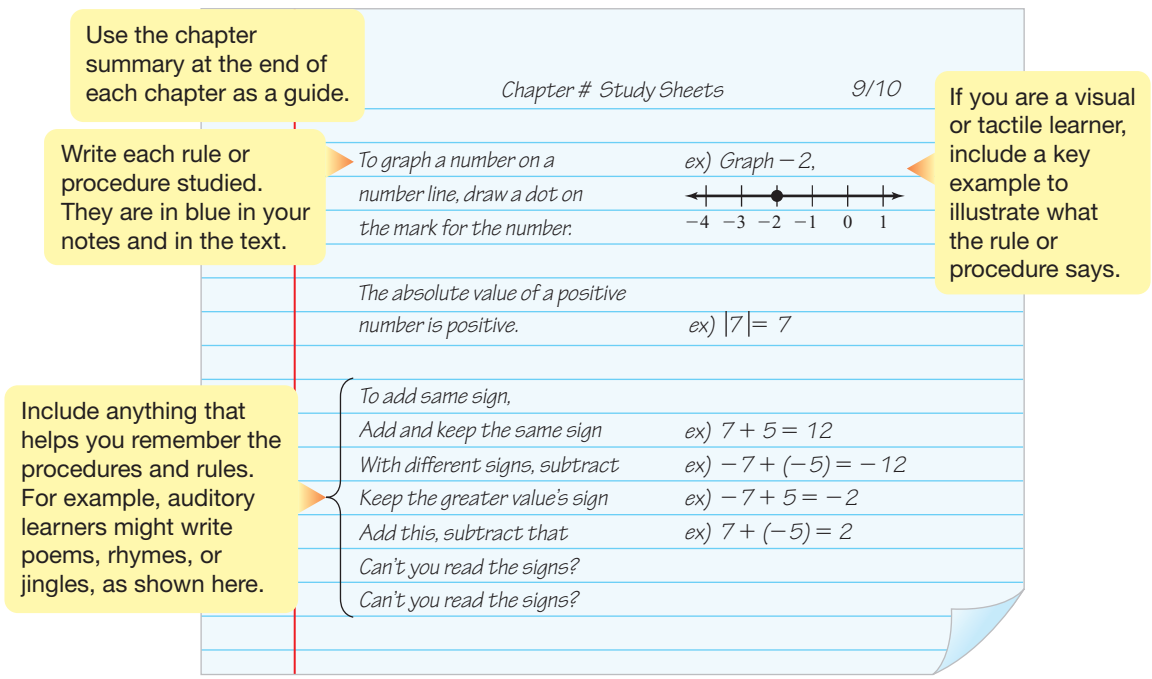
Your homework should look something like the following:



Study Materials

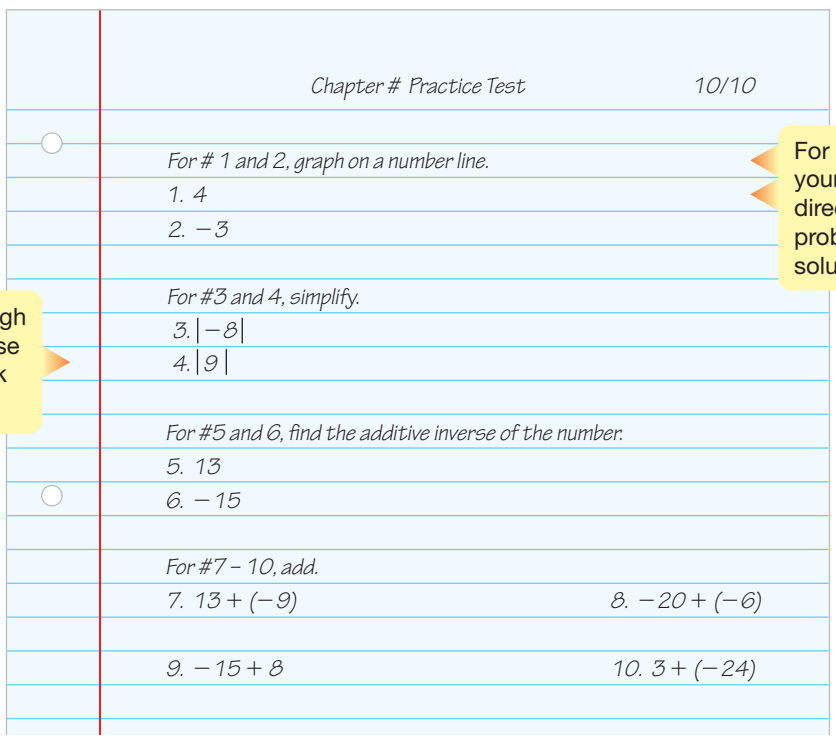
This section of the notebook contains three types of study materials for each chapter.

Study Material 1: The Study Sheet A study sheet contains *every* rule or procedure in the current chapter.



Study Material 2: The Practice Test If your instructor gives you a practice test, proceed to the discussion of creating a game plan.

If your instructor does not give you a practice test, use your notes to create your own practice test from the examples given in class. Include only the instructions and the problem, not the solutions. The following sample practice test was created from examples in the notes for Chapter 2 in a prealgebra course.



Chapter # Practice Test 10/10

For # 1 and 2, graph on a number line.

1. 4

2. -3

For #3 and 4, simplify.

3. $|-8|$

4. $|9|$

For #5 and 6, find the additive inverse of the number.

5. 13

6. -15

For #7 – 10, add.

7. $13 + (-9)$

8. $-20 + (-6)$

9. $-15 + 8$

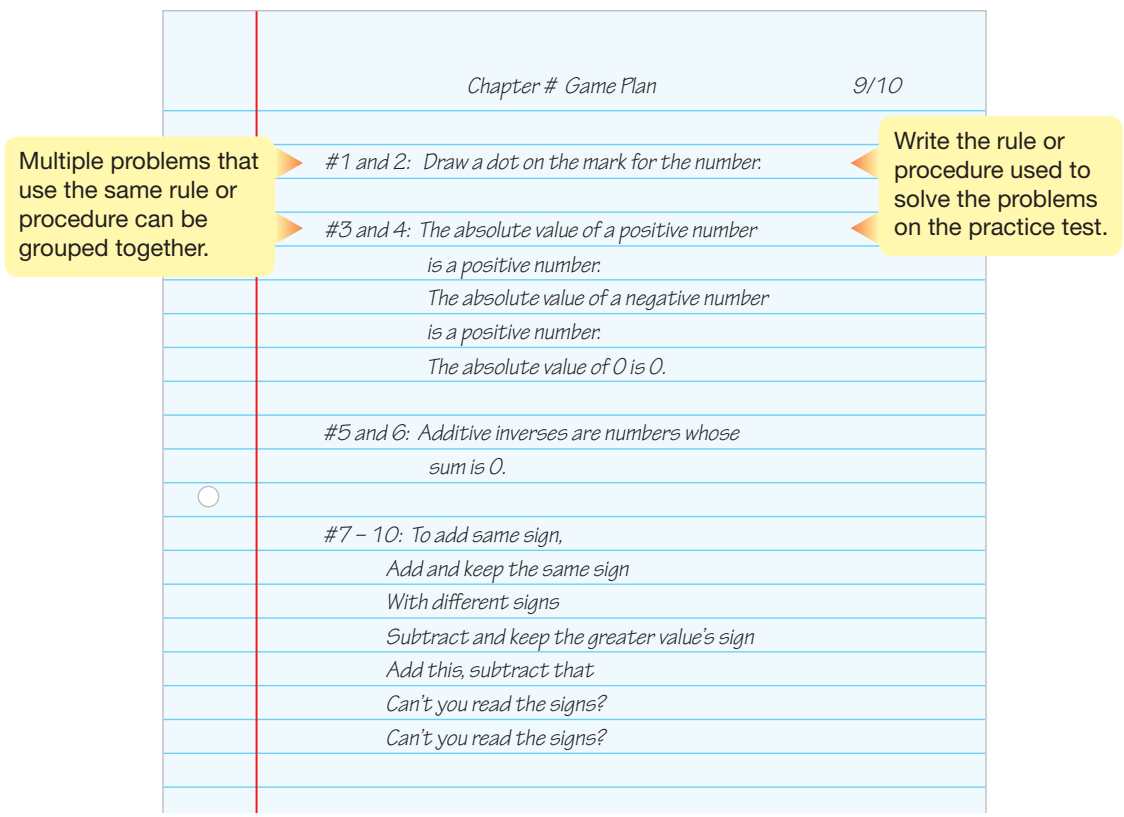
10. $3 + (-24)$

For each example in your notes, write the directions and the problem but not the solution.

After working through the practice test, use your notes to check your solutions.

Study Material 3: The Game Plan The game plan refines the study process further. It is your plan for the test based on the practice test. For each problem on your practice test, write the definition, rule, or procedure used to solve the problem.

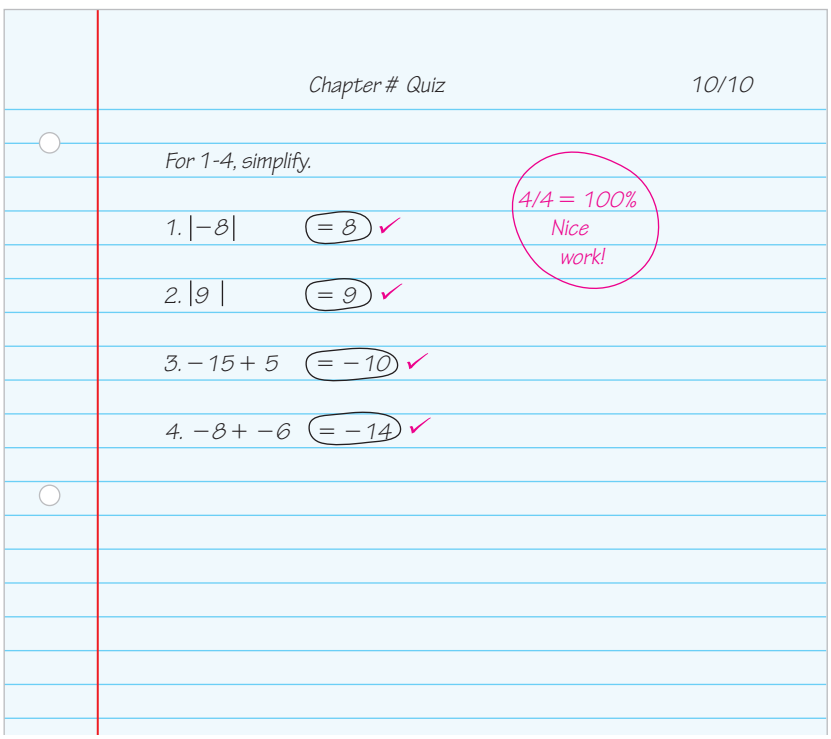
The sample shown gives the rule or procedure used to solve each problem on the preceding sample practice test. The rules and procedures came from the sample study sheet.



Quizzes/Tests

Archive all returned quizzes and tests in this section of the notebook.

- Midterm and final exam questions are often taken from the quizzes and tests, so they make excellent study tools for those cumulative exams.
- Keeping all graded quizzes and tests offers a backup system in the unlikely event your instructor should lose any of your scores.
- If a dispute arises about a particular score, you have the graded test to show your instructor.



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CHAPTER

1

Foundations of Algebra

Chapter Overview

This chapter is a review of arithmetic, which is the foundation of algebra. More specifically, we review the following topics:

- Number sets.
- Properties of real numbers.
- Simplifying expressions.
- Operations of arithmetic.
- Evaluating expressions.

This review is by no means a complete instruction of arithmetic. Because a solid foundation is important, if you encounter a topic in this chapter that is a particular weakness for you, consult with your instructor or other more complete sources for extra practice.

1.1 Number Sets and the Structure of Algebra

Objectives

1. Understand the structure of algebra.
2. Classify number sets.
3. Graph rational numbers on a number line.
4. Determine the absolute value of a number.
5. Compare numbers.

Warm-up *Refer to the* To the Student *Section on p. xiii.*

1. What are the four sections of the notebook?
2. What is the color code for notes?
3. Complete the Learning Style Inventory. What is your learning style?

Objective 1 Understand the structure of algebra.

Learning mathematics is like learning a language. When we learn a language, we must learn the alphabet, vocabulary, and sentence structure. Similarly, mathematics has its own alphabet, vocabulary, and sentence structure. In this section, we begin the development of the foundation of algebra with an overview of its components and structure. The basic components are **variables** and **constants**.

Definitions **Variable:** A symbol that can vary in value.
Constant: A symbol that does not vary in value.

Variables are usually letters of the alphabet such as x or y. Usually, constants are symbols for numbers such as $1, 2, \frac{3}{4}$, and 6.74. However, constants can sometimes be symbols such as e or the Greek letter π, each having special numeric values. Variables and constants are used to make **expressions**, **equations**, and **inequalities**.

Learning Strategy

It is important to sit up front in class because it helps you avoid distractions and makes it easier to hear any hints the professor might be giving.

—Jason J.

Definition **Expression:** A constant, a variable, or any combination of constants, variables, and arithmetic operations that describes a calculation.

Examples of expressions:

$$2 + 6 \quad 4x - 5 \quad \frac{1}{3}\pi r^2 h$$

Definition **Equation:** A mathematical relationship that contains an equal sign.

Examples of equations:

$$2 + 6 = 8 \quad 4x - 5 = 12 \quad V = \frac{1}{3}\pi r^2 h$$

Connection Think of expressions as phrases and equations as complete sentences. The expression $2 + 6$ is read "two plus six," which is not a complete sentence. The equation $2 + 6 = 8$ is read "two plus six is eight." Notice that the equal sign translates to the verb *is*, which makes the sentence a complete sentence.

Definition **Inequality:** A mathematical relationship that contains an inequality symbol

$$(\neq, <, >, \leq, \text{or} \geq).$$

Answers to Warm-up

1. notes, homework, study materials, graded work
2. red = definitions; blue = rules/procedures; pencil = all other notes
3. Answers may vary.

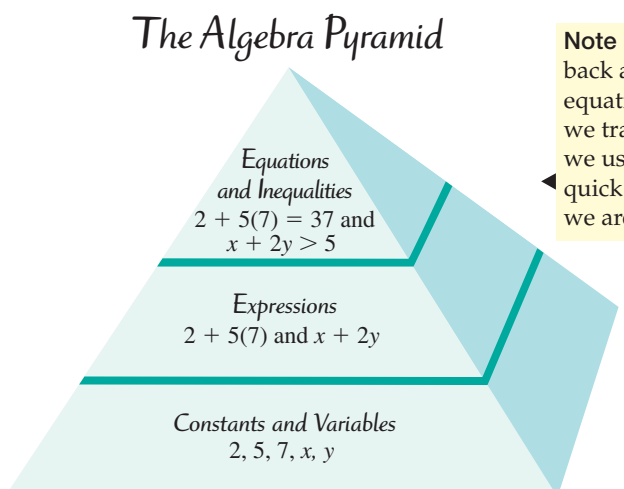
Inequality Symbols and Their Translations

Symbolic Form	Translation
$8 \neq 3$	Eight is not equal to three.
$5 < 7$	Five is less than seven.
$7 > 5$	Seven is greater than five.
$x \leq 3$	x is less than or equal to three.
$y \geq 2$	y is greater than or equal to two.

Learning Strategy

Developing a good study system and understanding how you best learn is essential to academic success. Make sure you familiarize yourself with the study system outlined in the To the Student section at the beginning of the text. Also take a moment to complete the Learning Styles Inventory found at the end of that section to discover your personal learning style. In these Learning Strategy boxes, we offer tips and suggestions on how to connect the study system and your learning style to help you be successful in the course.

The algebra pyramid shown illustrates how variables, constants, expressions, equations, and inequalities relate. At the foundation of algebra and our pyramid are constants and variables, which are used to build expressions, which in turn are used to build equations and inequalities.



Note During this course, we move back and forth between expressions, equations, and inequalities. When we transition from one to the other, we use the algebra pyramid as a quick visual so that it's clear what we are working on.

Objective 2 Classify number sets.

Numbers can be placed into different categories using **sets**.

Definition **Set:** A collection of objects.

Braces are used to indicate a set. For example, the set containing the numbers 1, 2, 3, and 4 is written $\{1, 2, 3, 4\}$. The numbers 1, 2, 3, and 4 are called the *members* or *elements* of this set.

Procedure **Writing Sets**

To write a set, write the members or elements of the set separated by commas within braces, { }.

Example 1 Write the set containing the first five letters of the alphabet.

Answer: {A, B, C, D, E}

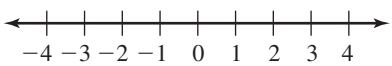
Your Turn 1 Write the set containing the first four months of the year.

Numbers are classified using number sets. The set of *natural numbers* contains the counting numbers $1, 2, 3, 4, \ldots$ and is written $\{1, 2, 3, \ldots\}$. The three dots are an *ellipsis* and indicate that the numbers continue forever in the same pattern. The set of *whole numbers* contains all of the natural numbers and 0 and is written $\{0, 1, 2, 3, \ldots\}$.

Answer to Your Turn 1
{January, February, March, April}

The set of *integers* contains all of the whole numbers and the opposite (or negative) of every natural number and is written $\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$. Notice that the integers continue forever in both directions.

A number line is often useful in mathematics. The following number line is marked with the integers. Note that the positive numbers are to the right of 0 and the negative numbers are to the left.



Although we can mark and view only a portion of the number line, the arrows at the ends indicate that the line and the numbers on it continue forever in both directions. There are other types of numbers that include the integers and all numbers between them. If we traveled along the number line forever in both directions, we would encounter every number in the set of *real numbers*.

Some of the real numbers that are not integers are the **rational numbers** that contain every real number that can be expressed as a ratio of integers.

Definition **Rational number:** Any real number that can be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$.

Note In the definition for a rational number, the notation $b \neq 0$ is important because if the denominator b were to equal 0, the fraction would be undefined. The reason it is undefined will be explained later.

For example, $\frac{3}{4}$ is a rational number because 3 and 4 are integers. Note that numbers such as 0.75 and 75% are also rational numbers because they can be written as $\frac{3}{4}$. It is important to realize that the definition of a rational number does not state that the number *must* be expressed in the form $\frac{a}{b}$. Rather, if a number *can* be expressed in the form $\frac{a}{b}$, it is a rational number. For example, the number 5 is a rational number because it can be expressed as $\frac{5}{1}$.

Example 2 Determine whether the given number is a rational number.

a. $\frac{2}{3}$

Answer: Yes, because 2 and 3 are integers.

b. 0.4

Answer: Yes, 0.4 is a rational number because it can be expressed as $\frac{4}{10}$ and 4 and 10 are integers.

c. $0.\overline{6}$

Answer: A bar written over a decimal digit indicates that the digit repeats without end. So $0.\overline{6} = 0.66666\ldots$, and we say that these decimal numbers are nonterminating decimal numbers. Usually, we encounter these numbers as quotients in certain division problems, such as when we write certain fractions as decimals. In this case, $0.\overline{6}$ is the decimal equivalent of $\frac{2}{3}$. Because $0.\overline{6}$ can be expressed as the fraction $\frac{2}{3}$, it is a rational number.

Note All nonterminating decimal numbers with repeating digits are rational numbers because they can be expressed as fractions with integers in both the numerator and denominator.

d. 3

Answer: Yes, because 3 can be thought of as $\frac{3}{1}, \frac{6}{2}, \frac{9}{3}$, etc. All integers are rational numbers.

Your Turn 2 Determine whether the given number is a rational number.

a. $\frac{4}{7}$ **b.** 0.56 **c.** $0.\overline{2}$ **d.** -7

Not all numbers can be expressed as a ratio of integers. One such number is π (pronounced "pie"). Because the exact value of π cannot be expressed as a ratio of integers, it is categorized as an **irrational number**.

Definition **Irrational number:** Any real number that is not rational.

Some other irrational numbers are $\sqrt{2}$ and $\sqrt{3}$. (Square roots are explained in more detail in Section 1.5.) Because an irrational number cannot be written as a ratio of integers, if a calculation involves an irrational number, we must leave it in symbolic form or use a rational number approximation. We can approximate π with rational numbers such as 3.14 and $\frac{22}{7}$. Any decimal representation of an irrational number is a nonrepeating, nonterminating decimal number. For example, 0.1010010001 . . . is irrational.

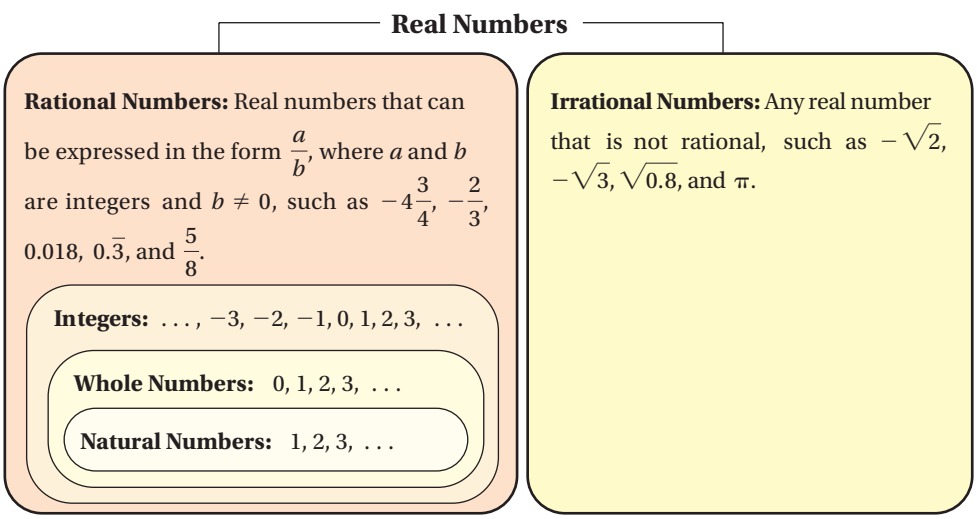
Every **real number** is either rational or irrational.

Definition **Real number:** Any rational or irrational number.

The following figure shows how the number sets relate in the real number system.

Of Interest

There are symbols for the number sets. In particular, the set of real numbers is often written as $\mathbb{R}$ or $\mathscr{R}$.



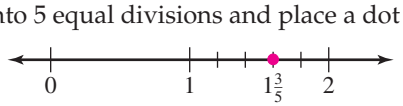
Objective 3 Graph rational numbers on a number line.

Number lines can be useful tools when comparing numbers or solving certain arithmetic problems. Let's review how to graph a number on a number line.

Example 3 Graph on a number line.

a. $1\frac{3}{5}$

Solution: The number $1\frac{3}{5}$ is located $\frac{3}{5}$ of the way between 1 and 2, so we divide the space between 1 and 2 into 5 equal divisions and place a dot on the 3rd mark.

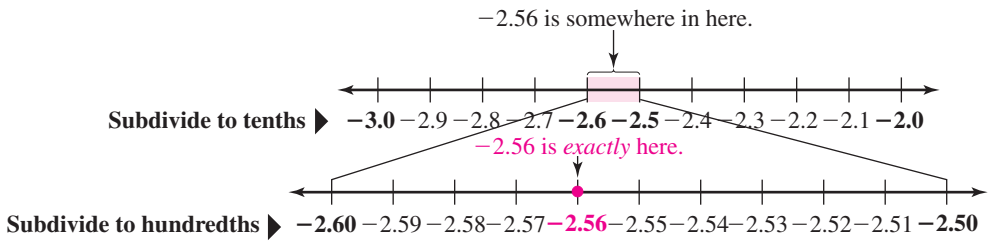


Answers to Your Turn 2

a. yes **b.** yes
c. yes **d.** yes

b. -2.56

Solution: Because -2.56 means $-2\frac{56}{100}$, we could divide the space between -2 and -3 into 100 divisions and count to the 56th mark. Because this is tedious to do, we gradually use smaller and smaller sections of the number line to graph the number.



Your Turn 3 Graph on a number line.

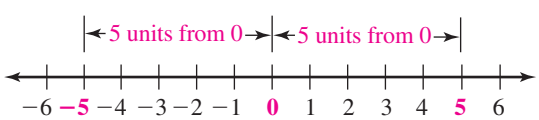
a. $2\frac{3}{4}$ **b.** -1.78

Objective 4 Determine the absolute value of a number.

The word *value* indicates how much something is worth, or its magnitude. In mathematics, **absolute value** indicates the magnitude of a number.

Definition **Absolute value:** A given number's distance from 0 on a number line.

For example, the absolute value of 5 is 5 because the number 5 is 5 units from 0 on a number line. Likewise, the absolute value of -5 is 5 because -5 is also 5 units from 0 on a number line.



The absolute value of a number n is written $|n|$. The examples just mentioned translate this way:

The absolute value of 5 is 5. The absolute value of −5 is 5.

Symbolic form: $|5| = 5$ $|-5| = 5$

What about the absolute value of 0? Because there are no units between 0 and itself, the absolute value of 0 is 0.

Rule **Absolute Value**
The absolute value of every real number is either positive or 0.

Example 4 Simplify.

a. $|-4.5|$

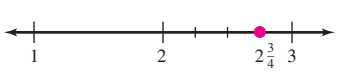
Answer: $|-4.5| = 4.5$ because -4.5 is 4.5 units from 0 on a number line.

Learning Strategy

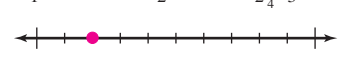
In the To the Student section, we suggest that when taking notes, you use a red pen for definitions and a blue pen for rules and procedures. Notice that we have used those colors in the design of the text to connect with your notes.

Answers to Your Turn 3

a.



b.



b. $\left|\frac{3}{8}\right|$

Answer: $\left|\frac{3}{8}\right| = \frac{3}{8}$ because $\frac{3}{8}$ is $\frac{3}{8}$ of a unit from 0 on a number line.

Your Turn 4 Simplify.

a. $\left|-2\frac{4}{5}\right|$ **b.** $|12.8|$

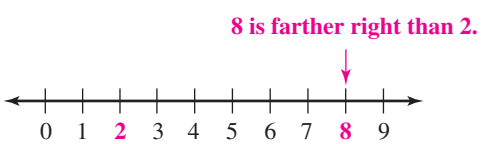
Objective 5 Compare numbers.

Number lines can also be used to determine which of two numbers is greater. Because numbers increase from left to right on a number line, the number farther to the right will be the greater of two numbers.

Rule Comparing Numbers

For any two real numbers a and b, a is greater than b if a is to the right of b on a number line. Equivalently, b is less than a if b is to the left of a on a number line.

Consider the following number line where we compare 2 and 8.



Because the number 8 is farther to the right on a number line than the number 2 is, we say that 8 is greater than 2, or in symbols, $8 > 2$. Or we could say that because 2 is to the left of 8, $2 < 8$.

Example 5 Use $=$, $<$, or $>$ to write a true statement.

a. $4 \square -4$

Answer: $4 > -4$ because 4 is farther to the right on a number line than -4 is.

b. $-2.7 \square -2.5$

Answer: $-2.7 < -2.5$ because -2.7 is farther to the left on a number line than -2.5 is.

c. $\left|3\frac{5}{6}\right| \square 3\frac{5}{6}$

Answer: $\left|3\frac{5}{6}\right| = 3\frac{5}{6}$ because the absolute value of $3\frac{5}{6}$ is equal to $3\frac{5}{6}$.

d. $|-0.7| \square -1.5$

Answer: $|-0.7| > -1.5$ because the absolute value of -0.7 is equal to 0.7, which is farther to the right on a number line than -1.5 is.

Your Turn 5 Use $=$, $<$, or $>$ to write a true statement.

a. $-15 \square -21$ **b.** $-4.1 \square 0$ **c.** $2\frac{5}{6} \square 2\frac{1}{4}$ **d.** $|-9.5| \square 9.5$

Answers to Your Turn 4

a. $2\frac{4}{5}$ **b.** 12.8

Answers to Your Turn 5

a. $-15 > -21$ **b.** $-4.1 < 0$

c. $2\frac{5}{6} > 2\frac{1}{4}$ **d.** $|-9.5| = 9.5$

1.1 Exercises

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Note: Exercises marked with a ★ represent challenging exercises.

Objective 1

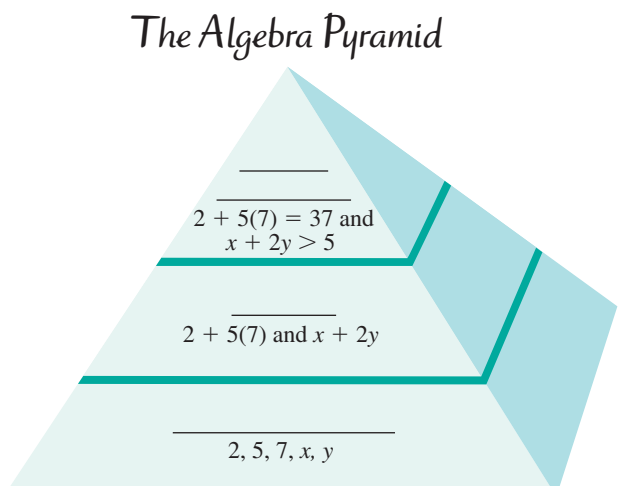
Prep Exercise 1 Explain the difference between a constant and a variable.

Prep Exercise 2 An expression is a constant, a variable, or any combination of constants, variables, and arithmetic operations that describes a(n) _____.

Prep Exercise 3 An equation is a mathematical relationship that contains a(n) _____.

Prep Exercise 4 List the inequality symbols.

Prep Exercise 5 Complete the name of each level of the algebra pyramid.



Objective 2

Prep Exercise 6 To write a set, write the members or elements of the set separated by commas within _____, _____.

For Exercises 1–10, write a set representing each description. See Example 1.

1. The days of the week

2. The last ten letters of the English alphabet

3. The vowels of the English alphabet

4. The states in the United States that do not share a border with any other state

5. The natural numbers that are multiples of 5

6. The even natural numbers

7. The odd natural numbers greater than 7

8. The even integers greater than or equal to 16

9. The integers greater than or equal to -6 but less than -2

10. The integers greater than -2.1 and less than $\frac{3}{4}$

Prep Exercise 7 Explain the difference between a rational number and an irrational number.

For Exercises 11–20, determine whether each number is a rational number or an irrational number. See Example 2.

11. $-\frac{4}{5}$ **12.** $\frac{1}{4}$ **13.** 9 **14.** -12 **15.** π

16. $\frac{\pi}{4}$ **17.** -0.21 **18.** -0.8 **19.** $0.\overline{6}$ **20.** $0.\overline{13}$

Prep Exercise 8 Every real number is either _____ or _____.

For Exercises 21–26, answer true or false.

21. Every rational number is a real number.

22. Every real number is a rational number.

23. Every whole number is an integer.

24. Every real number is a natural number.

25. A number exists that is both rational and irrational.

26. Zero is a rational number.

Objective 3

For Exercises 27–34, graph each number on a number line. See Example 3.

27. $-\frac{5}{6}$ **28.** $5\frac{1}{2}$ **29.** $2\frac{3}{8}$ **30.** $-\frac{2}{5}$

31. -3.5 **32.** 7.4 **33.** 2.45 **34.** -7.62

Objective 4

Prep Exercise 9 The absolute value of every real number is either _____ or _____.

For Exercises 35–44, simplify. See Example 4.

35. $|23|$ **36.** $|6|$ **37.** $|-2|$ **38.** $|-8|$ **39.** $|-5.7|$

40. $|-4.5|$ **41.** $\left|-3\frac{1}{8}\right|$ **42.** $\left|2\frac{3}{5}\right|$ **43.** $|0|$ **44.** $|-67.8|$

Objective 5

Prep Exercise 10 When comparing two numbers, the number farther to the _____ on a number line is the greater number.

For Exercises 45–72, use $=$ *,* $<$ *, or* $>$ *to write a true statement. See Example 5.*

45. $9 \square 3$ **46.** $2 \square 7$ **47.** $4 \square -3$ **48.** $-6 \square 5$ **49.** $-7 \square -8$