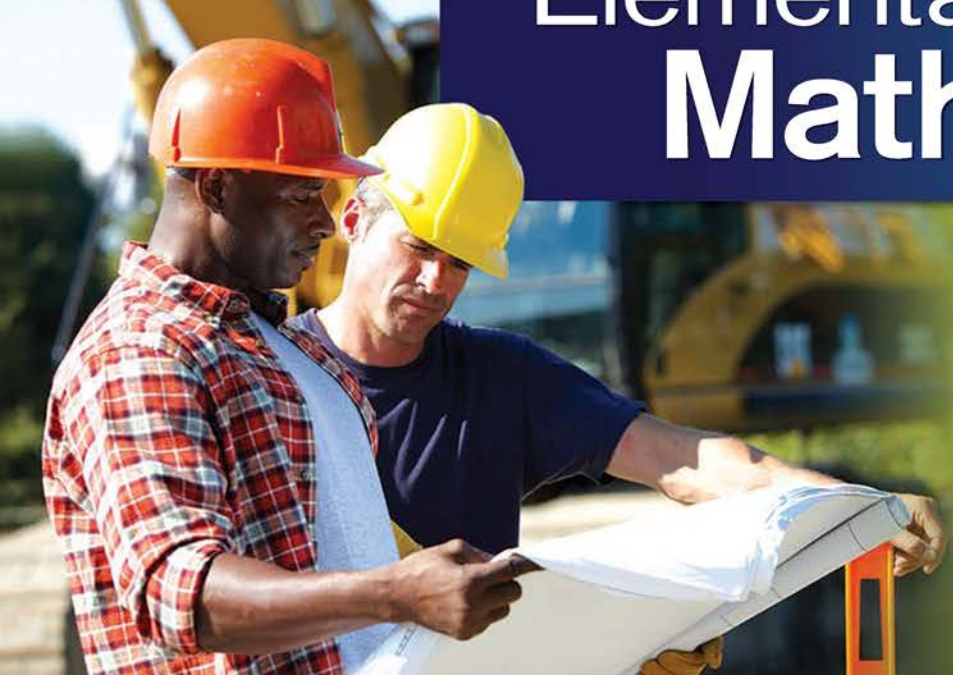
Dale Ewen ▪ C. Robert Nelson

Elementary Technical Mathematics

ELEVENTH EDITION



ELEVENTH EDITION

Elementary Technical Mathematics

Dale Ewen
Parkland Community College

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Elementary Technical Mathematics, Eleventh Edition
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CONTENTS

LIST OF APPLICATIONS

Agriculture and Horticulture

Electronics

Manufacturing

CAD/Drafting

HVAC

Welding

Allied Health

Culinary Arts

Aviation

Nautical miles flown, 73
Operational zone, 9
Plane speed, 48
Ratio of flight time for single engine rating to commercial rating, 271
Runway length, 54
Search time, 48
Speed of plane 72
Straight-line distance back to base, 496
Weight of baggage in compartments, 185

Natural Resources

Allowance for kerf, 50
Amount of N-P-K applied, 278
Amount of water to get an actual one inch of water over one acre, 278
Capacity of silo, 83
CO_2 level in atmosphere in 2010, 188
Collecting sea salt, 252
Converting area of lawn to acres, 54
Cords of fire wood burned, 43
Crossing plants, 50
Cruising timber, 11
Cubic miles of water in Cayuga Lake, 188
Deer and elk population control, 252
Density of deer, 85
Difference in height of two waterfalls, 339
Distance for hiker, 43
Distance of kite from a person, 498
Fertilizer cost, 63
Foods scrap compost, 188
Homeowner lawn, 43
Increase in population, 63
Length of cutboards, 339
Mixing two types of grain, 339
Municipal solid waste (MSW) decrease, 85
Petroleum reserves, 63
Population of deer, 85
Product weight on carton, 40
Salt contained in sea water, 278
Seating guests, 11
Settling tank at wastewater plant, 19
Survival rate of flock of ducks (sord), 85
Tilapia feed, 11
Tons of waste water, 83
Tree harvested for firewood, 50
Truckloads of fish, 54
Turns to retrieve line of fishing reel, 278
Use of a Biltmore stick in measuring height of tree, 54
Volume of cord of wood, 19
Volume of rick of firewood, 83
water in shopping center paved lot, 188
Weight of firewood, 85
Weight of fish, 186
Weight of trash for week, 186
Width of jaw opening of snake, 498

Business & Personal Finance

Amount borrowed from bank, 251
Amount invested to earn interest, 251
Amount needed to generate a 5% return, 252
Annual rate of interest for value of discount, 96
Cost using two types of ground beef, 252
Decision on how to finance auto, 95
Decrease in salary, 84
Decrease in value of house, 84
Distributing money, 251
Effective rate of interest for value of discount, 96
Effective rate of interest on early payment, 96
Effective rate of interest on purchase, 96
Effective rate of return on cash discount, 96
Effective rate of return, 96
Family loan, 95
Hours worked for each girl, 251
House payment on home loan, 95
Interest on savings account, 95
Investing money, 95
Investment in two types of bonds, 339
Investment necessary to cover CC dues, 252
Money owed on loan compounded annually, 95
Money owed on loan compounded daily, 95
Money owed on loan compounded monthly, 95
Money owed, 95
Payment on a new truck, 95
Percent of reduction, 278
Percent of the increase in pay, 278
Price of purchased goods, 83
Purchasing auto, 96
Rate of interest on loan, 83
Salary increase, 83
Sale of two carpets, 339
Sale price of discounted items, 84
Savings amount after 5 years, 95
Savings amount after 8 years, 95
Type of apartment rented, 339
Types of snorkel sold, 339

PREFACE

Elementary Technical Mathematics, Eleventh Edition, is intended for technical, trade, allied health, or Tech Prep programs. This book was written for students who plan to learn a technical skill, but who have minimal background in mathematics or need considerable review. To become proficient in most technical programs, students must learn basic mathematical skills. To that end, Chapters 1 through 4 cover basic arithmetic operations, fractions, decimals, percent, the metric system, and numbers as measurements. Chapters 5 through 11 present essential algebra needed in technical and trade programs. The essentials of geometry—relationships and formulas for the most common two- and three-dimensional figures—are given in detail in Chapter 12. Chapters 13 and 14 present a short but intensive study of trigonometry that includes right-triangle trigonometry as well as oblique triangles and graphing. The concepts of statistics that are most important to technical fields are discussed in Chapter 15. An introduction to binary and hexadecimal numbers is found in Chapter 16 for those who requested this material.

We have written this text to match the reading level of most technical students. Visual images engage these readers and stimulate the problem-solving process. We emphasize that these skills are essential for success in technical courses.

The following important text features have been retained from previous editions:

- We use a large number of applications from a wide variety of technical areas, including auto/diesel service, industrial and construction trades, electronics, agriculture and horticulture, allied health, CAD/drafting, HVAC, manufacturing, welding, aviation, natural resources, culinary arts, and business and personal finance.
- Chapter 1 reviews basic concepts in such a way that individuals, groups of students, or the entire class can easily study only those sections they need to review.
- A comprehensive introduction to basic algebra is presented for those students who need it as a prerequisite to more advanced algebra courses. However, the book has been written to allow the omission of selected sections or chapters without loss of continuity, to meet the needs of specific students.
- More than 6,490 exercises assist student learning of skills and concepts.
- More than 750 detailed, well-illustrated examples, many with step-by-step comments, support student understanding of skills and concepts.

- A chapter summary with a glossary of basic terms, a chapter review, and a chapter test appear at the end of each chapter as aids for students in preparing for quizzes and exams. Each chapter test is designed to be completed by an average student in no more than approximately 50 minutes.

CHAPTER 3 Review

Give the metric prefix for each value:

1. 0.001 **2.** 1000

Give the SI abbreviation for each prefix:

3. mega **4.** micro

Write the SI abbreviation for each quantity:

5. 42 millilitres **6.** 8.3 nanoseconds

Write the SI unit for each abbreviation:

7. 18 km **8.** 350 mA **9.** 50 μs

Which is larger?

10. 1 L or 1 mL **11.** 1 kW or 1 MW
12. 1 km^2 or 1 ha **13.** 1 m^3 or 1 L

Fill in each blank:

14. 650 m = _____ km **15.** 750 mL = _____ L
16. 6.1 kg = _____ g **17.** 4.2 A = _____ μA
18. 18 MW = _____ W **19.** 25 μs = _____ ns
20. 250 cm^2 = _____ mm^2
21. 25,000 m^2 = _____ ha
22. 0.6 m^3 = _____ cm^3 **23.** 250 cm^3 = _____ mL
24. 72°F = _____ °C **25.** −25°C = _____ °F
26. Water freezes at _____ °C.
27. Water boils at _____ °C.
28. 180 lb = _____ kg **29.** 126 ft = _____ m
30. 360 cm = _____ in. **31.** 275 in^2 = _____ cm^2
32. 18 yd^2 = _____ ft^2 **33.** 5 m^3 = _____ ft^3
34. 15.0 acres = _____ ha

CHAPTER 3 Test

1. Give the metric prefix for 1000.
2. Give the metric prefix for 0.01.
3. Which is larger, 200 mg or 1 g?
4. Write the SI unit for the abbreviation 240 μL.
5. Write the abbreviation for 30 hectograms.
6. Which is longer, 1 km or 25 cm?

Fill in each blank:

7. 4.25 km = _____ m **8.** 7.28 mm = _____ μm
9. 72 m = _____ mm **10.** 256 hm = _____ cm
11. 12 dg = _____ mg **12.** 16.2 g = _____ mg
13. 7.236 metric tons = _____ kg
14. 310 g = _____ cg **15.** 72 hg = _____ mg
16. 1.52 dL = _____ L **17.** 175 L = _____ m^3

21. What is the basic SI unit of time?
22. Write the abbreviation for 25 kilowatts.

Fill in each blank:

23. 280 W = _____ kW **24.** 13.9 mA = _____ A
25. 720 ps = _____ ns
26. What is the basic SI unit for temperature?
27. What is the freezing temperature of water on the Celsius scale?

Fill in each blank, rounding each result to three significant digits when necessary:

28. 25°C = _____ °F **29.** 28°F = _____ °C
30. 98.6°F = _____ °C **31.** 100 km = _____ mi
32. 200 cm = _____ in. **33.** 1.8 ft^3 = _____ in^3

- The text design and second color help to make the text more easily understood, highlight important concepts, and enhance the art presentation.
- A reference of useful, frequently referenced information—such as metric system prefixes, U.S. weights and measures, metric and U.S. conversion, and formulas from geometry—is printed on the inside covers.

- The use of a scientific calculator has been integrated in an easy-to-use format with calculator flowcharts and displays throughout the text to reflect its nearly universal use in technical classes and on the job. The instructor should inform the students when *not* to use a calculator.

Using a Calculator to Multiply and Divide Fractions

Example 16 Multiply: $2\frac{5}{6} \times 4\frac{1}{2}$.

2 [A b/c] 5 [A b/c] 6 [×] 4 [A b/c] 1 [A b/c] 2 [=]

12 3/4

Thus, $2\frac{5}{6} \times 4\frac{1}{2} = 12\frac{3}{4}$.

Example 17 Divide: $5\frac{5}{7} \div 8\frac{1}{3}$.

5 [A b/c] 5 [A b/c] 7 [÷] 8 [A b/c] 1 [A b/c] 3 [=]

24/35

Thus, $5\frac{5}{7} \div 8\frac{1}{3} = \frac{24}{35}$.

- Cumulative reviews are provided at the end of every even-numbered chapter to help students review for comprehensive exams.

Cumulative Review CHAPTERS 1–6

1. Find the prime factorization of 696.
2. Change 0.081 to a percent.
3. Write 3.015×10^{-4} in decimal form.
4. Write 28,500 in scientific notation.
5. 5 ha = _____ m^2
6. 101°F = _____ °C
7. 6250 in^2 = _____ ft^2
8. Give the number of significant digits (accuracy) of each measurement:
   a. 110 cm **b.** 6000 mi **c.** 24.005 s
9. Read the measurement shown on the vernier caliper in Illustration 1 **a.** in metric units and **b.** in U.S. units.

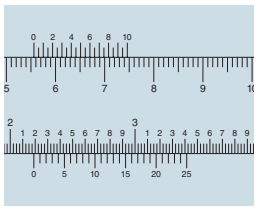


ILLUSTRATION 1

11. Use the rules for addition of measurements to find the sum of 25,000 W; 17,900 W; 13,962 W; 8752 W; and 428,000 W.

Simplify:

12. $(2x - 5y) + (3y - 4x) - 2(3x - 5y)$
13. $(4y^3 + 3y - 5) - (2y^3 - 4y^2 - 2y + 6)$
14. $(3y^3)^3$
15. $-2x(x^2 - 3x + 4)$
16. $(6y^3 - 5y^2 - y + 2)(2y - 1)$
17. $(4x - 3y)(5x + 2y)$
18. $\frac{215\,x^2y^3}{45x^3y^5}$
19. $(16x^2y^3)(-5x^4y^5)$
20. $\frac{x^3 + 2x^2 - 11x - 20}{x + 5}$
21. $3x^2 - 4xy + 5y^2 - (-3x^2) + (-7xy) + 10y^2$

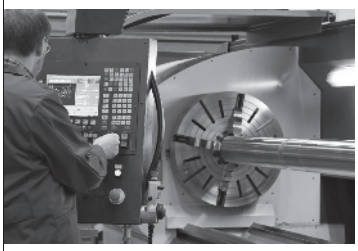
Solve:

22. $4x - 2 = 12$
23. $\frac{x}{4} - 5 = 9$
24. $4x - 3 = 7x + 15$
25. $\frac{5x}{8} = \frac{3}{2}$

- Studies show that current students will experience several career changes during their working lives. The chapter-opening pages illustrate various career paths for students to consider as their careers, technology, and the workplace evolve. The basic information provided in the chapter openers about a technical career is explored in further detail on the Cengage book companion website at www.cengage.com/mathematics/ewen.

Mathematics at Work

Modern manufacturing companies require a wide variety of technology specialists for their operations. Manufacturing technology specialists set up, operate, and maintain industrial and manufacturing equipment as well as computer-numeric-controlled (CNC) and other automated equipment that make a large variety of products according to controlled specifications. Some focus on systematic equipment maintenance and repair. Others specialize in materials transportation and distribution; that is, they are responsible for moving and distributing the products to the sales locations and/or consumers after they are manufactured. Other key team members include designers, engineers, draftspersons, and quality control specialists. Training and education for these careers are available at many community colleges and trade schools. Some require a bachelor's degree. For more information, go to the website **www.cengage.com/mathematics/ewen**.



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Manufacturing Technology Specialist
Technician working with numerically controlled milling machine

- Special application exercises in the areas of auto/diesel service, industrial and construction trades, electronics, agriculture and horticulture, allied health, CAD/drafting, HVAC, manufacturing, welding, aviation, natural resources, culinary arts, and business and personal finance have been submitted by faculty in these technical areas and are marked with related icons.

Sample Ratio and Proportion Applications

49. A plane flies for 3 h and uses 25 gal of 100*LL* aviation fuel. How much will be used if the plane flies for only 1.2 h?

50. Metal duct that is 6 in. in diameter costs $7.50 for 5 ft. If 16.5 ft are needed for an order, what is the cost?

51. Suppose 20 gal of water and 3 lb of pesticide are applied per acre. How much pesticide should you put in a 350-gal spray tank? Assume that the pesticide dissolves in the water and has no volume.

52. A farmer uses 150 lb of a chemical on a 40-acre field. How many pounds will he need for a 220-acre field? Assume the same rate of application.

53. Suppose a yield of 100 bu of corn per acre removes 90 lb of nitrogen, phosphorus, and potash (or potassium) (N, P, and K). How many pounds of N, P, and K would be removed by a yield of 120 bu per acre?

54. A farmer has a total yield of 42,000 bu of corn from a 350-acre farm. What total yield should he expect from a similar 560-acre farm?

Sample Applications of Systems of Linear Equations

14. In a parallel circuit, the total current is 1.25 A through the two branches. One branch has a resistance of 50 Ω, and the other has a resistance of 200 Ω. What current is flowing through each branch? *Note:* In a parallel circuit, the products of the current in amperes and the resistance in ohms are equal in all branches.

18. In testing a hybrid engine, various solutions of gasoline and methanol are being tried. How much of a 95% gasoline solution and how much of an 80% gasoline solution would be needed to make 240 gal of a 90% gasoline solution?

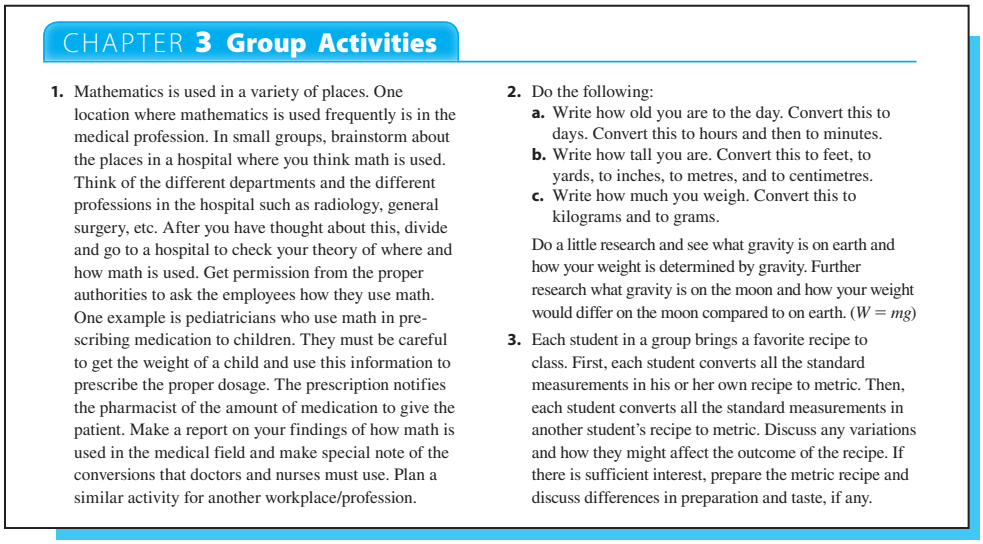
22. A lawn seed mix containing 8% bluegrass is mixed with one that contains 15% bluegrass. How many pounds of each are needed to make 55 lb of a mixture that is 12% bluegrass?

25. A nurse gives 1000 mL of an intravenous (IV) solution over a period of 8 h. It is given first at a rate of 140 mL/h, then at a reduced rate of 100 mL/h. How long should it be given at each rate?

32. One concrete mix contains four times as much gravel as cement. The total volume is 15 yd^3. How much of each ingredient is used?

43. If the length of a building is $2\frac{1}{2}$ times the width and each dimension is increased by 5 ft, then the perimeter is 230 ft. Find the dimensions of the original building.

- Group activity projects are included at the end of each chapter.



CHAPTER 3 Group Activities

1. Mathematics is used in a variety of places. One location where mathematics is used frequently is in the medical profession. In small groups, brainstorm about the places in a hospital where you think math is used. Think of the different departments and the different professions in the hospital such as radiology, general surgery, etc. After you have thought about this, divide and go to a hospital to check your theory of where and how math is used. Get permission from the proper authorities to ask the employees how they use math. One example is pediatricians who use math in prescribing medication to children. They must be careful to get the weight of a child and use this information to prescribe the proper dosage. The prescription notifies the pharmacist of the amount of medication to give the patient. Make a report on your findings of how math is used in the medical field and make special note of the conversions that doctors and nurses must use. Plan a similar activity for another workplace/profession.
2. Do the following:
   a. Write how old you are to the day. Convert this to days. Convert this to hours and then to minutes.
   b. Write how tall you are. Convert this to feet, to yards, to inches, to metres, and to centimetres.
   c. Write how much you weigh. Convert this to kilograms and to grams.

   Do a little research and see what gravity is on earth and how your weight is determined by gravity. Further research what gravity is on the moon and how your weight would differ on the moon compared to on earth. ($W = mg$)
3. Each student in a group brings a favorite recipe to class. First, each student converts all the standard measurements in his or her own recipe to metric. Then, each student converts all the standard measurements in another student's recipe to metric. Discuss any variations and how they might affect the outcome of the recipe. If there is sufficient interest, prepare the metric recipe and discuss differences in preparation and taste, if any.

- An instructor's edition that includes all the answers to exercises is available.

Significant changes in the eleventh edition include the following:

- new categories of culinary arts and business and personal finance
- new and revised applications with the help and expertise of professionals in the areas of agriculture with horticulture added, auto/diesel service, and allied health
- new Appendix C Simple Inequalities
- more than 150 additional new exercises.

Useful ancillaries available to qualified adopters of this text include the following:

- **Instructor's Edition** The Instructor's Edition features an appendix containing the answers to all problems in the book. (978-1-285-19921-4)
- **Instructor Companion Website** Everything you need for your course in one place! This collection of book-specific lecture and class tools is available online via www.cengage.com/login. Formerly delivered on PowerLecture Discs, access and download PowerPoint presentations, images, Solution Builder, and much more.
- **Solution Builder** Easily build solution sets for homework or exams using Solution Builder's online solutions manual. www.cengage.com/solutionbuilder
- **Enhanced WebAssign Homework with LOE Access**
  (Printed Access Card ISBN 9781285858029, Online Access Code ISBN: 9781285858036) Exclusively from Cengage Learning, Enhanced WebAssign combines the exceptional Mathematics content that you know and love with the immediate feedback, rich tutorial content, and interactive, fully customizable eBooks (You-Book), helping students to develop a deeper conceptual understanding of their subject matter. Online assignments canbe built by selecting from thousands of text-specific problems or can be supplemented with problems from any Cengage Learning textbook.

Student Resources:

- **Student Solutions Manual**
  Author: James Lapp
  (ISBN: 978-1-28519927-6)
  The Student Solutions Manual provides worked-out solutions to all of the odd-numbered exercises in the text.
- **Enhanced WebAssign Homework LOE Printed Access Card for One Term Math and Science**
  (Printed Access Card ISBN 9781285858029, Online Access Code ISBN: 9781285858036)
  Enhanced WebAssign (assigned by the instructor) provides you with instant feedback on homework assignments. This online homework system is easy to use and includes helpful links to textbook sections, video examples, and problem-specific tutorials.

We are grateful for the courtesy of the L. S. Starrett Company in allowing us to use photographs of their instruments in Chapter 4. A special effort was made to review and update the applications with the expertise of professionals in the following technical areas: Agriculture with Horticulture applications reviewed and added by Nina H. Mitchell, Hopkinsville Community College; Auto/Diesel Service by William J. deKryger, Central Michigan University; and Allied Health by Catherine W. Johnson, Alamance Community College. Nelson Collins of Joliet Junior College supplied the new Culinary Arts applications. We greatly appreciate their special assistance.

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Dale Ewen
C. Robert Nelson

1
Basic Concepts

Mathematics at Work

Automotive service technicians inspect, maintain, and repair automobiles, light trucks, and vans. In the past, these workers were called mechanics. The increasing sophistication of automotive technology now requires workers to be able to use computerized shop equipment and work with electronic components in addition to the traditional hand tools. When a mechanical or electronic problem occurs, the technician uses a diagnostic approach to repair the problem based on information from the owner and the information obtained from the service equipment and computerized databases and service manuals.

The National Automotive Technicians Education Foundation (NATEF), an affiliate of the National Institute for Automotive Service Excellence (ASE), certifies automotive service technician, collision repair and refinish technician, engine specialist, and medium/heavy truck technician training programs offered by community colleges, postsecondary trade schools, technical institutes, and high schools. Although voluntary, NATEF certification signifies that the program meets uniform standards for instructional facilities, equipment, staff credentials, and curriculum. Various automobile manufacturers and their participating dealers also sponsor two-year associate degree programs at postsecondary schools across the United States. For more information, go to the website **www.cengage.com/mathematics/ewen**

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Automotive Service Technician
Automotive service technician working on an automobile

OBJECTIVES

- Add, subtract, multiply, and divide whole numbers.
- Add, subtract, multiply, and divide whole numbers with a scientific calculator.
- Apply the rules for order of operations.
- Find the area and volume of geometric figures.
- Evaluate formulas.
- Find the prime factorization of whole numbers.
- Add, subtract, multiply, and divide fractions.
- Add, subtract, multiply, and divide fractions with a scientific calculator.
- Use conversion factors to change from one unit to another within the U.S. system of weights and measures.
- Add, subtract, multiply, and divide decimal fractions.
- Add, subtract, multiply, and divide decimal fractions with a scientific calculator.
- Round numbers to a particular place value.
- Apply the percent concept; change a percent to a decimal, a decimal to a percent, a fraction to a percent, and a percent to a fraction.
- Solve application problems involving the addition, subtraction, multiplication, and division of whole numbers, fractions, and decimal fractions and percents.
- Find powers and roots of numbers using a scientific calculator.
- Solve personal finance problems involving percent.

UNIT 1A Review of Operations with Whole Numbers

1.1 Review of Basic Operations

The **positive integers** are the numbers 1, 2, 3, 4, 5, 6, and so on. They can also be written as +1, +2, +3, and so on, but usually the *positive* (+) sign is omitted. The **whole numbers** are the numbers 0, 1, 2, 3, 4, 5, 6, and so on. That is, the whole numbers consist of the positive integers and zero.

The value of any digit in a number is determined by its place in the particular number. Each place represents a certain power of 10. By powers of 10, we mean the following:

$10^0 = 1$
$10^1 = 10$
$10^2 = 10 \times 10 = 100$ (the second power of 10)
$10^3 = 10 \times 10 \times 10 = 1000$ (the third power of 10)
$10^4 = 10 \times 10 \times 10 \times 10 = 10{,}000$ (the fourth power of 10) and so on.

NOTE: A small superscript number (such as the 2 in 10^2) is called an *exponent*.

The number 2354 means 2 thousands plus 3 hundreds plus 5 tens plus 4 ones.

In the number 236,895,174, each digit has been multiplied by some power of 10, as shown below.

	(ten millions)		(hundred thousands)		(thousands)		(tens)	
	10^7		10^5		10^3		10^1	
2	3	6,	8	9	5,	1	7	4
10^8		10^6		10^4		10^2		10^0
(hundred millions)		(millions)		(ten thousands)		(hundreds)		(units)

The "+" (plus) symbol is the sign for addition, as in the expression $5 + 7$. The result of adding the numbers (in this case, 12) is called the **sum**. Integers are added in columns with the digits representing like powers of 10 in the same vertical line. (*Vertical* means up and down.)

Example 1 Add: $238 + 15 + 9 + 3564$.

$$\begin{array}{r} 238 \\ 15 \\ 9 \\ \underline{3564} \\ 3826 \end{array}$$

Subtraction is the inverse operation of addition. Therefore, subtraction can be thought of in terms of addition. The "−" (minus) sign is the symbol for subtraction. The quantity $5 - 3$ can be thought of as "what number added to 3 gives 5?" The result of subtraction is called the **difference**.

To check a subtraction, add the difference to the second number. If the sum is equal to the first number, the subtraction has been done correctly.

Example 2 Subtract: $2843 - 1928$.

Subtract:

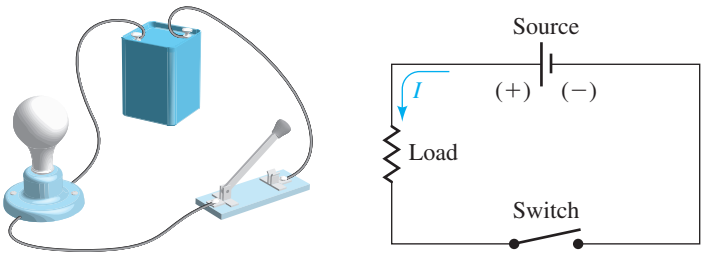
$$\begin{array}{rl} 2843 & \text{first number} \\ \underline{-1928} & \text{second number} \\ 915 & \text{difference} \end{array}$$

Check:

$$\begin{array}{rl} 1928 & \text{second number} \\ \underline{+915} & \text{difference} \\ 2843 & \text{This sum equals the first number, so} \\ & \text{915 is the correct difference.} \end{array}$$

Next, let's study some applications. To communicate about problems in electricity, technicians have developed a "language" of their own. It is a picture language that uses symbols and diagrams. The symbols used most often are listed in Table 2 of Appendix A. The circuit diagram is the most common and useful way to show a circuit. Note how each

component (part) of the picture (Figure 1.1a) is represented by its symbol in the circuit diagram (Figure 1.1b) in the same relative position.



(a) Picture diagram **(b)** Circuit diagram

figure 1.1
Components in a circuit

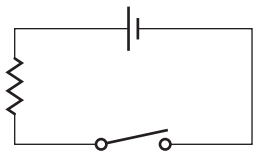
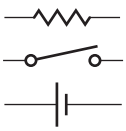


figure 1.2

The light bulb may be represented as a resistance. Then the circuit diagram in Figure 1.1b would appear as in Figure 1.2, where



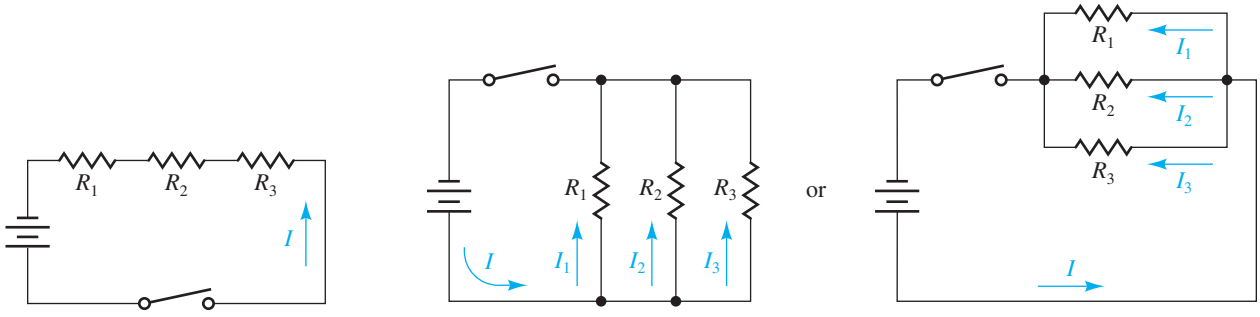
represents the resistor

represents the switch

represents the source. The short line represents the negative terminal of a battery, and the long line represents the positive terminal. The current flows from positive to negative.

NOTE: In this book we assume that the charge carriers are positive, and we draw our current arrows in the direction that a positive charge would follow. This is a common practice used by most technicians and engineers. However, you may find the negative-charge–current-flow convention is also used in many books. Regardless of the convention used, the formulas and results are the same.

There are two basic types of electrical circuits: series and parallel. An electrical circuit with only one path for the current, I, to flow is called a *series* circuit (Figure 1.3a). An electrical circuit with more than one path for the current to flow is called a *parallel* circuit (Figure 1.3b). A circuit breaker or fuse in a house is wired in series with its outlets. The outlets themselves are wired in parallel.



(a) Series circuit **(b)** Parallel circuits

figure 1.3
Two basic types of electrical circuits

Example 3 In a series circuit, the total resistance equals the sum of all the resistances in the circuit. Find the total resistance in the series circuit in Figure 1.4. Resistance is measured in ohms, Ω.

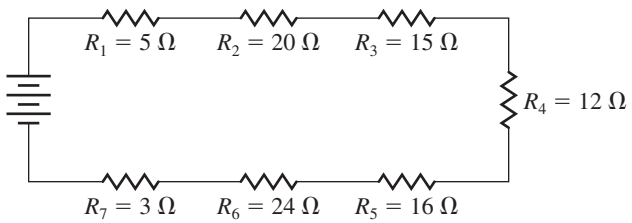


figure **1.4**

The total resistance is

$$\begin{array}{r} 5\ \Omega \\ 20\ \Omega \\ 15\ \Omega \\ 12\ \Omega \\ 16\ \Omega \\ 24\ \Omega \\ 3\ \Omega \\ \hline 95\ \Omega \end{array}$$

Example 4 Studs are upright wooden or metal pieces in the walls of a building, to which siding, insulation panels, drywall, or decorative paneling is attached. (A wall portion with seven studs is shown in Figure 1.5.) Studs are normally placed 16 in. on center and are placed double at all internal and external corners of a building. The number of studs needed in a wall can be estimated by finding the number of linear feet (ft) of the wall. How many studs are needed for the exterior walls of the building in Figure 1.6?

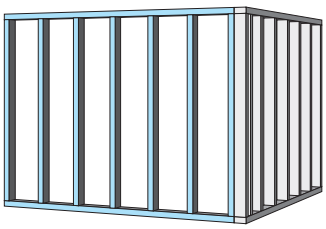


figure **1.5**

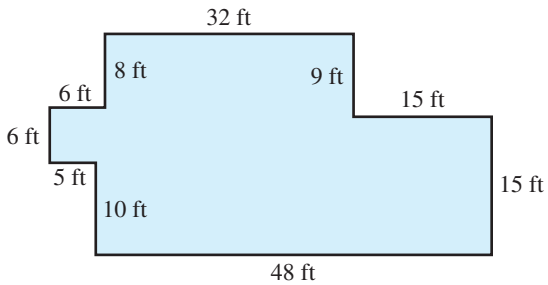


figure **1.6**

The outside perimeter of the building is the sum of the lengths of the sides of the building:

$$\begin{array}{r} 48\ \text{ft} \\ 15\ \text{ft} \\ 15\ \text{ft} \\ 9\ \text{ft} \\ 32\ \text{ft} \\ 8\ \text{ft} \\ 6\ \text{ft} \\ 6\ \text{ft} \\ 5\ \text{ft} \\ 10\ \text{ft} \\ \hline 154\ \text{ft} \end{array}$$

Therefore, approximately 154 studs are needed in the outside wall.

Repeated addition of the same number can be shortened by multiplication. The "×" (times) and the "·" (raised dot) are used to indicate multiplication. When adding the lengths of five pipes, each 7 ft long, we have 7 ft + 7 ft + 7 ft + 7 ft + 7 ft = 35 ft of pipe. In multiplication, this would be 5×7 ft = 35 ft. The 5 and 7 are called *factors*. The result of multiplying numbers (in this case, 35) is called the **product**. Computing areas, volumes, forces, and distances requires skills in multiplication.

Example 5 Multiply: 358×18.

$$\begin{array}{r} 358 \\ \times\ 18 \\ \hline 2864 \\ 358 \\ \hline 6444 \end{array}$$

Division is the inverse operation of multiplication. The following symbols are used to show division: $15 \div 5$, $5\overline{)15}$, 15/5, and $\frac{15}{5}$. The quantity $15 \div 5$ can also be thought of as "what number times 5 gives 15?" The answer to this question is 3, which is 15 divided by 5. The result of dividing numbers (in this case, 3) is called the **quotient**. The number to be divided, 15, is called the *dividend*. The number you divide by, 5, is called the *divisor*.

Example 6 Divide: $84 \div 6$.

$$\begin{array}{rl} 14 & \leftarrow \text{quotient} \\ 6\overline{)84} & \leftarrow \text{dividend} \\ \text{divisor} \uparrow\ 6 & \\ \hline 24 & \\ 24 & \\ \hline 0 & \leftarrow \text{remainder} \end{array}$$

Example 7 Divide: $115 \div 7$.

$$\begin{array}{rl} 16 & \leftarrow \text{quotient} \\ 7\overline{)115} & \leftarrow \text{dividend} \\ \text{divisor} \uparrow\ 7 & \\ \hline 45 & \\ 42 & \\ \hline 3 & \leftarrow \text{remainder} \end{array}$$

The *remainder* (when not 0) is usually written in one of two ways: with an "r" preceding it or with the remainder written over the divisor as a fraction, as shown in Example 8. (Fractions are discussed in Unit 1B.)

Example 8 Divide: $534 \div 24$.

$$\begin{array}{rl} 22 \text{ r } 6 \quad \text{or} \quad 22\frac{6}{24} & \text{This quotient may be written 22 r 6 or } 22\tfrac{6}{24}. \\ 24\overline{)534} & \\ 48 & \\ \hline 54 & \\ 48 & \\ \hline 6 & \end{array}$$

Example 9 Ohm's law states that in a simple electrical circuit, the current I (measured in amps, A) equals the voltage E (measured in volts, V) divided by the resistance R (measured in ohms, Ω). Find the current in the circuit of Figure 1.7.

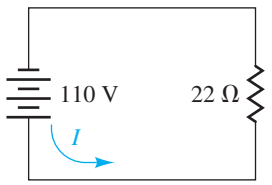


figure 1.7

The current $I = \frac{E}{R} = \frac{110}{22} = 5$ A.

Example 10 A 16-row corn planter costs \$118,500. It has a 10-year life and a salvage value of \$10,000. What is the annual depreciation? (Use the straight-line depreciation method.)

The straight-line depreciation method means that the difference between the cost and the salvage value is divided evenly over the life of the item. In this case, the difference between the cost and the salvage value is

\$118,500	cost
−\$10,000	salvage
\$108,500	difference

This difference divided by 10, the life of the item, is \$10,850. This is the annual depreciation.

Example 11 Restaurants purchase potatoes to use for baked potatoes. The potatoes are often called bakers and can come in cases containing 90, 120, and so on, potatoes. If 3 cases of bakers with 90 potatoes per case are ordered plus 2 cases of bakers with 120 potatoes per case, how many total individual bakers are ordered?

3 cases × 90 potatoes/case	= 270 potatoes
2 cases × 120 potatoes/case	= 240 potatoes
Total	510 potatoes

Using a Scientific Calculator

Use of a scientific calculator is integrated throughout this text. To demonstrate how to use a common scientific calculator, we show which keys to use and the order in which they are pushed. We have chosen to illustrate the most common types of algebraic logic calculators. Yours may differ. If so, consult your manual.

NOTE: We will always assume that your calculator is cleared before you begin any calculation.

Use a calculator to add, subtract, multiply, and divide as shown in the following examples.

Example 12 Add: 9463
125
9
80

9463 [+] 125 [+] 9 [+] 80 [=]

9677

The sum is 9677.

Example 13 Subtract: 3500
1628

3500 [−] 1628 [=]

1872

The result is 1872.

Example 14 Multiply: 125 × 68.

125 [×] 68 [=]

8500

The product is 8500.

Example 15 Divide: 8700 ÷ 15.

8700 [÷] 15 [=]

580

The quotient is 580.

NOTE: Your instructor will indicate which exercises should be completed using a calculator.

EXERCISES 1.1

Add:

1. 832 + 9 + 56 + 2358

2. 324 + 973 + 66 + 9430

3.
384
291
147
632

4.
78
107
45
217
9
123

5. 197 + 1072 + 10,877 + 15,532 + 768,098

6. 160,000 + 19,000 + 4,160,000 + 506,000

Subtract and check:

7.
7561
2397

8.
4000
702

9. 98,405 − 72,397

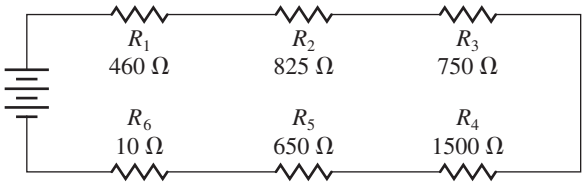
10. 417,286 − 287,156

11.
4000
1180

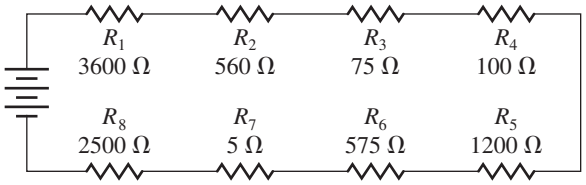
12.
60,000
9,876

Find the total resistance in each series circuit:

13.



14.



15. Approximately how many studs are needed for the exterior walls in the building shown in Illustration 1? (See Example 4.)

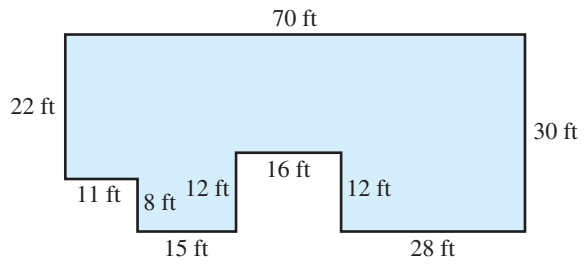


ILLUSTRATION 1

16. A pipe 24 ft long is cut into four pieces: the first 4 ft long, the second 5 ft long, and the third 7 ft long. What is the length of the remaining piece? (Assume no waste from cutting.)

17. A welder needs to weld together pipes of lengths 10 ft, 15 ft, and 14 ft. What is the total length of the new pipe?

18. A welder ordered a 125-ft^3 cylinder of argon gas, a shielding gas for TIG welding. After a few days, only 78 ft^3 remained. How much argon was used?

19. Find the total input and output (I-O) in cubic centimetres (cm^3)* for a patient. By how much does the input of fluids exceed the output?

Input: 300 cm^3, 550 cm^3, 150 cm^3, 75 cm^3, 150 cm^3, 450 cm^3, 250 cm^3
Output: 325 cm^3, 150 cm^3, 525 cm^3, 250 cm^3, 175 cm^3

20. A student pilot must complete 40 h of total flight time as required for her private pilot certificate. She had already entered 31 h of flight time in her logbook. Monday she logged another 2 h, then Wednesday she logged another 3 h, and Friday she logged yet another 2 h. If she can fly 3 h more on Saturday, will she have enough total time as required for the certificate?

Multiply:

21. $\begin{array}{r} 567 \\ \times\ 48 \end{array}$

22. $\begin{array}{r} 8374 \\ \times\ 203 \end{array}$

23. $71{,}263 \times 255$

24. 1520×320

25. 6800×5200

26. $30{,}010 \times 4080$

Divide (use the remainder form with r):

27. $4\overline{)7236}$

28. $5\overline{)308{,}736}$

29. $4668 \div 12$

30. $15{,}648 \div 36$

31. $67{,}560 \div 80$

32. $\dfrac{188{,}000}{120}$

33. An automobile uses gasoline at the rate of 31 miles per gallon (mi/gal or mpg) and has a 16-gallon tank. How far can it travel on one tank of gas?

34. An automobile uses gasoline at a rate of 12 kilometres per litre (km/L) and has a 65-litre tank. How far can it travel on one tank of gas?

35. A four-cylinder engine has a total displacement of 1300 cm^3. Find the displacement of each piston.

36. An automobile travels 1274 mi and uses 49 gal of gasoline. Find its mileage in miles per gallon.

37. An automobile travels 2340 km and uses 180 L of gasoline. Find its fuel consumption in kilometres per litre.

38. To replace some damaged ductwork, 20 linear feet of 8-in. × 16-in. duct is needed. The cost is $13 per 4 linear feet. What is the cost of replacement?

39. The bill for a new transmission was received. The total cost for labor was $516. If the car was serviced for 6 h, find the cost of labor per hour.

40. The cost for a set of four tires is $508. What is the cost of each tire?

41. A small Cessna aircraft has enough fuel to fly for 4 h. If the aircraft cruises at a ground speed of 125 miles per hour (mi/h or mph), how many miles can the aircraft fly in the 4 h?

42. A small plane takes off and climbs at a rate of 500 ft/min. If the plane levels off after 15 min, how high is the plane?

43. Inventory shows the following lengths of 3-inch steel pipe:

5 pieces 18 ft long
42 pieces 15 ft long
158 pieces 12 ft long
105 pieces 10 ft long
79 pieces 8 ft long
87 pieces 6 ft long

What is the total linear feet of pipe in inventory?

44. An order of lumber contains 36 boards 12 ft long, 28 boards 10 ft long, 36 boards 8 ft long, and 12 boards 16 ft long. How many boards are contained in the order? How many linear feet of lumber are contained in the order?

*Although cm^3 is the "official" metric abbreviation for cubic centimetres and will be used throughout this book, some readers may be more familiar with the abbreviation "cc," which is still used in some medical and allied health areas.