

Ninth Edition

Basic College Mathematics

Lial

Salzman

Hestwood

Ninth
Edition

Basic College Mathematics

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This book is dedicated to Margaret L. Lial
Always passionate about mathematics and teaching,
Always a valued colleague, a mentor, and a friend,
Always in our memory.

In appreciation of your lasting support and never-ending enthusiasm: family, colleagues, and more than a generation of motivated students.

Stan Salzman

This book is dedicated to my dad, who always told me when I was young that girls could learn math, and to my students at Minneapolis Community and Technical College, who keep me in touch with the real world.

Diana Hestwood

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Preface

The ninth edition of *Basic College Mathematics* continues our ongoing commitment to provide the best possible text and supplements package that will help instructors teach and students succeed. To that end, we have addressed the diverse needs of today's students by creating a tightly coordinated text and technology package that includes integrated activities to help students improve their study skills, an attractive design, updated applications and graphs, helpful features, and careful explanations of concepts. We've also expanded the supplements and study aids. We've revamped the video series into a complete Lial Video Library with expanded video coverage and new, easier navigation. And we've added the new Lial MyWorkBook. We have also responded to the suggestions of users and reviewers and have added many new examples and exercises based on their feedback.

The program is designed to help students achieve success in a developmental mathematics program. It provides the necessary review and coverage of whole numbers, fractions, decimals, ratio and proportion, percent, and measurement, as well as an introduction to algebra and geometry and a preview of statistics. It is part of a series that also includes the following books:

- *Essential Mathematics*, Fourth Edition, by Lial and Salzman
- *Prealgebra*, Fifth Edition, by Lial and Hestwood
- *Introductory Algebra*, Tenth Edition, by Lial, Hornsby, and McGinnis
- *Intermediate Algebra*, Tenth Edition, by Lial, Hornsby, and McGinnis
- *Introductory and Intermediate Algebra*, Fifth Edition, by Lial, Hornsby, and McGinnis
- *Prealgebra and Introductory Algebra*, Fourth Edition, by Lial, Hestwood, Hornsby, and McGinnis
- *Developmental Mathematics: Basic Mathematics and Algebra*, Third Edition, by Lial, Hornsby, McGinnis, Salzman, and Hestwood

WHAT'S NEW IN THIS EDITION

The scope and sequence of topics in *Basic College Mathematics* has stood the test of time and rates highly with our reviewers. Therefore, you will find the table of contents intact, making the transition to the new edition easier.





- ▶ **Examples and Exercises** Throughout the text, examples and exercises have been adjusted or replaced to reflect current data and practices. Applications have been updated and cover a wider variety of topics, such as the fields of technology, ecology, and health sciences.
- ▶ **Guided Solutions** Selected exercises in the margins and in the exercise sets, marked with a **GS** icon, now show the first few solution steps. This provides guidance to students as they start learning a new concept or procedure and gets them off to a successful start. (See p. 301 margin, and p. 356, Exercises 3-4.)
- ▶ **Concept Checks** The Concept Checks at the beginning of each exercise set assure students that they have necessary background skills or information to proceed. Concept Checks later in the exercise sets help students summarize and consolidate their learning by writing explanations, correcting common errors, and practicing mathematical processes. (See pp. 285-286.)
- ▶ **Vocabulary Tips** Many students at this level of mathematics do not have strong reading skills. The vocabulary tips included in the margins throughout the book help them to learn the meaning of root words and prefixes commonly used in mathematics vocabulary (for example, *equ-*, *centi*, *tri-*), distinguish the mathematical meaning from the common usage of particular words (such as *volume*, *average*), and provide tips for remembering the difference between often-confused terms (such as LCM and LCD on p. 215).

- ▶ **Teaching Tips** Although the mathematical content in this text is familiar to instructors, they may not have experience in teaching the material to adult students. The Teaching Tips, printed in the margins of the Annotated Instructor’s Edition, provide helpful comments from colleagues with successful experience at this level. Common trouble spots are noted, with suggestions for improving student understanding. (See p. 276.) Simple, but effective, hands-on activities are also included. (See p. 548.)
- ▶ **Lial Video Library** The Lial Video Library, available in MyMathLab and on the Video Resources DVD, provides students with a wealth of video resources to help them navigate the road to success. All video resources in the library include optional subtitles in English. The Lial Video Library includes Section Lecture Videos, Solutions Clips, Quick Review Lectures, and Chapter Test Prep Videos. The Chapter Test Prep Videos are also available on YouTube (searchable using author name and book title), or by scanning the QR code on the inside back cover for easy access.
- ▶ **MyWorkBook** This new workbook provides Guided Examples and corresponding Now Try Exercises for each text objective. The extra practice exercises for every section of the text, with ample space for students to show their work, are correlated to Examples, Lecture Videos, and Exercise Solution Clips, to give students the help they need to successfully complete problems. Additionally, MyWorkBook lists the learning objectives and key vocabulary terms for every text section, along with vocabulary practice problems.
- ▶ **Math in the Media** Each one-page activity presents a relevant look at how mathematics is used in the media. Designed to help instructors answer the often-asked question, “When will I ever use this stuff?,” these activities ask students to read and interpret data from newspaper articles, the Internet, and other familiar, real-world sources. (See p. 196.) The activities are well-suited to collaborative work or they can be completed by individuals or used for open-ended class discussions.
- ▶ **Study Skills** Thirteen carefully designed study skills activities provide opportunities for students to practice proven strategies for learning mathematics. Poor study skills and behaviors are major factors in low success rates in mathematics courses. Research shows that a few generic tips sprinkled here and there are not enough to help students change their study behaviors. Because students need specific instruction in study skills, we have contextualized them, integrating them into the text material. Topics include note taking, homework, study cards, math anxiety, test preparation, test taking, preparing for a final exam, and more. (See pp. 138–139, 180–181, and 182–183.) Most are located within the first few chapters so that students can use the skills throughout the course. (See the Contents for titles and locations.) The first activity, “Your Brain *Can* Learn Mathematics,” explains how the brain actually learns and remembers so that students understand why the study skills will help them succeed in the course.

HALLMARK FEATURES

We believe students and instructors will welcome these familiar hallmark features.

- ▶ **Chapter Openers** The new and engaging Chapter Openers portray real life situations making math relevant for students. (See Chapter 2, p. 113.)
- ▶ **Real-Life Applications** We are always on the lookout for interesting data to use in real-life applications. As a result, we have included many new or updated examples and exercises throughout the text that focus on real-life applications of mathematics. Students are often asked to find data in a table, chart, graph, or advertisement. (See pp. 156 and 157.) These applied problems provide an up-to-date flavor that will appeal to and motivate students.
- ▶ **Figures and Photos** Today’s students are more visually oriented than ever. Thus, we have made a concerted effort to include mathematical figures, diagrams, tables, and graphs whenever possible. (See p. 157.) Many of the graphs use a style similar to that seen by students in today’s print and electronic media. Photos have been incorporated to enhance applications in examples and exercises. (See p. 158.)

- ▶ **Emphasis on Problem Solving** Introduced at the end of Chapter 1, our six-step process for solving application problems is integrated throughout the text. The six steps, *Read, Plan, Estimate, Solve, State the Answer,* and *Check,* are emphasized in boldface type and repeated in specific problem-solving examples in Chapters 1, 2, 3, 5, 6, 7, and 9. (See p. 162.)
- ▶ **Learning Objectives** Each section begins with clearly stated, numbered objectives, and the material within sections is keyed to these objectives so that students know exactly what concepts are covered. (See p. 114.)
- ▶ **Pointers** More pointers have been added to examples to provide students with important on-the-spot reminders and warnings about common pitfalls. (See pp. 132 and 162.)
- ▶ **Cautions and Notes** These color-coded and boxed comments, one of the most popular features of previous editions, warn students about common errors and emphasize important ideas throughout the exposition. (See pp. 144–145.) Cautions are highlighted in yellow and Notes are highlighted with blue tabs.
-  ▶ **Calculator Tips** These optional tips, marked with a red calculator icon, offer helpful information and instruction for students using calculators in the course. (See p. 268.)
- ▶ **Margin Problems** Margin problems, with answers immediately available on the bottom of the page, are found in every section of the text. (See pp. 121–122.) This key feature allows students to immediately practice the material covered in the examples in preparation for the exercise sets.
- ▶ **Ample and Varied Exercise Sets** The text contains a wealth of exercises to provide students with opportunities to practice, apply, connect, and extend the skills they are learning. Numerous illustrations, tables, graphs, and photos help students visualize the problems they are solving. Problem types include skill building, writing, estimation, and calculator exercises, as well as applications and correct-the-error problems. In the Annotated Instructor's Edition of the text, the writing exercises are marked with an icon  so that instructors may assign these problems at their discretion. Exercises suitable for calculator work are marked in both the student and instructor editions with a calculator icon . (See pp. 175–179.) Students can watch an instructor work through the complete solution for all exercises marked with a Play Button icon  on the Videos on DVD or in MyMathLab.
- ▶ **Relating Concepts Exercises** These help students tie concepts together and develop higher level problem-solving skills as they compare and contrast ideas, identify and describe patterns, and extend concepts to new situations. (See pp. 151, 294, and 306.) These exercises make great collaborative activities for pairs or small groups of students.
- ▶ **Solutions** Solutions to selected section exercises are included in the back of the book (following the Answers section). This provides students with easily accessible step-by-step help in solving the exercises that are most commonly missed. Solutions are provided for the exercises marked with a square of blue color around the exercise number, for example, **15**.
- ▶ **Summary Exercises** All chapters now include this helpful mid-chapter review. These exercises provide students with the all-important *mixed* practice they need at these critical points in their skill development. (See pp. 140–141.)
- ▶ **Ample Opportunity for Review** Each chapter ends with a Chapter Summary featuring: Key Terms with definitions and helpful graphics, New Formulas, New Symbols, Test Your Word Power, and a Quick Review of each section's content with additional examples. Also included is a comprehensive set of Chapter Review Exercises keyed to individual sections, a set of Mixed Review Exercises, and a Chapter Test. Students can watch an instructor work out the full solutions to the Chapter Test problems in the Chapter Test Prep Videos. Beginning with Chapter 2, each chapter concludes with a set of Cumulative Review Exercises. (See pp. 184–195.)
- ▶ **Test Your Word Power** This feature, incorporated into each Chapter Summary, helps students understand and master mathematical vocabulary. Key terms from the chapter are presented along with three possible definitions in a multiple-choice format. Answers and examples illustrating each term are provided. (See p. 185.)

STUDENT SUPPLEMENTS

Student's Solutions Manual

- By Jeffery A. Cole, Anoka-Ramsey Community College
- Provides detailed solutions to the odd-numbered section-level exercises and to all margin, Relating Concepts, Summary, Chapter Review, Chapter Test, and Cumulative Review Exercises

ISBNs: 0-321-83660-X, 978-0-321-83660-1


NEW MyWorkBook

- Provides Guided Examples and corresponding Now Try Exercises for each text objective
- Refers students to correlated Examples, Lecture Videos, and Exercise Solution Clips
- Includes extra practice exercises for every section of the text with ample space for students to show their work
- Lists the learning objectives and key vocabulary terms for every text section, along with vocabulary practice problems

ISBNs: 0-321-83682-0, 978-0-321-83682-3



NEW Lial Video Library

The Lial Video Library, available in MyMathLab and on the Video Resources DVD, provides students with a wealth of video resources to help them navigate the road to success! All video resources in the library include optional subtitles in English. The Lial Video Library includes the following resources:

- **Section Lecture Videos** offer a new navigation menu that allows students to easily focus on the key examples and exercises that they need to review in each section. Optional Spanish subtitles are available.
- **Solutions Clips** show an instructor working through the complete solutions to selected exercises from the text. Exercises with a solution clip are marked in the text and e-book with a Play Button icon .
- **Quick Review Lectures** provide a short summary lecture of each key concept from the Quick Reviews at the end of every chapter in the text.
- **The Chapter Test Prep Videos** provide step-by-step solutions to all exercises from the Chapter Tests. These videos provide guidance and support when students need it the most: the night before an exam. The Chapter Test Prep Videos are also available on YouTube (searchable using author name and book title), or by scanning the QR code on the inside back cover for easy access.

INSTRUCTOR SUPPLEMENTS

Annotated Instructor's Edition

- Provides answers to all text exercises in color next to the corresponding problems
- Icons identify writing  and calculator  exercises

ISBNs: 0-321-82631-0, 978-0-321-82631-2

Instructor's Solutions Manual (Download only)

- By Jeffery A. Cole, Anoka-Ramsey Community College
 - Provides complete solutions to all exercises in the text
 - Available for download at www.pearsonhighered.com
- ISBNs: 0-321-82568-3, 978-0-321-82568-1**

Instructor's Resource Manual with Tests and Mini-Lectures (Download only)

- Contains a test bank with two diagnostic pretests, six free-response and two multiple-choice test forms per chapter, and two final exams
 - Contains a mini-lecture for each section of the text with objectives, key examples, and teaching tips
 - Includes a correlation guide from the eighth to the ninth edition and phonetic spellings for all key terms in the text
 - Includes resources to help both new and adjunct faculty with course preparation and classroom management, by offering helpful teaching tips correlated to the sections of the text
 - Available for download at www.pearsonhighered.com
- ISBNs: 0-321-57461-3, 978-0-321-57461-9**

ADDITIONAL MEDIA SUPPLEMENTS

**MyMathLab® Online Course (access code required)**

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 a **trusted partner** with educational expertise and an eye on the future.

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

MyMathLab® Ready to Go Course (access code required)

These new Ready to Go courses provide students with all the same great MyMathLab features that they are used to but make it easier for instructors to get started. Each course includes pre-assigned homework and quizzes to make creating a course even simpler.

Ask your Pearson representative about the details for this particular course or to see a copy of this course.

MyMathLab® Plus/MyStatLab™ Plus

MyLabsPlus combines proven results and engaging experiences from MyMathLab® and MyStatLab™ with convenient management tools and a dedicated services team. Designed to support growing math and statistics programs, it includes additional features such as:

- **Batch Enrollment:** Schools can create the login name and password for every student and instructor, so everyone can be ready to start class on the first day. Automation of this process is also possible through integration with the school's Student Information System.
- **Login from your campus portal:** Instructors and their students can link directly from their campus portal into the MyLabsPlus courses. A Pearson service team works with the institution to create a single sign-on experience for instructors and students.
- **Advanced Reporting:** MyLabsPlus's advanced reporting enables instructors to review and analyze students' strengths and weaknesses by tracking their performance on tests, assignments, and tutorials. Administrators can review grades and assignments across all courses on a MyLabsPlus campus for a broad overview of program performance.
- **24/7 Support:** Students and instructors receive 24/7 support, 365 days a year, by email or online chat.

MyLabsPlus is available to qualified adopters. For more information, visit our website at www.mylabsplus.com or contact your Pearson representative.

MathXL®**MathXL® Online Course (access code required)**

MathXL® is the homework and assessment engine that runs MyMathLab. (MyMathLab is MathXL plus a learning management system.)

With MathXL, instructors can:

- Create, edit, and assign online homework and tests using algorithmically-generated exercises correlated at the objective level to the textbook.
- Create and assign their own online exercises and import TestGen tests for added flexibility.
- Maintain records of all student work tracked in MathXL's online gradebook.

With MathXL, students can:

- Take chapter tests in MathXL and receive personalized study plans and/or personalized homework assignments based on their test results.
- Use the study plan and/or the homework to link directly to tutorial exercises for the objectives they need to study.
- Access supplemental animations and video clips directly from selected exercises.

MathXL is available to qualified adopters. For more information, visit our website at www.mathxl.com, or contact your Pearson representative.

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 testbank are available for download from Pearson Education's online catalog.

PowerPoint® Lecture Slides

- Present key concepts and definitions from the text
- Available for download at www.pearsonhighered.com or in MyMathLab

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Linda Russell, who developed and wrote the Study Skills activities that appear throughout this text, also worked to make the text more readable for developmental-level students, wrote many of the vocabulary tips, and provided much-needed help during the production phase. Her many years of teaching and working with students at this level was invaluable.

The ultimate measure of this textbook's success is whether it helps students master basic skills, develop problem-solving techniques, and increase their confidence in learning and using mathematics. In order for us, as authors, to know what to keep and what to improve for the next edition, we need to hear from you, the instructor, and you, the student. Please tell us what you like and where you need additional help by sending an e-mail to math@pearson.com. We appreciate your feedback!

Stanley A. Salzman
 Diana L. Hestwood

1

Whole Numbers



The Golden Gate Bridge, connecting San Francisco and Marin Counties, was completed in 1937 and is 8981 feet long. The bridge is supported by two main towers which are constructed with 1,200,000 rivets, rises 746 feet above the water, and has had more than 2,153,896,448 cars and trucks cross over it. In this chapter we discuss whole numbers, which are used daily in our lives.

Study Skills *Your Brain Can Learn Mathematics*

1.1 Reading and Writing Whole Numbers

Study Skills *Using Your Textbook*

1.2 Adding Whole Numbers

1.3 Subtracting Whole Numbers

1.4 Multiplying Whole Numbers

1.5 Dividing Whole Numbers

1.6 Long Division

Summary Exercises *Whole Numbers Computation*

1.7 Rounding Whole Numbers

1.8 Exponents, Roots, and Order of Operations

Study Skills *Taking Lecture Notes*

1.9 Reading Pictographs, Bar Graphs, and Line Graphs

1.10 Solving Application Problems

Study Skills

YOUR BRAIN *CAN* LEARN MATHEMATICS

OBJECTIVES

- 1 Describe how practice fosters dendrite growth.
- 2 Explain the effect of anxiety on the brain.

Your brain knows how to learn, just as your lungs know how to breathe; however, there are important things you can do to maximize your brain's ability to do its work. This short introduction will help you choose effective strategies for learning mathematics. This is a simplified explanation of a complex process.

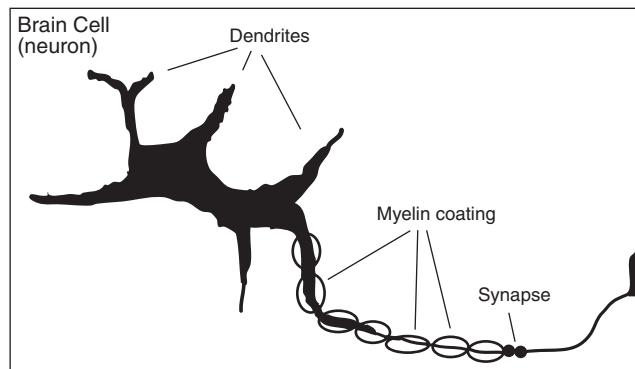
Your brain's outer layer is called the **neocortex**, which is where higher level thinking, language, reasoning, and purposeful behavior occur. The neocortex has about 100 billion (100,000,000,000) brain cells called **neurons**.

Learning Something New

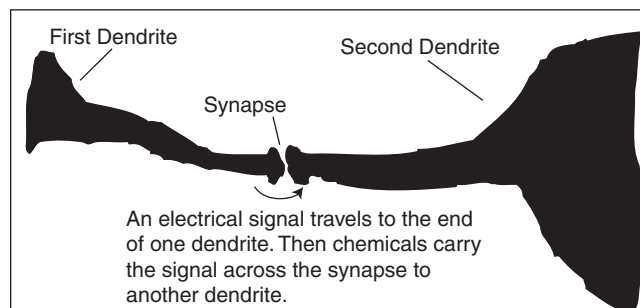
- ▶ As you learn something new, threadlike branches grow out of each neuron. These branches are called **dendrites**.
- ▶ When the dendrite from one neuron grows close enough to the dendrite from another neuron, a connection is made. There is a small gap at the connection point called a **synapse**. One dendrite sends an electrical signal across the gap to another dendrite.
- ▶ *Learning = growth and connecting of dendrites.*

Remembering New Skills

- ▶ When you practice a skill just once or twice, the connections between neurons are very weak. If you do not practice the skill again, the dendrites at the connection points wither and die back. You have forgotten the new skill!



A neuron with several dendrites: one dendrite has developed a myelin coating through repeated practice.



A close-up view of the connection (synapse) between two dendrites.

- ▶ If you practice a new skill many times, the dendrites for that skill become coated with a fatty protein called **myelin**. Each time one dendrite sends a signal to another dendrite, the myelin coating becomes thicker and smoother, allowing the signals to move faster and with less interference. Thinking can now occur more quickly and easily, and **you will remember the skill for a long time** because the dendrite connections are very strong.

Become An Effective Student

- ▶ You grow dendrites specifically for the thing you are studying. If you practice dividing fractions, you will grow specialized dendrites just for dividing fractions. If you **watch other people** solve fraction problems, **you will grow dendrites for watching, not for solving**. So, be sure you are actively learning and practicing.
- ▶ If you practice something the **wrong** way, you will develop strong dendrite connections for doing it the wrong way! So, as you study, check frequently that you are getting correct answers.
- ▶ As you study a new topic that is related to things you already know, you will grow new dendrites, but your brain will also send signals throughout the network of dendrites for the related topics. In this way, you build a complex **neural network** that allows you to apply concepts, see differences and similarities between ideas, and understand relationships between concepts.

In the first few chapters of this textbook you will find “brain friendly” activities that are designed to help you grow and develop your own reliable neural networks for mathematics. Since you must grow your own dendrites (no one can grow them for you), these activities show you how to

- ▶ develop new dendrites,
- ▶ strengthen existing ones, and
- ▶ encourage the myelin coating to become thicker so signals are sent with less effort.

When you incorporate the activities into your regular study routine, you will discover that you understand better, remember longer, and forget less.

Also remember that **it does take time for dendrites to grow**. Trying to cram in several new concepts and skills at the last minute is not possible. Your dendrites simply can't grow that quickly. You can't expect to develop huge muscles by lifting weights for just one evening before a body building competition! In the same way, practice the study techniques **throughout the course** to facilitate strong growth of dendrites.

When Anxiety Strikes

If you are under stress or feeling anxious, such as during a test, your body secretes **adrenaline** into your system. Adrenaline in the brain blocks connections between neurons. In other words, you can't think! If you've ever experienced “blinking out” on a test, you know what adrenaline does. You'll learn several solutions to that problem in later activities.

Start Your Course Right!

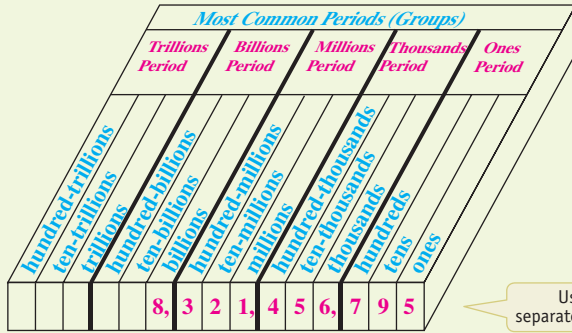
- ▶ Attend all class sessions (especially the first one).
- ▶ Gather the necessary supplies.
- ▶ Carefully read the syllabus for the course, and ask questions if you don't understand.

Notice the comma between the hundreds and thousands position in the number 725,283 in **Example 2**.

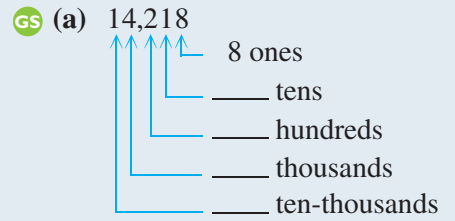
Work Problem 2 at the Side. ▶

Using Commas

Commas are used to separate each group of three digits, starting from the right. This makes numbers easier to read. (An exception: Commas are frequently omitted in four-digit numbers such as 9748 or 1329.) Each three-digit group is called a **period**. Some instructors prefer to just call them **groups**.



2 Identify the place value of each digit.



(b) 460,329

3 In the number 3,251,609,328 identify the digits in each period (group).

(a) billions period

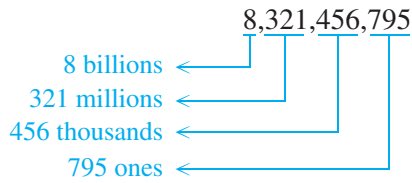
(b) millions period

(c) thousands period

(d) ones period

EXAMPLE 3 Knowing the Period or Group Names

Write the digits in each period of 8,321,456,795.



Work Problem 3 at the Side. ▶

Use the following rule to read a number with more than three digits.

Writing Numbers in Words

Start at the left when writing a number in words or saying it aloud. Write or say the digit names in each period (group), followed by the name of the period, except for the period name “ones,” which is *not* used.

OBJECTIVE 3 Write a number in words or digits. The following examples show how to write names for whole numbers.

EXAMPLE 4 Writing Numbers in Words

Write each number in words.

(a) 57

This number means 5 tens and 7 ones, or 50 ones and 7 ones. Write the number as

fifty-seven.

Continued on Next Page

Answers

2. (a) 1 : ten-thousands
4 : thousands
2 : hundreds
1 : tens
8 : ones

- (b) 4 : hundred-thousands
6 : ten-thousands
0 : thousands
3 : hundreds
2 : tens
9 : ones

3. (a) 3 (b) 251 (c) 609 (d) 328

4 Write each number in words.

(a) 18

(b) 36

(c) 418

(d) 902

5 Write each number in words.

GS (a) 3104

three _____,

one _____ four

GS (b) 95,372

ninety-five _____,
three hundred seventy-two

(c) 100,075,002

(d) 11,022,040,000

6 Rewrite each number using digits.

(a) one thousand, four hundred thirty-seven

(b) nine hundred seventy-one thousand, six

(c) eighty-two million, three hundred twenty-five

Answers

4. (a) eighteen

(b) thirty-six

(c) four hundred eighteen

(d) nine hundred two

5. (a) three thousand, one hundred four

(b) ninety-five thousand, three hundred seventy-two

(c) one hundred million, seventy-five thousand, two

(d) eleven billion, twenty-two million, forty thousand

6. (a) 1437 (b) 971,006 (c) 82,000,325

(b) 94

ninety-four

Remember: Start at the left to read a number.

(c) 874

eight hundred seventy-four

(d) 601

six hundred one

◀ Work Problem 4 at the Side.

CAUTION

The word *and* should never be used when writing whole numbers. You will often hear someone say “five hundred *and* twenty-two,” but the use of “and” is not correct since “522” is a whole number. When you work with decimal numbers, the word *and* is used to show the position of the decimal point. For example, 98.6 is read as “ninety-eight *and* six tenths.” Practice with decimal numbers is a topic in **Chapter 4**.

EXAMPLE 5 Writing Numbers in Words by Using Period Names

Write each number in words.

(a) 725,283

seven hundred twenty-five **thousand**, two hundred eighty-three
 Number in period Name of period Number in period (not necessary to write “ones”)

(b) 7252

seven **thousand**, two hundred fifty-two
 Name of period No period name needed

Careful: Do not use “and” when reading a whole number.

(c) 111,356,075

one hundred eleven **million**, three hundred fifty-six **thousand**, seventy-five

(d) 17,000,017,000

seventeen **billion**, seventeen **thousand**

The period name is not used for the ones period.

◀ Work Problem 5 at the Side.

EXAMPLE 6 Writing Numbers in Digits

Rewrite each number using digits.

(a) six **thousand**, twenty-two

6022

With 4 digits or fewer, no comma is needed.

(b) two hundred fifty-six **thousand**, six hundred twelve

256,612

(c) nine **million**, five hundred fifty-nine

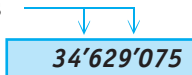
9,000,559

Zeros indicate there are no thousands.

◀ Work Problem 6 at the Side.

 **Calculator Tip**

Does your calculator show a comma between each group of three digits? Probably not, but try entering a long number such as 34,629,075. Notice that there is no key with a comma on it, so you do not enter commas. A few calculators may show the position of the commas *above* the digits, like this



34'629'075

Most of the time you will have to write in the commas where needed.

OBJECTIVE 4 **Read a table.** A common way of showing number values is by using a **table**. Tables organize and display facts so that they are more easily understood. The following table shows some past facts and future predictions for the United States. These numbers give us a glimpse of what we can expect in the 21st century.

NUMBERS FOR THE 21ST CENTURY

Year	1990	2010	2020*
U.S. population	261 million	309 million	338 million
Household income	\$42,936	\$46,326	\$55,735
Average yearly salary	\$21,129	\$28,834	\$32,080

*Estimated figures

Source: *Family Circle* magazine; U.S. Census Bureau.

If you read from left to right along the row labeled “U.S. population,” you find that the population in 1990 was 261 million, then the population in 2010 was 309 million, and the estimated population for 2020 is 338 million.

EXAMPLE 7 Reading a Table

Use the table to find each number, and write the number in words.

- (a) The estimated household income in the year 2020

Read from left to right along the row labeled “Household income” until you reach the 2020 column and find \$55,735.

Fifty-five thousand, seven hundred thirty-five dollars

- (b) The average yearly salary in 1990

Read from left to right along the row labeled “Average yearly salary.” In the 1990 column you find \$21,129.

Remember:
Use hyphens
when
necessary.

Twenty-one thousand, one hundred twenty-nine dollars

Work Problem 7 at the Side. ►

Note

Notice in **Example 7** that hyphens are used when writing numbers in words. A hyphen is used when writing the numbers 21 through 99 (twenty-one through ninety-nine), except for numbers ending in zero (20, 30, 40, 90).

- 7 Use the table to find each number, and write the number in digits when given in words, or write the number in words when given in digits.

- GS (a) The population in 2010

The U.S. population in the 2010 column is 309 million and is written in digits as 3____,000,000

- (b) The estimated population in 2020

- (c) Household income in 1990

- (d) The estimated average yearly salary in 2020

Answers

7. (a) 0; 9; 309,000,000
 (b) 338,000,000
 (c) forty-two thousand, nine hundred thirty-six dollars
 (d) thirty-two thousand, eighty dollars

1.1 Exercises

FOR
EXTRA
HELP

MyMathLab®

CONCEPT CHECK Choose the letter of the correct response.

- The digit in the hundreds place in the whole number 3065 is
(a) 5 (b) 3 (c) 0 (d) 6
- The digit in the ten-thousands place in the whole number 134,681 is
(a) 6 (b) 3 (c) 8 (d) 1

Write the digit for the given **place value** in each whole number. See Examples 1 and 2.

- | | | | |
|-----------------|-----------------|------------------|------------------|
| 3. 18,015 | 4. 86,332 | 5. 7,628,592,183 | 6. 1,700,225,016 |
| ▶ ten-thousands | ▶ ten-thousands | ▶ millions | ▶ billions |
| ▶ hundreds | ▶ ones | ▶ thousands | ▶ millions |

CONCEPT CHECK Identify the correct period.

- Write the digits in the thousands period in the whole number 552,687,318.
- Write the digits in the millions period in the whole number 947,321,876,528.

Write the digits for the given **period** (group) in each whole number. See Example 3.

- | | |
|--------------|---------------------|
| 9. 3,561,435 | 10. 100,258,100,006 |
| ▶ millions | ▶ billions |
| ▶ thousands | ▶ millions |
| ▶ ones | ▶ thousands |
| | ▶ ones |
- Do you think the fact that humans have four fingers and a thumb on each hand explains why we use a number system based on ten digits? Explain.
 - The decimal system uses ten digits. Fingers and toes are often referred to as digits. In your opinion, is there a relationship here? Explain.

CONCEPT CHECK Answer true or false for each statement.

- The number 23,115 is written in words as twenty-three thousand and one hundred and fifteen.
- The number 37,886 is written in words as thirty-seven thousand, eight hundred eighty-six.

Write each number in words. See Examples 4 and 5.

- | | |
|---|--|
| 15. 346,009 | 16. 218,033 |
| GS three hundred forty six _____, _____ | GS two hundred eighteen _____, thirty- _____ |
| ▶ | |
| 17. 25,756,665 | 18. 999,993,000 |

Write each number using digits. See Example 6.

- | | |
|---|--|
| 19. sixty-three thousand, one hundred sixty-three | 20. ninety-five thousand, one hundred eleven |
| GS <u>6</u> _____, <u>1</u> _____ | GS <u>9</u> _____, _____ <u>1</u> |
| ▶ | |
| 21. ten million, two hundred twenty-three | 22. one hundred million, two hundred |
| ▶ | |

Write the numbers from each sentence using digits. See Example 6.

23. There are three million, two hundred thousand parachute jumps in the United States each year. (Source: History Channel.)



24. A full-grown caterpillar is 27,000 times its birth size. A 9-pound human baby growing at the same rate would weigh two hundred forty-three thousand pounds by college graduation. (Source: Spirit Magazine.)



25. The number of cans of Pepsi Cola sold each day is fifty million, fifty-one thousand, five hundred seven. (Source: Andy Rooney, 60 Minutes.)

26. In the United States we drink one hundred forty-six billion, three hundred eighty-five million cups of coffee every year. (Source: Spirit Magazine.)

27. There are fifty-four million, seven hundred fifty thousand Hot Wheels sold each year. (Source: Andy Rooney, 60 Minutes.)



28. A middle-income family will typically spend two hundred twenty-one thousand dollars to raise a child to the age of eighteen. (Source: Los Angeles Times.)



29. Rewrite eight hundred trillion, six hundred twenty-one million, twenty thousand, two hundred fifteen by using digits.

30. Rewrite 2,153,896,448, the number of vehicles that have crossed the Golden Gate Bridge, in words.

The table at the right shows various ways people get to work. Use the table to answer Exercises 31–34. See Example 7.

31. Which method of transportation is least used? Write the number in words.

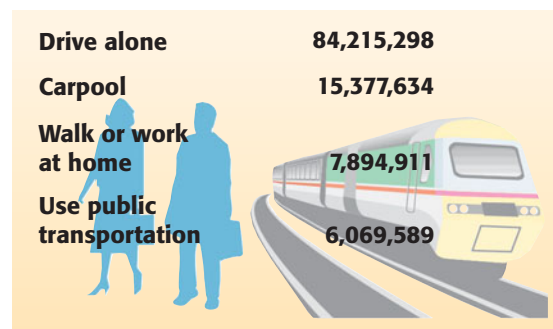
32. Which method of transportation is most used? Write the number in words.

33. Find the number of people who walk to work or work at home, and write it in words.

34. Find the number of people who carpool, and write it in words.

GETTING TO WORK

How workers 16 and over get to work:



Source: U.S. Census Bureau.