

**Student's Survival and Solutions Manual for**

# **MATHEMATICS**

## **Its Power and Utility**

**TENTH EDITION**

Karl J. Smith

**Cengage Learning**

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20 Davis Drive  
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## PREFACE

This manual was designed to help you bridge the gap between the textbook and a working knowledge of mathematics. It has been said that “Mathematics is not a Spectator Sport” and this means you cannot learn mathematics by simply attending class, but instead you must build a body of information that will enable you to do problem solving in the real world. I decided to entitle this supplement, *Student's Survival and Solutions Manual* because I want it to be more than a Student Solutions Manual. Thirty years of teaching experience have given me the ability to anticipate the types of errors and difficulties you may have while taking this course. Here I will show you some of the steps that are left out of the text, and most all of these steps in the included problems.

There are several things you must do if you wish to be successful with mathematics:

- Attend every class.
- Read the book.  
Regardless of how clear and lucid your professor's lecture on a particular topic may be, do not attempt to do the problems without first reading the text and studying the examples. It will serve to reinforce and clarify the concepts and procedures.
- **Problems, Problems, Problems, problems...**  
You must work problems every day; work the assigned problems; work **ESSENTIAL IDEA** problems. Look over the entire problem set (even those problems which are not assigned).
- Ask questions when you are stuck (and you will get stuck — that is part of the process).
- Keep asking questions until receiving answers that are understandable to you.
- Today's calculators are good at obtaining answers, and if all that is desired is an answer, then you have relegated yourself to the level of a machine. Do not work problems to obtain answers. It is the *concepts* that are important. Even though a solutions manual is basically a “how to” document, always ask *why* a particular approach was used, and understand the concept the problem is illustrating.

For the most part, this manual includes complete solutions to the odd-numbered problems. Notice that the complete solutions for the self-tests are given at the end of the review sections in the textbook.

# CHAPTER 1

## Arithmetic, Calculators, and Problem Solving

**SURVIVAL HINT:** *If your instructor does not begin with Chapter 1, you might wish to take some time looking over this chapter anyway. Please read page 1 of the textbook because it tells you what this part of the book is all about. As you look through this first chapter you will notice that we cover fractions, decimals, and numeration systems. We also introduce you to using a calculator. If you have a manual for your calculator, do not attempt to read it; part of what this book will do is to teach you how to use a calculator to do the type of problems you are considering at the time. You may remember some things about fractions, decimals, and numeration systems, or you may have forgotten more than you remember. That is ok; **relax** --- it is our job.... the book and your instructor have been assigned the task of making sure you understand the topic.*

*Find out from your instructor what is expected of you. You will probably need a copy of this textbook, pencils and paper, a straight-edge, and a calculator. (By the way, the cover for your calculator makes a good straight-edge.) Put your name and phone number inside the cover of your calculator, so if you lose it, it is, at least, possible that it be returned.*

*As you begin on your mathematics journey, Bon Voyage!*

### 1.1 Math Anxiety, page 4

**SURVIVAL HINT:** *There are, of course, no right or wrong answers to Problems 1-25. In the book from which these myths were obtained (*Mind Over Math*) there is a whole chapter justifying that these are myths, and the authors cite specific studies to support their conclusions. As you do these problems, remember that a **myth** is a popular belief or tradition that has grown up around something which is an unfounded or false notion. Don't be afraid to express your own ideas when answering these questions.*

### Problem Set 1.1, page 9

1. Write a couple of paragraphs about your math history. You are writing this for yourself, not for your teacher.
2. Read the "Math Anxiety Bill of Rights" on page 6 and then make up your own list.
3. When you see this stop signal, stop and study the material because it will be used later.
4. When you see this caution sign, make a special note of the material next to the caution sign, because it will be used throughout the rest of the book.
5. The yield sign means that you will need to remember the result, but it is not necessary for you to understand the derivation.
6. The bump sign means that some unexpected or difficult material follows, and you will need to slow down to understand the discussion.
- 7-36. We will generally not give answers to those questions marked **IN YOUR OWN WORDS**. This problems do not have "right" or "wrong" answers, but rather are included to help you advance your success in this course. Do you best to answer the question.

- ## 1.2 Formulating the Problem, page 11

### New Terms Introduced in this Section

Addition	Counting number	Difference
Distributive property	Elementary operations	Estimation
Juxtaposition	Natural number	Product
Quotient	Simplify a numerical expression	Numerical expression
Sum	Translation	Whole number

**1. a.**  $10 - 2 \times 3 = 10 - 6$   
 $= 4$

**b.**       Display: 4

3. (1) Parentheses first  
(2) Multiplication and division, reading from left to right  
(3) Addition and subtraction, reading from left to right
4. Distributive Property:  $a(b + c) = ab + ac$

1. State the order of operations.
2. Explain the distributive property in your own words.

Because these items are essential to your understanding of the material, we give the answer to all of the essential ideas in this Survival Manual. Your instructor may or may not assign these problems, but it would be a good idea to designate a section of your notebook **ESSENTIAL IDEAS** and then put into this section **all** of the essential ideas.



5.  $4 + 6 \times 8 = 4 + 48$  *Multiplication first*  
 $= 52$  *Addition*

False; the error was to add first.

7.  $2 \times (3 + 4) = 2 \times 3 + 2 \times 4$  is an example of the distributive property; what is shown here is *simplification*, so the statement is wrong.

9. False; it is a whole number.

11. a.  $5 + 6 \times 2 = 5 + 12$  *Multiplication*  
 $= 17$  *Addition*

Since the last operation was addition, we call this a *sum*.

b.  $8 + 2 \times 3 = 8 + 6$  *Multiplication*  
 $= 14$  *Addition*

Since the last operation was addition, we call this a *sum*.

13. a.  $12 \div 6 + 3 = 2 + 3$  *Division*  
 $= 5$  *Addition*

Since the last operation was addition, we call this a *sum*.

b.  $100 \div 10 \div 2 = 10 \div 2$  *Division (left to right)*  
 $= 5$  *Division*

Since the last operation was division, we call this a *quotient*.

15. a.  $15 + 6 \div 3 = 15 + 2$  *Division*  
 $= 17$  *Addition*

Since the last operation was addition, we call this a *sum*.

b.  $16 - 6 \div 3 = 16 - 2$  *Division*  
 $= 14$  *Subtraction*

Since the last operation was subtraction, we call this a *difference*.

17. a.  $4 \times 3 + 4 \times 5 = 12 + 20$  *Multiplication (left to right)*  
 $= 32$  *Addition*

Since the last operation was addition, we call this a *sum*.

b.  $8 \times 2 + 8 \times 5 = 16 + 40$  *Multiplication (left to right)*  
 $= 56$  *Addition*

Since the last operation was addition, we call this a *sum*.

19. a.  $2 + 15 \div 3 \times 5 = 2 + 5 \times 5$  *Division*  
 $= 2 + 25$  *Multiplication*  
 $= 27$  *Addition*

Since the last operation was addition, we call this a *sum*.

$$\begin{aligned}\text{b. } 5 + 12 \div 3 \times 2 &= 5 + 4 \times 2 && \text{Division (left to right)} \\ &= 5 + 8 && \text{Multiplication} \\ &= 13 && \text{Addition}\end{aligned}$$

Since the last operation was addition, we call this a *sum*.

$$\begin{aligned}\text{21 a. } (20 - 8) \div 4 \times 2 + 3 &= 12 \div 4 \times 2 + 3 && \text{Parentheses} \\ &= 3 \times 2 + 3 && \text{Division} \\ &= 6 + 3 && \text{Multiplication} \\ &= 9 && \text{Addition}\end{aligned}$$

Since the last operation was addition, we call this a *sum*.

$$\begin{aligned}\text{b. } 20 - 8 \div 4 \times 2 + 3 &= 20 - 2 \times 2 + 3 && \text{Division (left to right)} \\ &= 20 - 4 + 3 && \text{Multiplication} \\ &= 16 + 3 && \text{Subtraction (left to right)} \\ &= 19 && \text{Addition}\end{aligned}$$

Since the last operation was addition, we call this a *sum*.

$$\begin{aligned}\text{23 a. } 2 \times 18 + 9 \div 3 - 5 \times 2 &= 36 + 3 - 10 && \text{Multiplication /division (left to right)} \\ &= 29 && \text{Addition/subtraction (left to right)}\end{aligned}$$

Since the last operation was subtraction, we call this a *difference*.

$$\begin{aligned}\text{b. } 2 \times (18 + 9) \div 3 - 5 \times 2 &= 2 \times 27 \div 3 - 5 \times 2 && \text{Parentheses} \\ &= 54 \div 3 - 5 \times 2 && \text{Multiplication (left to right)} \\ &= 18 - 10 && \text{Multiplication /division (left to right)} \\ &= 8 && \text{Subtraction}\end{aligned}$$

Since the last operation was subtraction, we call this a *difference*.

$$\text{25 a. } 3 \times (4 + 8) = 3 \times 4 + 3 \times 8 \qquad \text{b. } 7 \times (9 + 4) = 7 \times 9 + 7 \times 4$$

$$\text{27 a. } 4 \times (300 + 20 + 7) = 4 \times 300 + 4 \times 20 + 4 \times 7$$

$$\text{b. } 6 \times (500 + 30 + 3) = 6 \times 500 + 6 \times 30 + 6 \times 3$$

29. “The sum” means “+” and “the product” means “×”:  $3 + 2 \times 4$ . Parentheses are not necessary because the order of operations requires that the product be done before the addition.

31. “Times” means “×” and “sum” means “+”:  $10(5 + 6)$

The parentheses are used to indicate the order of operations and they are also used to indicate multiplication.

33.  $8 \times 5 + 10$ ; if we wanted  $8 \times (5 + 10)$  we would need to say “Eight times the quantity five plus ten.”

35.  $8(11 - 9)$ ; the difference requires parentheses for the correct order of operations.

37. Press: 716 − 5 × 91 =      Display: 261

Since the last operation was subtraction, we call this a *difference*.

39. Press: 8 × 14 + 8 × 86 =      Display: 800

Since the last operation was subtraction, we call this a *sum*.

41. Press:  $\boxed{12} \boxed{\times} \boxed{63} \boxed{+} \boxed{12} \boxed{\times} \boxed{27} \boxed{=}$  Display: 1,080

Since the last operation was subtraction, we call this a *sum*.

43. Press:  $\boxed{(} \boxed{18} \boxed{+} \boxed{2} \boxed{)} \boxed{\times} \boxed{(} \boxed{82} \boxed{-} \boxed{2} \boxed{)} \boxed{=}$

Don't forget the times sign for the indicated multiplication. Display: 1,600

Since the last operation was multiplication, we call this a *product*.

45. Press:  $\boxed{5} \boxed{+} \boxed{3} \boxed{\times} \boxed{7} \boxed{+} \boxed{65} \boxed{-} \boxed{8} \boxed{\times} \boxed{4} \boxed{=}$  Display: 59

Since the last operation was subtraction, we call this a *difference*.

47. Press:  $\boxed{27} \boxed{\times} \boxed{550} \boxed{-} \boxed{27} \boxed{\times} \boxed{450} \boxed{=}$  Display: 2,700

Since the last operation was subtraction, we call this a *difference*.

49. Press:  $\boxed{1214} \boxed{-} \boxed{18} \boxed{\times} \boxed{14} \boxed{+} \boxed{35} \boxed{\times} \boxed{8121} \boxed{=}$  Display: 285,197

Since the last operation was subtraction, we call this a *sum*.

51. Press:  $\boxed{62} \boxed{\times} \boxed{(} \boxed{48} \boxed{-} \boxed{12} \boxed{)} \boxed{+} \boxed{13} \boxed{\times} \boxed{(} \boxed{12} \boxed{-} \boxed{5} \boxed{)} \boxed{=}$

Display: 2,323; since the last operation was subtraction, we call this a *sum*.

*Estimates for Problems 53-60 may vary.*

53. Each day has 24 hours so we estimate

$$360 \times 24 \approx 400 \times 20$$

$$\approx 8,000$$

We estimate this time to be 8,000 hours. The exact answer is 8,640 hours.

55. We estimate

$$1,025.66 - 255.83 \approx 1,000 - 250$$

$$\approx 750$$

We estimate the deduction to be \$750. The exact answer is \$769.83.

57. We estimate by assuming a 40 hour work week for 50 weeks a year:

$$18 \times 40 \times 50 \approx 18 \times 2,000$$

$$\approx 36,000$$

We estimate the annual salary to be \$36,000. The exact answer is \$37,440.

59. We estimate  $23 \times 15 \approx 20 \times 15$

$$\approx 300$$

We estimate we can drive 300 miles. The exact answer is 345 miles.

## 1.3 Fractions and Decimals, page 19

**SURVIVAL HINT:** A fraction is an indicated division. For example,  $\frac{1}{2}$  is one unit (the proverbial pie) divided into two parts, so it is  $1 \div 2$ . This section is devoted to developing your number sense regarding fractions. You may or may not have developed this number sense in previous arithmetic classes, but now is a good time for a refresher.

**New Terms Introduced in this Section**

Approximately equal to symbol	Column names	Common fraction
Decimal	Decimal fraction	Decimal point
Denominator	Division by zero	Fraction
Hundred	Improper fraction	Mixed number
Numerator	Place-value names	Proper fraction
Remainder	Repeating decimal	Ten
Rational number	Terminating decimal	Trailing zeros

**Problem Set 1.3, page 26**

3. A fraction is a quotient of a whole number divided by a counting number.
4. a. 1    b. 10    c. 100    d. 1000    e. 10000  
The answers are getting larger. Answers vary; it looks like the closer the divisor is to 0 the larger the answer.
5. The place value names (in decreasing order) are: trillions, hundred billions, ten billions, billions, hundred millions, ten millions, millions, hundred thousands, ten thousands, thousands, hundreds, tens, units, decimal point, tenths, hundredths, thousandths, ten-thousandths, hundred-thousandths, and millionths.

**SURVIVAL HINT:** Did you remember to look at the ESSENTIAL IDEAS? Even if they were not assigned, you should add these terms to your notebook:

1. Fraction
2. Common fraction/decimal fraction
3. Division by 0 is not permitted.
4. Place value names

7. False; can't divide by 0.
9. True; we can affix any number of trailing zeros.
11. False;  $0.\overline{6} = 0.0.666\cdots$
13. False; by calculator, the answer is approximately 27.96709753.
15. a. proper;  $\boxed{8} \div \boxed{13} = \boxed{\phantom{00}}$       b. proper;  $\boxed{17} \div \boxed{21} = \boxed{\phantom{00}}$
17. a.  $\boxed{4} \boxed{+} \boxed{3} \boxed{\div} \boxed{7} = \boxed{\phantom{00}}$       b.  $\boxed{2} \boxed{+} \boxed{1} \boxed{\div} \boxed{2} = \boxed{\phantom{00}}$
19. a.  $\frac{16}{3} = 5\frac{1}{3}$       Divide 3 into 16 to obtain 5, with a remainder of 1.  
      b.  $\frac{25}{4} = 6\frac{1}{4}$       Divide 4 into 25 to obtain 6, with a remainder of 1.  
      c.  $\frac{141}{10} = 14\frac{1}{10}$       Divide 10 into 141 to obtain 14, with a remainder of 1.  
      d.  $\frac{163}{10} = 16\frac{3}{10}$       Divide 10 into 163 to obtain 16, with a remainder of 3.

21. a.  $\frac{27}{16} = 1\frac{11}{16}$  Divide 16 into 27 to obtain 1, with a remainder of 11.  
 b.  $\frac{177}{10} = 17\frac{7}{10}$  Divide 10 into 177 to obtain 17, with a remainder of 7.  
 c.  $\frac{33}{16} = 2\frac{1}{16}$  Divide 16 into 33 to obtain 2, with a remainder of 1.  
 d.  $\frac{27}{7} = 3\frac{6}{7}$  Divide 7 into 27 to obtain 3, with a remainder of 5.
23. a.  $\frac{83}{5} = 16\frac{3}{5}$  Divide 5 into 83 to obtain 16, with a remainder of 3.  
 b.  $\frac{42}{3} = 14$  Divide 3 into 42 to obtain 14.  
 c.  $\frac{18}{3} = 6$  Divide 3 into 18 to obtain 6.  
 d.  $\frac{125}{4} = 31\frac{1}{4}$  Divide 4 into 125 to obtain 31, with a remainder of 1.
25. a.  $1\frac{3}{4} = \frac{7}{4}$   $4 \times 1 + 3 = 7$   
 b.  $3\frac{3}{5} = \frac{18}{5}$   $5 \times 3 + 3 = 18$
27. a.  $3\frac{2}{3} = \frac{11}{3}$   $3 \times 3 + 2 = 11$   
 b.  $5\frac{1}{5} = \frac{26}{5}$   $5 \times 5 + 1 = 26$
29. a.  $1\frac{3}{10} = \frac{13}{10}$   $10 \times 1 + 3 = 13$   
 b.  $4\frac{2}{5} = \frac{22}{5}$   $5 \times 4 + 2 = 22$
31. a.  $17\frac{2}{3} = \frac{53}{3}$   $3 \times 17 + 2 = 53$   
 b.  $12\frac{4}{5} = \frac{64}{5}$   $5 \times 12 + 4 = 64$
33. a.  $1\frac{14}{15} = \frac{29}{15}$   $15 \times 1 + 14 = 29$   
 b.  $2\frac{13}{17} = \frac{47}{17}$   $17 \times 2 + 13 = 47$
35. a.  $18\frac{7}{8} = \frac{151}{8}$   $8 \times 18 + 7 = 151$   
 b.  $3\frac{11}{12} = \frac{47}{12}$   $12 \times 3 + 11 = 47$

**SURVIVAL HINT:** In Problems 36-47, do not round the decimal representations. For example,

$$\frac{1}{3} = 0.\overline{3}$$

Note the bar over the three; this shows that the three repeats. It is NOT correct to write

$$\frac{1}{3} = 0.33333 \text{ or } \frac{1}{3} = 0.33$$

or any other such representation. The three repeats and does not terminate. That is, in doing the long division, there is never a remainder of zero.

37. a.  $\frac{5}{6} = 0.8\overline{3}$  Long division;  $5 \div 6$ ; by calculator:       
 Continue with the division until you see the digits repeat. There is one repeating digit.
- b.  $\frac{7}{6} = 1.1\overline{6}$  Long division;  $7 \div 6$ ; by calculator:       
 Continue with the division until you see the digits repeat. There is one repeating digit.

39. a.  $2\frac{1}{2} = 2.5$  Long division;  $1 \div 2$ ; by calculator:  $\boxed{1} \boxed{\div} \boxed{2} \boxed{=}$   
Continue with the division until the remainder is zero.
- b.  $5\frac{1}{3} = 5.\bar{3}$  Long division;  $1 \div 3$ ; by calculator:  $\boxed{1} \boxed{\div} \boxed{3} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
41. a.  $6\frac{1}{12} = 6.08\bar{3}$  Long division;  $1 \div 12$ ; by calculator:  $\boxed{1} \boxed{\div} \boxed{12} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
- b.  $6\frac{2}{3} = 6.\bar{6}$  Long division;  $2 \div 3$ ; by calculator:  $\boxed{2} \boxed{\div} \boxed{3} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
43. a.  $7\frac{5}{6} = 7.8\bar{3}$  Long division;  $5 \div 6$ ; by calculator:  $\boxed{5} \boxed{\div} \boxed{6} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
- b.  $4\frac{1}{15} = 4.0\bar{6}$  Long division;  $1 \div 15$ ; by calculator:  $\boxed{1} \boxed{\div} \boxed{15} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
45. a.  $2\frac{2}{3} = 2.\bar{6}$  Long division;  $2 \div 3$ ; by calculator:  $\boxed{2} \boxed{\div} \boxed{3} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
- b.  $4\frac{1}{6} = 4.1\bar{6}$  Long division;  $1 \div 6$ ; by calculator:  $\boxed{1} \boxed{\div} \boxed{6} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
47. a.  $4\frac{3}{8} = 4.375$  Long division;  $3 \div 8$ ; by calculator:  $\boxed{3} \boxed{\div} \boxed{8} \boxed{=}$   
Continue with the division until the remainder is zero.
- b.  $3\frac{1}{9} = 3.\bar{1}$  Long division;  $1 \div 9$ ; by calculator:  $\boxed{1} \boxed{\div} \boxed{9} \boxed{=}$   
Continue with the division until you see the digits repeat. There is one repeating digit.
49. a. The square is divided into one hundred small parts, and we see 82 of them are shaded, so  $\frac{82}{100}$  or  $\frac{41}{50}$  of the square is shaded.
- b. The circle is divided into 8 parts and 5 parts are shaded;  $\frac{5}{8}$ .

**SURVIVAL HINT:** Your answers to Problems 50-51 may vary. Estimating is not an easy skill to learn, so relax and do the best you can.

51. a. The square is divided into one hundred small parts, and we see 63 of them are shaded, so 0.63 of the square is shaded.
- b. The square is divided into one hundred small parts and there are four small triangles, each pair of which can form a square so there is a total of  $2 \times 9 = 18$  of those squares are not shaded. Thus, the shaded portion is  $100 - 18 = 82$  or 0.82 of the large square.

**SURVIVAL HINT:** Do not round the answers to Problem 53, but use the overbar to indicate the repeating decimals. If your calculator does not show a pattern, you must approximate the answer.

53. a. Press:  $\boxed{7} \boxed{\div} \boxed{15} \boxed{=}$  Display: .466666666666 Answer:  $0.4\overline{6}$   
 b. Press:  $\boxed{7} \boxed{\div} \boxed{22} \boxed{=}$  Display: .318181818181 Answer:  $0.3\overline{18}$

55. First, note that  $\frac{1}{2} = 0.5$ :  $100 \times \$52\frac{1}{2} = 100 \times \$52.5$   
 $= \$5,250$

*To multiply by 100, move the decimal point two places to the right.*

57. First, note that  $\frac{1}{4} = 0.25$ :  $200 \times \$42\frac{1}{4} = 200 \times \$42.25$   
 $= 100 \times 2 \times \$42.25$   
 $= 100 \times \$84.50$   
 $= \$8,450$

*To multiply by 100, move the decimal point two places to the right.*

59. First, note that  $\frac{1}{8} = 0.125$ :  $100 \times \$63\frac{1}{8} = 100 \times \$63.125$   
 $= \$6,312.50$

*To multiply by 100, move the decimal point two places to the right.*

## 1.4 Rounding and Estimation, page 28

**SURVIVAL HINT:** *Take a look at the essential ideas. Add these ideas to your journal.*

### New Terms Introduced in this Section

Rounding money

Rounding numbers

### Problem Set 1.4, page 31

- The rounding place digit is the name of the positional column to which the number is being rounded.
- Estimation is making a reasonably accurate guess. It is important in everyday life in many situations in which an exact answers is not needed. For example, when making a purchase, deciding on which route to take, how long a task may take to complete, or tipping at a restaurant.
- $30.\boxed{0}5$  rounded to the nearest tenth is 30.1, so the statement is false. The error is that the number was rounded to the nearest unit, rather than the nearest tenth.
- $3,6\boxed{8}4,999$  rounded to the nearest ten thousand is 3,680,000, so the statement is false. The error is that one was added to the rounding place digit and it should not have been.

9.  $23 \times 12 \approx 25 \times 10 = 250$ ; estimate is correct.
11. 2.312 Rounding place digit is marked.  
2.3 Digit to the right is a 1, so delete the "12".
13. 6,287.4513 Rounding place digit is marked.  
6,287.45 Digit to the right is a 1, so delete the "13".
15. 5.291 Digit to the right is a 9, so add one  
5.3 to the rounding place digit and delete the "91".
17. 6.287.4513 Digit to the right is an 8, so add  
6,300 one to the rounding place digit and change the digits to the right to zeros. Drop the zeros to the right of the decimal point.
19. 12.8197 Digit to the right is a 9, so  
12.82 add one to the rounding place digit and delete the "97".
21. 4.81792 Digit to the right is a 9, so  
4.818 add one to the rounding place digit and delete the "92".
23. 4.8199 Digit to the right is a 8, so  
5 add one to the rounding place digit and delete the ".8199".
25. \$12.993 Digit to the right is a 3, so  
\$12.99 delete the "3".
27. \$14.998 Digit to the right is a 8, so  
\$15.00 add one to the rounding place digit and delete the "8". Note that adding 1 to 9 causes a carry into the next column. That is,  
\$14.99 + \$0.01 = \$15.00.
29. 694.3814 Digit to the right is an 4, so  
690 change the numerals to the right of the rounding place digit to zeros; then delete those to the right of the decimal point.
31. \$86,125 Digit to the right is an 1, so  
\$86,000 change the digits to the right of the rounding place digit to zeros.
33. From the calculator display, we see  $2/3$  is represented as 0.666666667. The digit to the right is a 6, so add 1 to the rounding place digit and drop the digits to the right to obtain: 0.667.
35. From the calculator display, we see  $2/17$  is represented as 0.1176470588. The digit to the right is a 6, so add 1 to the rounding place digit and drop the digits to the right to obtain: 0.118.
37. From the calculator display, we see  $7/51$  is represented as 0.137254902. The digit to the right is a 2, so do not change the rounding place digit but drop the digits to the right to obtain: 0.137.
39.  $\frac{2}{6} \approx 0.3333333333$ ; rounded answer: 0.333; by calculator:  $\boxed{2} \boxed{\div} \boxed{6} \boxed{=}$



41.  $\frac{5}{12} \approx 0.4166666666$ ; rounded answer: 0.417; by calculator:  $\boxed{5} \boxed{\div} \boxed{12} \boxed{=}$
43.  $\frac{152}{478} \approx 0.3179916318$ ; rounded answer: 0.318; by calculator:  $\boxed{152} \boxed{\div} \boxed{478} \boxed{=}$
45. B *Think:*  $4.82 \approx 5$  mi, so it is about 10 miles round trip;  $5 \times 10 = 50$ .
47. C *Think:*  $\$35,000 \approx \$36,000$  and  $\$36,000 \div 12 = \$3,000$ .
49. B *Think:*  $\$1,000 \approx \$1,200$  and  $\$1,200 \div 12 = \$100$ .
51.  $\frac{\$15,000}{12} = \$1,250$ ; by calculator:  $\boxed{15000} \boxed{\div} \boxed{12} \boxed{=}$
53.  $\frac{\$1,818.75}{150} = \$12.125$ ; rounded answer: \$12.13; by calculator:  $\boxed{1818.75} \boxed{\div} \boxed{150} \boxed{=}$
55.  $\frac{\$850}{12} \approx \$70.83333333$ ; rounded answer: \$70.83; by calculator:  $\boxed{850} \boxed{\div} \boxed{12} \boxed{=}$
57.  $\frac{\$674}{6} \approx \$112.3333333$ ; rounded answer \$112.33; by calculator:  $\boxed{674} \boxed{\div} \boxed{6} \boxed{=}$

## 1.5 Exponents and Prime Factorization, page 33

**SURVIVAL HINT:** *There are many ideas in this section which you will use daily in your future math work. Be sure you understand the concept of an exponent, and that of a prime factorization.*

### New Terms Introduced in this Section

Base	Composite	Cubed	Exponent
Exponential notation	Factor	Factoring	Factorization
Factor tree	Googol	Power	Powers of ten
Prime factorization	Prime number	Scientific notation	Squared

### Problem Set 1.5, page 39

- An exponent is a number used to indicate repeated multiplication. In other words, it is the number of repeated factors. In  $b^n$  it is the number  $n$ .
- A number is in scientific notation when that number is written as a power of 10 or as a decimal number between 1 and 10 times a power of 10.
- An excellent way to find the prime factorization is to use factor trees.
- The  $y^x$  is an exponent key and EE is used for scientific notation.

**SURVIVAL HINT:** *Take a look at the four preceding essential ideas. Add these ideas to your journal.*

- a. one million    b. 10    c. 6    d.  $10 \times 10 \times 10 \times 10 \times 10 \times 10$
- a. one thousand    b. 10    c. 3    d.  $10 \times 10 \times 10$
- a. one-tenth    b. 10    c.  $-1$     d. 0.1
- a. one-hundredth    b. 10    c.  $-2$     d. 0.01

**11.** False;  $5^2$  means  $5 \times 5$ .

**13.** False;  $4^3 = 4 \times 4 \times 4$ ; there are two multiplications (not three).

**15. a.** In scientific notation, the decimal point goes after the first nonzero digit:

$$3.2 \times 10^3 = 3,200$$

Decide on the exponent by counting the number of decimal places necessary to write this number, 3.2, as the given number. We see it is three places.

*Move the decimal point 3 places to the right.*

**b.**  $2.5 \times 10^4 = 25,000$

*Move the decimal point 4 places to the right.*

**c.**  $1.8 \times 10^7 = 18,000,000$

*Move the decimal point 7 places to the right.*

**d.**  $6.4 \times 10^2 = 640$

*Move the decimal point 2 places to the right.*

**17. a.**  $4.21 \times 10^{-6} = 0.00000421$

*Move the decimal point 6 places to the left.*

**b.**  $9.2 \times 10^7 = 92,000,000$

*Move the decimal point 7 places to the right.*

**c.**  $1 \times 10^0 = 1$

*Don't move the decimal point.*

**d.**  $1.5 \times 10^0 = 1.5$

*Don't move the decimal point.*

**19. a.** "E9" means " $\times 10^9$ ", so  $6.34\text{E}9 = 6.34 \times 10^9$

**b.**  $5.2019\text{E}11 = 5.2019 \times 10^{11}$

**c.** "08" means " $\times 10^8$ ", so  $4.093745\text{ }08 = 4.093745 \times 10^8$

**d.**  $8.291029292\text{ }12 = 8.291029292 \times 10^{12}$

**21. a.**  $7.2 \times 10^{10} = 72,000,000,000$

*Move the decimal point 10 places to the right.*

**b.**  $4.5 \times 10^3 = 4,500$

*Move the decimal point 3 places to the right.*

**23. a.**  $2.1 \times 10^{-3} = 0.0021$

*Move the decimal point 3 places to the left.*

**b.**  $4.6 \times 10^{-7} = 0.00000046$

*Move the decimal point 7 places to the left.*

**25. a.**  $3.2 \times 10^0 = 3.2$

*Move the decimal point 0 places.*

**b.**  $8.03 \times 10^{-4} = 0.000803$

*Move the decimal point 4 places to the left.*

$$\begin{aligned} 27. \text{ a. } 7^2 &= 7 \times 7 \\ &= 49 \end{aligned}$$

$$\begin{aligned} \text{ b. } 5^2 &= 5 \times 5 \\ &= 25 \end{aligned}$$

$$\begin{aligned} 29. \text{ a. } 2.18928271 \ 10 &= 2.18928271 \times 10^{10} \\ &= 21,892,827,100 \end{aligned}$$

*Move the decimal point 10 places to the right.*

$$\begin{aligned} \text{ b. } 0.0000329 \ 07 &= 0.0000329 \times 10^7 \\ &= 329 \end{aligned}$$

*Move the decimal point 7 places to the right.*

$$\begin{aligned} 31. \ 2^3 + 5(4 + 3) &= 2^3 + 5(7) \\ &= 8 + 35 \\ &= 43 \end{aligned}$$

$$\begin{aligned} 33. \ (2 + 5)^2 - 4^2 &= 7^2 - 4^2 \\ &= 49 - 16 \\ &= 33 \end{aligned}$$

$$\begin{aligned} 35. \ (7 + 3 \cdot 2)^2 &= (7 + 6)^2 \\ &= 13^2 \\ &= 169 \end{aligned}$$

$$\begin{aligned} 37. \text{ a. } 12 &= 4 \times 3 \\ &= (2 \times 2) \times 3 \\ &= 2^2 \times 3 \end{aligned}$$

$$\begin{aligned} \text{ b. } 20 &= 4 \times 5 \\ &= (2 \times 2) \times 5 \\ &= 2^2 \times 5 \end{aligned}$$

$$\begin{aligned} 39. \text{ a. } 256 &= 2 \times 128 \\ &= 2 \times 2 \times 64 \\ &= 2 \times 2 \times 2 \times 32 \\ &= 2 \times 2 \times 2 \times 2 \times 16 \\ &= 2 \times 2 \times 2 \times 2 \times 2 \times 8 \\ &= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 4 \\ &= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \\ &= 2^8 \end{aligned}$$

$$\begin{aligned} \text{ b. } 18 &= 2 \times 9 \\ &= 2 \times 3 \times 3 \\ &= 2 \times 3^2 \end{aligned}$$

$$\begin{aligned} 41. \text{ a. } 400 &= 4 \times 100 \\ &= 2 \times 2 \times 10 \times 10 \\ &= 2 \times 2 \times 2 \times 5 \times 2 \times 5 \\ &= 2^4 \times 5^2 \end{aligned}$$

$$\begin{aligned} \text{ b. } 1,000 &= 10 \times 100 \\ &= 2 \times 5 \times 10 \times 10 \\ &= 2 \times 5 \times 2 \times 5 \times 2 \times 5 \\ &= 2^3 \times 5^3 \end{aligned}$$

43. a. See which prime divides evenly into the given number. If it does not divide evenly, move to the next prime. If it does divide evenly, try that same number again.

$$\begin{aligned}
 4,459 &= 7 \times 637 \\
 &= 7 \times 7 \times 91 \\
 &= 7 \times 7 \times 7 \times 13 \\
 &= 7^3 \times 13
 \end{aligned}$$

$$\begin{aligned}
 \text{b. } 229,333 &= 13 \times 17,641 \\
 &= 13 \times 13 \times 1,357 \\
 &= 13 \times 13 \times 23 \times 59 \\
 &= 13^2 \times 23 \times 59
 \end{aligned}$$

- 45. a.** Use your calculator and the list of primes to see which prime divides evenly into the given number. If it does not divide evenly, move to the next prime. If it does divide evenly, try that same number again.

$$\begin{aligned}
 45,733 &= 19 \times 2,407 \\
 &= 19 \times 29 \times 83
 \end{aligned}$$

$$\begin{aligned}
 \text{b. } 29,791 &= 31 \times 961 \\
 &= 31 \times 31 \times 31 \\
 &= 31^3
 \end{aligned}$$

- 47.** First estimate the number of seconds in a year:

$$\begin{aligned}
 24 \times 60 \times 60 \times 365 &= 24 \times 6 \times 10 \times 6 \times 10 \times 3.65 \times 10^2 \\
 &\approx 24 \times 6 \times 6 \times 3.65 \times 10^4
 \end{aligned}$$

Now multiply this number by your age (in years) to see that the most reasonable exponent is the one shown in choice A.

- 49.** Choice A is a penny, choice B is a dime, and choice C is a dollar; the best choice is C.  
**51.** Choice B is a very small number (and not even a possibility), and choice C is too large, so the best choice must be A.  
**53.**  $41,840,000 = 4.184 \times 10^7$   
**55.**  $3.33 \times 10^5 = 333,000$   
**57. a.**  $5 \times 10^{23} = 500,000,000,000,000,000,000,000$

**b.** By calculator, 

5	×	10	^	23	×	60	×	60	×	24	×	365	=
---	---	----	---	----	---	----	---	----	---	----	---	-----	---

  
 $1.5768 \times 10^{31}$ .

- 59. NOTE:** no calculator; this is an estimation problem.

$$\begin{aligned}
 &\$1.89 + \$0.79 + \$1.39 + \$1.61 + \$0.59 + \$2.50 + \$1.89 + \$0.99 + \$1.97 + \$1.99 \\
 &+ \$0.99 + \$1.09 + \$1.79 \approx \$2 + \$1 + \$1 + \$2 + \$1 + \$2 + \$2 + \$1 + \$2 + \$2 + \$1 \\
 &+ \$1 + \$2 = \$20 \text{ (Actual, with calculator is \$19.48)}
 \end{aligned}$$

**1.6 Common Fractions, page 42**

**SURVIVAL HINT:** *You may have had problems with fractions in the past, but the emphasis here is on understanding fractions and learning how to use a calculator to help you with calculation involving fractions. If you are feeling anxious about this topic, it may be time to take a break with some of the anxiety reducing techniques introduced in the first section of this book. Relax.... ask questions, and you will succeed!*

**New Terms Introduced in this Section**

Canceling	Completely reduce fraction	Complex decimal
Divide fractions	Fundamental property of fractions	Invert
Multiply fractions	Reciprocal	Reduced fraction
Reducing fractions	Simplify a fractional expression	

**Problem Set 1.6, page 48**

3. Use the fundamental property of fractions (see the answer to Problem 1) to eliminate all common factors (other than 1 or  $-1$ ).
4. A fraction is reduced when there is no number (except 1) that divides into both the numerator and denominator.
5. To multiply fractions, multiply numerators and multiply denominators.
6. To divide fractions, invert and multiply.
7. A terminating decimal is a fraction whose decimal representation ends.
8. (1) Multiply the given number without its decimal point by the decimal name of the last digit.  
(2) By the decimal name of the last digit, we mean: one place is tenth, or  $\frac{1}{10}$ ; two places is hundredth, or  $\frac{1}{100}$ ; three places is thousandth, or  $\frac{1}{1,000}$ ;  $\dots$ .
9. A reduced fraction is one in which there is no common factor (other than 1 and  $-1$ ) between the numerator and denominator; this is true.

11. F;  $8 \times \frac{3}{2} = \frac{24}{2} = 12$

13.  $\frac{2}{3} \div \frac{4}{5} = \frac{2}{3} \times \frac{5}{4}$  but  $\frac{4}{5} \div \frac{2}{3} = \frac{4}{5} \times \frac{3}{2}$  These results are different, so the statement is  

$$= \frac{5}{6} \qquad \qquad \qquad = \frac{6}{5}$$

false.

15. a.  $\frac{2}{4} = \frac{1 \times 2}{2 \times 2}$   

$$= \frac{1}{2}$$

b.  $\frac{3}{9} = \frac{1 \times 3}{3 \times 3}$   

$$= \frac{1}{3}$$

c.  $\frac{4}{16} = \frac{1 \times 4}{4 \times 4}$   

$$= \frac{1}{4}$$

d.  $\frac{2}{10} = \frac{1 \times 2}{5 \times 2}$   

$$= \frac{1}{5}$$

$$\begin{array}{llll}
 \text{17. a. } \frac{72}{15} = \frac{24 \times 3}{5 \times 3} & \text{b. } \frac{42}{14} = \frac{3 \times 14}{14} & \text{c. } \frac{16}{24} = \frac{2 \times 8}{3 \times 8} & \text{d. } \frac{128}{256} = \frac{1 \times 128}{2 \times 128} \\
 & = 3 & = \frac{2}{3} & = \frac{1}{2} \\
 \text{19. a. } \frac{140}{420} = \frac{1 \times 140}{3 \times 140} & \text{b. } \frac{75}{50} = \frac{3 \times 25}{2 \times 25} & \text{c. } \frac{240}{672} = \frac{5 \times 48}{14 \times 48} & \text{d. } \frac{5,670}{12,150} = \frac{7 \times 810}{15 \times 810} \\
 & = \frac{1}{3} & = \frac{5}{14} & = \frac{7}{15}
 \end{array}$$

21. Shade two of the five rows and three of the four columns. There are 6 of the 20 squares that are double shaded. This can also be stated as three-tenths of the large square.

23. Shade four of the five rows and one of the three columns. There are 4 of the 15 squares that are double shaded.

25. Divide the side into six parts and the top into three parts. Then, shade one of the six rows and two of the three columns. There are 2 of the 18 squares that are double shaded. This can also be stated as one-ninth of the large square.

27. In this problem, you are verifying for yourself that division gives the same result as “invert and multiply.”

a. The divisor is 5, and the answer is 3. Also,  $15 \times \frac{1}{5} = 3$ .

b. The divisor is 3, the answer is 2. Also,  $6 \times \frac{1}{3} = 2$ .

29. In this problem, you are verifying for yourself that division gives the same result as “invert and multiply.”

a. The divisor is 4, and the answer is 5. Also,  $20 \times \frac{1}{4} = 5$ .

b. The divisor is 16, the answer is 15. Also,  $240 \times \frac{1}{16} = 15$ .

$$\begin{array}{ll}
 \text{31. a. } \frac{1}{4} \times \frac{1}{6} = \frac{1 \times 1}{4 \times 6} & \text{b. } \frac{2}{3} \times \frac{4}{5} = \frac{2 \times 2 \times 2}{3 \times 5} \\
 & = \frac{8}{15} \\
 \text{c. } \frac{3}{4} \times \frac{1}{6} = \frac{3 \times 1}{2 \times 2 \times 2 \times 3} & \text{d. } \frac{7}{20} \times \frac{100}{14} = \frac{7 \times 2 \times 2 \times 5 \times 5}{2 \times 2 \times 5 \times 2 \times 7} \\
 & = \frac{5}{2}
 \end{array}$$

**SURVIVAL HINT:** Note  $\frac{5}{2}$  is reduced. You do not need to write this answer as the mixed number  $2\frac{1}{2}$ .

$$\begin{array}{ll}
 \text{e. } \frac{5}{9} \times \frac{18}{25} = \frac{5 \times 2 \times 3 \times 3}{3 \times 3 \times 5 \times 5} & \text{f. } \frac{2}{3} \times \frac{3}{8} = \frac{2 \times 3}{3 \times 2 \times 2 \times 2} \\
 & = \frac{1}{4} \\
 & = \frac{2}{5}
 \end{array}$$

33. a.  $\frac{1}{2} \div \frac{1}{3} = \frac{1}{2} \times \frac{3}{1} = \frac{3}{2}$       b.  $\frac{1}{3} \div \frac{1}{2} = \frac{1}{3} \times \frac{2}{1} = \frac{2}{3}$       c.  $\frac{2}{3} \div \frac{1}{2} = \frac{2}{3} \times \frac{2}{1} = \frac{4}{3}$

d.  $\frac{3}{4} \div \frac{2}{3} = \frac{3}{4} \times \frac{3}{2} = \frac{9}{8}$       e.  $\frac{2}{5} \times \frac{15}{8} = \frac{2 \times 3 \times 5}{5 \times 2 \times 2 \times 2} = \frac{3}{4}$       f.  $\frac{5}{3} \times \frac{9}{15} = \frac{5 \times 3 \times 3}{3 \times 3 \times 5} = 1$

35. a.  $\frac{4}{5} \div \frac{4}{5} = \frac{4}{5} \times \frac{5}{4} = 1$       b.  $\frac{7}{9} \div \frac{7}{9} = \frac{7}{9} \times \frac{9}{7} = 1$       c.  $\frac{8}{3} \div \frac{8}{3} = \frac{8}{3} \times \frac{3}{8} = 1$

d.  $\frac{4}{5} \times 5 = \frac{4}{5} \times \frac{5}{1} = 4$       e.  $\frac{3}{5} \div \frac{3}{7} = \frac{3}{5} \times \frac{7}{3} = \frac{7}{5}$       f.  $\frac{6}{7} \div \frac{2}{3} = \frac{2 \times 3}{7} \times \frac{3}{2} = \frac{9}{7}$

**SURVIVAL HINT:** You may be able to do these mentally, any number divided by itself is 1.

37. a.  $\frac{2}{5} \div 3 = \frac{2}{5} \times \frac{1}{3} = \frac{2}{15}$       b.  $\frac{3}{8} \div 3 = \frac{3}{8} \times \frac{1}{3} = \frac{1}{8}$       c.  $\frac{3}{5} \div 5 = \frac{3}{5} \times \frac{1}{5} = \frac{3}{25}$

d.  $3 \div \frac{1}{6} = 3 \times 6 = 18$       e.  $2\frac{1}{2} \div 3 = \frac{5}{2} \times \frac{1}{3} = \frac{5}{6}$       f.  $6\frac{1}{2} \div 3 = \frac{13}{2} \times \frac{1}{3} = \frac{13}{6}$

39. a.  $2\frac{2}{5} \times 1\frac{4}{5} = \frac{12}{5} \times \frac{9}{5} = \frac{108}{25}$       b.  $5\frac{1}{2} \times 3\frac{2}{3} = \frac{11}{2} \times \frac{11}{3} = \frac{121}{6}$

c.  $4\frac{1}{6} \times 3\frac{3}{8} = \frac{25}{6} \times \frac{27}{8} = \frac{25 \times 3 \times 9}{2 \times 3 \times 8} = \frac{225}{16}$       d.  $1\frac{1}{6} \times 2\frac{1}{3} = \frac{7}{6} \times \frac{7}{3} = \frac{49}{18}$

e.  $6\frac{1}{2} \times \frac{5}{6} = \frac{13}{2} \times \frac{5}{6} = \frac{65}{12}$       f.  $3\frac{4}{5} \times \frac{1}{2} = \frac{19}{5} \times \frac{1}{2} = \frac{19}{10}$

$$\begin{array}{ll}
 \text{41. a. } \frac{1}{2} \times \frac{8}{9} \times \frac{3}{16} = \frac{1 \times 8 \times 3}{2 \times 3 \times 3 \times 2 \times 8} & \text{b. } \frac{2}{3} \times \frac{5}{8} \times \frac{16}{100} = \frac{2 \times 5 \times 2 \times 8}{3 \times 8 \times 5 \times 2 \times 2 \times 5} \\
 & = \frac{1}{12} \\
 \text{c. } \frac{2}{3} \times \frac{4}{5} \times \frac{15}{16} = \frac{2 \times 4 \times 3 \times 5}{3 \times 5 \times 2 \times 2 \times 4} & \text{d. } 2\frac{1}{2} \times 3\frac{1}{6} \times 1\frac{1}{5} = \frac{5}{2} \times \frac{19}{6} \times \frac{6}{5} \\
 & = \frac{19}{2} \\
 \text{e. } \left(\frac{1}{2} \div \frac{1}{2}\right) \div \frac{1}{4} = 1 \times \frac{4}{1} & \text{f. } \frac{1}{2} \div \left(\frac{1}{3} \div \frac{1}{4}\right) = \frac{1}{2} \div \left(\frac{4}{3}\right) \\
 & = \frac{1}{2} \times \frac{3}{4} \\
 & = \frac{3}{8} \\
 \text{43. a. } 0.25 = \frac{25}{100} = \frac{1}{4} & \text{b. } 0.87 = \frac{87}{100} & \text{c. } 0.375 = \frac{375}{1,000} = \frac{3}{8} \\
 \text{45. a. } 0.78 = \frac{78}{100} = \frac{39}{50} & \text{b. } 0.85 = \frac{85}{100} = \frac{17}{20} & \text{c. } 0.246 = \frac{246}{1,000} = \frac{123}{500} \\
 \text{47. a. } 0.66\frac{2}{3} = 66\frac{2}{3} \times \frac{1}{100} & \text{b. } 0.87\frac{1}{2} = 87\frac{1}{2} \times \frac{1}{100} & \text{c. } 0.16\frac{2}{3} = 16\frac{2}{3} \times \frac{1}{100} \\
 & = \frac{200}{3} \times \frac{1}{100} & = \frac{175}{2} \times \frac{1}{100} & = \frac{50}{3} \times \frac{1}{100} \\
 & = \frac{2}{3} & = \frac{25 \times 7 \times 1}{2 \times 25 \times 4} & = \frac{1}{6} \\
 & & = \frac{7}{8}
 \end{array}$$

**SURVIVAL HINT:** *You may know these answers from memory.*

$$\begin{array}{lll}
 \text{49. a. } 0.1\frac{1}{9} = 1\frac{1}{9} \times \frac{1}{10} & \text{b. } 0.5\frac{5}{9} = 5\frac{5}{9} \times \frac{1}{10} & \text{c. } 0.08\frac{1}{3} = 8\frac{1}{3} \times \frac{1}{100} \\
 & = \frac{50}{9} \times \frac{1}{10} & = \frac{25}{3} \times \frac{1}{100} \\
 & = \frac{5}{9} & = \frac{1}{12} \\
 \text{51. } \frac{1}{10} \times \text{AGE} \times \text{SALARY} = \frac{1}{10} \times 30 \times \$46,000 \\
 & = 3 \times \$46,000 \\
 & = \$138,000
 \end{array}$$



$$\begin{aligned}
 53. \quad \frac{1}{10} \times \text{AGE} \times \text{SALARY} &= \frac{1}{10} \times 50 \times \$125,000 \\
 &= 5 \times \$125,000 \\
 &= \$625,000
 \end{aligned}$$

**SURVIVAL HINT:** *Translate the word "of" to mean multiply.*

$$55. \quad \frac{3}{16} \times \$12,512 = \$2,346$$

By calculator:  $\boxed{3} \boxed{\div} \boxed{16} \boxed{\times} \boxed{12512} \boxed{=}$

$$57. \quad \$227.00 \div 20 = \$11.35$$

By calculator:  $\boxed{227} \boxed{\times} \boxed{20} \boxed{=}$

$$\begin{aligned}
 59. \quad \$44,000 \div 4\frac{2}{5} &= \frac{\$44,000}{1} \div \frac{22}{5} \\
 &= \frac{\$44,000}{1} \times \frac{5}{22} \\
 &= \frac{\$2,000 \times 22 \times 5}{22} \\
 &= \$10,000
 \end{aligned}$$

## 1.7 Adding and Subtracting Fractions, page 50

**SURVIVAL HINT:** *The ESSENTIAL IDEAS in the first two problems summarize what you need to remember from this section.*

### New Terms Introduced in this Section

Common denominator	Extended order of operations	LCD
Lowest common denominator	Subtraction of fractions	

### Problem Set 1.7, page 56

1. **Step 1** Find the LCD.

**Step 2** Change the forms of the fractions to obtain forms with common denominators.

**Step 3** Add the numerators of the fractions with common denominators.

3. This job would require at least two cuts, so the total is:

$$\begin{aligned}
 2 \times \frac{1}{16} + 5\frac{1}{4} + 7\frac{1}{2} + 5\frac{3}{16} &= \frac{2}{16} + 5\frac{4}{16} + 7\frac{8}{16} + 5\frac{3}{16} \\
 &= 17\frac{17}{16} \\
 &= 18\frac{1}{16}
 \end{aligned}$$

The smallest single length is  $18\frac{1}{16}$  inches.

5. (1) First, perform any operations enclosed in parentheses.  
 (2) Next, perform any operations that involve raising to a power.  
 (3) Perform multiplication and division, reading from left to right.  
 (4) Do addition and subtraction, reading from left to right.
6. **Step 1** Factor all given denominators into prime factors; write this factorization using exponents.  
**Step 2** List each different prime factor you found in the prime factorization of the denominators.  
**Step 3** On each prime in the list from Step 2, place the largest exponent that appears on that prime factor anywhere in the factorization of the denominators.  
**Step 4** The LCD is the product of the prime factors with the exponents found in Step 3.
7. False; do not add the denominators; the correct answer is  $\frac{3}{8} + \frac{4}{8} = \frac{7}{8}$ .
9. This problem and solution have no errors.
11. This problem and solution have no errors.
13.  $\frac{19}{40} \approx \frac{20}{40} = \frac{1}{2}$  The correct response is A.
15.  $\frac{19}{40} - \frac{3}{10} \approx \frac{20}{40} - \frac{12}{40}$   
 $= \frac{8}{40}$   
 $= \frac{1}{5}$

The correct response is D.

17. If I multiply a number by a number larger than 1, the result is larger, but if I multiply a number by a number smaller than 1, the result is smaller. The correct response is B.
19. If I divide a number by a number larger than 1 the result is smaller, but if I divide a number by a number smaller than 1, then the result is larger. The correct response is A.
21. a.  $\frac{2}{5} + \frac{1}{5} = \frac{3}{5}$     b.  $\frac{3}{7} + \frac{5}{7} = \frac{8}{7}$     c.  $\frac{5}{11} + \frac{3}{11} = \frac{8}{11}$

**SURVIVAL HINT:** A number is **reduced** if there is no number other than 1 that divides into both the numerator and denominator. This means, for example, the result in Problem 21b is reduced.

$$\text{d. } \frac{3}{2} + \frac{5}{2} = \frac{8}{2} = 4 \quad \text{e. } \frac{7}{3} - \frac{4}{3} = \frac{3}{3} = 1 \quad \text{f. } \frac{5}{9} + \frac{1}{9} = \frac{6}{9} = \frac{2}{3}$$

$$\begin{array}{r} \text{23. a. } 2\frac{2}{3} \\ + 1\frac{1}{3} \\ \hline 3\frac{3}{3} = 4 \end{array} \quad \text{b. } \begin{array}{r} 6\frac{4}{5} \\ + 2\frac{1}{5} \\ \hline 8\frac{5}{5} = 9 \end{array} \quad \text{c. } \begin{array}{r} 8\frac{3}{8} \\ + 4\frac{5}{8} \\ \hline 12\frac{8}{8} = 13 \end{array}$$

$$\begin{array}{r} \text{d. } 5\frac{1}{3} = 4\frac{4}{3} \\ - 3\frac{2}{3} = -3\frac{2}{3} \\ \hline 1\frac{2}{3} \end{array} \quad \text{e. } \begin{array}{r} 14\frac{1}{8} = 13\frac{9}{8} \\ - 8\frac{5}{8} = -8\frac{5}{8} \\ \hline 5\frac{4}{8} = 5\frac{1}{2} \end{array} \quad \text{f. } \begin{array}{r} 6\frac{1}{4} = 5\frac{5}{4} \\ - 5\frac{3}{4} = -5\frac{3}{4} \\ \hline \frac{2}{4} = \frac{1}{2} \end{array}$$

25. Pick larger exponents for LCD. These are shown in boldface.

$$\begin{array}{ll} \text{a. } 4 = 2^2 & \text{b. } 12 = \mathbf{2^2} \times 3 \\ 12 = \mathbf{2^2} \times \mathbf{3} & 90 = 2 \times \mathbf{3^2} \times \mathbf{5} \\ \text{LCD} = 2^2 \times 3 = 12 & \text{LCD} = 2^2 \times 3^2 \times 5 = 180 \\ \text{c. } 12 = 2^2 \times 3 & \text{d. } 90 = \mathbf{2} \times \mathbf{3^2} \times \mathbf{5} \\ 336 = \mathbf{2^4} \times \mathbf{3} \times \mathbf{7} & 210 = 2 \times 3 \times 5 \times 7 \\ \text{LCD} = 2^4 \times 3 \times 7 = 336 & \text{LCD} = 2 \times 3^2 \times 5 \times 7 = 630 \end{array}$$

27. Pick larger exponents for LCD. These are shown in boldface.

$$\begin{array}{ll} \text{a. } 735 = 3 \times 5 \times \mathbf{7^2} & \text{b. } 315 = \mathbf{3^2} \times 5 \times 7 \\ 1,125 = \mathbf{3^2} \times \mathbf{5^3} & 735 = 3 \times \mathbf{5} \times \mathbf{7^2} \\ \text{LCD} = 3^2 \times 5^3 \times 7^2 = 55,125 & \text{LCD} = 3^2 \times 5 \times 7^2 = 2,205 \\ \text{c. } 420 = \mathbf{2^2} \times 3 \times 5 \times 7 & \text{d. } 600 = \mathbf{2^3} \times 3 \times \mathbf{5^2} \\ 450 = 2 \times \mathbf{3^2} \times \mathbf{5^2} & 90 = 2 \times \mathbf{3^2} \times 5 \\ \text{LCD} = 2^2 \times 3^2 \times 5^2 \times 7 = 6,300 & 30 = 2 \times 3 \times 5 \\ & \text{LCD} = 2^3 \times 3^2 \times 5^2 = 1,800 \end{array}$$

$$\begin{array}{ll} \text{29. a. LCD is 6; } \frac{5}{6} - \frac{1}{3} = \frac{5}{6} - \frac{2}{6} & \text{b. LCD is 24; } \frac{5}{6} + \frac{5}{8} = \frac{20}{24} + \frac{15}{24} \\ & = \frac{35}{24} \\ & = \frac{1}{2} \end{array}$$

c. LCD is 24;  $\frac{5}{8} - \frac{1}{3} = \frac{15}{24} - \frac{8}{24}$   
 $= \frac{7}{24}$

d. LCD is 12;  $\frac{3}{4} - \frac{5}{12} = \frac{9}{12} - \frac{5}{12}$   
 $= \frac{4}{12}$   
 $= \frac{1}{3}$

e. LCD is 30;  $\frac{3}{5} + \frac{1}{6} = \frac{18}{30} + \frac{5}{30}$   
 $= \frac{23}{30}$

f. LCD is 12;  $\frac{3}{4} + \frac{1}{12} = \frac{9}{12} + \frac{1}{12}$   
 $= \frac{10}{12}$   
 $= \frac{5}{6}$

31. a.  $2\frac{1}{2} = 2\frac{2}{4}$   
 $+ 4\frac{3}{4} = 4\frac{3}{4}$   


---

 $6\frac{5}{4} = 7\frac{1}{4}$

b.  $1\frac{2}{3} = 1\frac{4}{6}$   
 $+ 5\frac{1}{2} = 5\frac{3}{6}$   


---

 $6\frac{7}{6} = 7\frac{1}{6}$

c.  $3\frac{3}{8} = 3\frac{3}{8}$   
 $+ 5\frac{1}{2} = 5\frac{4}{8}$   


---

 $8\frac{7}{8}$

33. a.  $8 = 2^3$   
 $3 = 3$   
 $6 = 2 \times 3$   
 $\text{LCD} = 2^3 \times 3 = 24$

$\frac{1}{8} = \frac{1 \times 3}{8 \times 3} = \frac{3}{24}$   
 $2\frac{2}{3} = 2\frac{2 \times 8}{3 \times 8} = 2\frac{16}{24}$   
 $+ \frac{1}{6} = \frac{1 \times 4}{6 \times 4} = \frac{4}{24}$   


---

 $2\frac{23}{24}$

b.  $5 = 5$   
 $7 = 7$   
 $10 = 2 \times 5$   
 $\text{LCD} = 2 \times 5 \times 7 = 70$

$\frac{4}{5} = \frac{4 \times 14}{5 \times 14} = \frac{56}{70}$   
 $\frac{3}{7} = \frac{3 \times 10}{7 \times 10} = \frac{30}{70}$   
 $+ \frac{3}{10} = \frac{3 \times 7}{10 \times 7} = \frac{21}{70}$   


---

 $\frac{107}{70} = 1\frac{37}{70}$

$$\begin{array}{rcl}
 \text{35. a.} & 3 = 3 & 7\frac{2}{3} = 7\frac{2 \times 2}{3 \times 2} = 7\frac{4}{6} \\
 & 2 = 2 & 5\frac{1}{2} = 5\frac{1 \times 3}{2 \times 3} = 5\frac{3}{6} \\
 & 6 = 2 \times 3 & \\
 & \text{LCD} = 2 \times 3 = 6 & \\
 & & + 12\frac{1}{6} = 12\frac{1}{6} = 12\frac{1}{6} \\
 & & \hline
 & & 24\frac{8}{6} = 25\frac{2}{6} = 25\frac{1}{3}
 \end{array}$$

$$\begin{array}{rcl}
 \text{b.} & 8 = 2^3 & 12\frac{3}{8} = 12\frac{3}{8} \\
 & 2 = 2 & 2\frac{1}{2} = 2\frac{4}{8} \\
 & \text{LCD} = 2^3 = 8 & \\
 & & + 5\frac{1}{8} = 5\frac{1}{8} \\
 & & \hline
 & & 19\frac{8}{8} = 20
 \end{array}$$

$$\begin{array}{rcl}
 \text{37. a.} & \frac{1}{2} \times \frac{2}{3} + \frac{1}{5} = \frac{1}{3} + \frac{1}{5} & \text{Multiplication before addition} \\
 & = \frac{5}{15} + \frac{3}{15} & \\
 & = \frac{8}{15} &
 \end{array}$$

$$\begin{array}{rcl}
 \text{b.} & \frac{1}{5} \div \frac{1}{3} \div \frac{1}{4} = \frac{1}{5} \times \frac{3}{1} \div \frac{1}{4} & \text{Division, left to right} \\
 & = \frac{3}{5} \times \frac{4}{1} & \\
 & = \frac{12}{5} &
 \end{array}$$

$$\begin{array}{rcl}
 \text{39. a.} & \frac{3 \times 3 + 5 \times 2}{5 \times 3} = \frac{9 + 10}{15} & \text{b.} \quad \frac{3 \times 5 + 7 \times 4}{7 \times 5} = \frac{15 + 28}{35} \\
 & = \frac{19}{15} & \\
 & & = \frac{43}{35}
 \end{array}$$

41. Multiplication before addition:  $\frac{4}{5} \times \frac{17}{95} + \frac{4}{5} \times \frac{78}{95} = \frac{4}{5} \times \left( \frac{17}{95} + \frac{78}{95} \right)$

$$= \frac{4}{5} \times 1$$

$$= \frac{4}{5}$$

By calculator:  $(4 \div 5) \times (17 \div 95) + (4 \div 5) \times (78 \div 95) =$  Display: 0.8 Answer is 0.8 or  $\frac{4}{5}$ .

43. Parentheses first:  $\left( \frac{4}{5} + \frac{2}{3} \right) \div \frac{1}{5} + 2 = \left( \frac{12}{15} + \frac{10}{15} \right) \div \frac{1}{5} + 2$

$$= \frac{22}{15} \times \frac{5}{1} + 2$$

$$= \frac{22}{3} + \frac{6}{3}$$

$$= \frac{28}{3}$$

By calculator:  $(4 \div 5 + 2 \div 3) \div (1 \div 5) + 2 =$  Display: 9.333333333 Answer is  $9.\bar{3}$  or  $9\frac{1}{3}$ .

45. By calculator:  $15 \div 253 + (53 \div 104 - 25 \div 208) =$  Display: .4487116145 (This is an approximate answer.)

47. First find the regions labeled “B” and add up their areas: The first one at the left is  $\frac{1}{2}$  of  $\frac{1}{4}$ ; The second one is at the right and is  $\frac{1}{3}$  of  $\frac{1}{2}$ :

$$\frac{1}{2} \cdot \frac{1}{4} + \frac{1}{3} \cdot \frac{1}{2} = \frac{1}{8} + \frac{1}{6}$$

*Multiplication before addition*

$$= \frac{1 \times 3}{8 \times 3} + \frac{1 \times 4}{6 \times 4}$$

$$= \frac{3}{24} + \frac{4}{24}$$

$$= \frac{7}{24}$$

49. For this one, we find the portion that is not C. The C portion at the left is  $\frac{1}{4}$  and the C portion at the right is  $\frac{1}{3}$  of  $\frac{1}{2}$  or  $\frac{1}{6}$ :

$$\frac{1}{4} + \frac{1}{6} = \frac{1 \times 3}{4 \times 3} + \frac{1 \times 2}{6 \times 2}$$

$$= \frac{3}{12} + \frac{2}{12}$$

$$= \frac{5}{12}$$

Thus, the portion that is not C is:  $1 - \frac{5}{12} = \frac{7}{12}$

**51.** This is the portion that is not B. From Problem 47, the portion that is B is  $\frac{7}{24}$ . Thus, we find

$$1 - \frac{7}{24} = \frac{17}{24}$$

**53.** We see the square is divided into three columns of equal size. We are looking for the parts labeled K: in the first column K is  $\frac{1}{3}$  of  $\frac{1}{2}$  or  $\frac{1}{6}$  of that column; in the second column it is  $\frac{1}{3}$  of that column; there is no K in the third column. Thus,

$$\begin{aligned} \frac{1}{6} \times \frac{1}{3} + \frac{1}{3} \times \frac{1}{3} + 0 \times \frac{1}{3} &= \frac{1}{18} + \frac{1}{9} \\ &= \frac{1}{18} + \frac{2}{18} \\ &= \frac{3}{18} \\ &= \frac{1}{6} \end{aligned}$$

**55.** We see the square is divided into three columns of equal size. We are looking for the parts labeled Y: in the first column Y is  $\frac{1}{2}$  of that column; in the second column it is  $\frac{1}{3}$  of that column; there is no Y in the third column. Thus,

$$\begin{aligned} \frac{1}{2} \times \frac{1}{3} + \frac{1}{3} \times \frac{1}{3} + 0 \times \frac{1}{3} &= \frac{1}{6} + \frac{1}{9} \\ &= \frac{3}{18} + \frac{2}{18} \\ &= \frac{5}{18} \end{aligned}$$

**57.** R or G or Y is everything that is not K:

$$1 - \frac{1}{6} = \frac{5}{6}$$

The fact that K is  $\frac{1}{6}$  of the square was found in Problem 53.

$$\begin{aligned}
 59. \quad 1\frac{1}{4} + 2\frac{2}{3} + 3\frac{1}{2} &= 1\frac{3}{12} + 2\frac{8}{12} + 3\frac{6}{12} \\
 &= 6\frac{17}{12} \\
 &= 7\frac{5}{12}
 \end{aligned}$$

The total weight is  $7\frac{5}{12}$  pounds.

## 1.8 Hindu-Arabic Numeration System, page 58

**SURVIVAL HINT:** *The ESSENTIAL IDEAS in the first three problems summarize what you need to remember from this section.*

### New Terms Introduced in this Section

Abacus	Expanded notation	Hindu-Arabic numerals	Number
Number	Numeral	Numeration system	

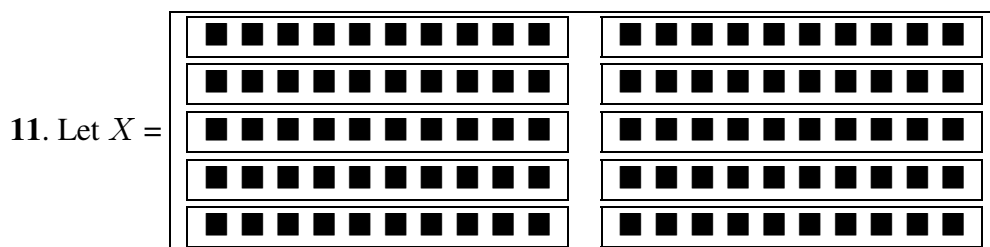
### Problem Set 1.8, page 61

1. A decimal numeration system refers to a numeration system with 10 symbols and rules for combining those symbols to represent all numbers. If we refer to the decimal numeration system we use everyday then (1) there are ten symbols, (2) larger numbers are expressed in terms of powers of 10, and (3) it is positional.
3. A Hindu-Arabic numeral is one of the decimal numerals we use everyday: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.
5. A *number* is an expression of quantity whereas a *numeral* is a symbol used to represent a number.
6. Expanded notation is writing a number by showing the meaning of each digit in that number.
7. a. 100    b. 400    8. a. 2    b. 64

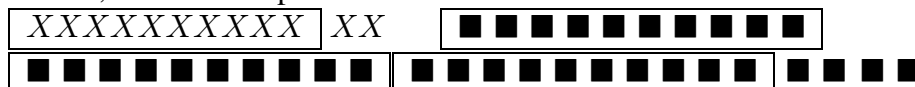
9.

The diagram shows base ten blocks for the number 142. It consists of one large cube (representing 1000), four flats (each representing 100, totaling 400), two rods (each representing 10, totaling 20), and two units (each representing 1, totaling 2). The blocks are arranged in a way that shows the composition of the number 142.

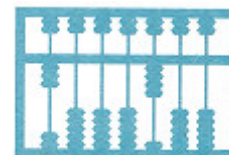
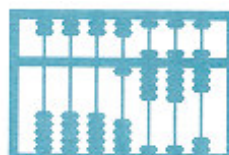




Then 1,234 can be represented as



13. 5 units      15. 5 thousandths      17. 5 ten thousands
19. a.  $10^5 = 100,000$  Five zeros      b.  $10^3 = 1,000$  Three zeros
21. a.  $5 \times 10^3 = 5,000$       b.  $5 \times 10^2 = 500$
23. a.  $6 \times 10^{-2} = 0.06$       b.  $9 \times 10^{-5} = 0.00009$
25. a.  $1 \times 10^4 + 0 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0 = 10,234$   
b.  $6 \times 10^1 + 5 \times 10^0 + 0 \times 10^{-1} + 8 \times 10^{-2} + 9 \times 10^{-3} = 65.089$
27. a.  $7 \times 10^6 + 3 \times 10^{-2} = 7,000,000.03$       b.  $6 \times 10^9 + 2 \times 10^{-3} = 6,000,000,000.002$
29.  $3 \times 10^3 + 2 \times 10^1 + 8 \times 10^0 + 5 \times 10^{-1} + 4 \times 10^{-2} + 2 \times 10^{-4} = 3,028.5402$
31. a.  $741 = 7 \times 10^2 + 4 \times 10 + 1$   
b.  $728,407 = 7 \times 10^5 + 2 \times 10^4 + 8 \times 10^3 + 4 \times 10^2 + 7$
33. a.  $47.00215 = 4 \times 10^1 + 7 + 2 \times 10^{-3} + 1 \times 10^{-4} + 5 \times 10^{-5}$   
b.  $521 = 5 \times 10^2 + 2 \times 10 + 1$
35. a.  $428.31 = 4 \times 10^2 + 2 \times 10^1 + 8 + 3 \times 10^{-1} + 1 \times 10^{-2}$   
b.  $5,245.5 = 5 \times 10^3 + 2 \times 10^2 + 4 \times 10^1 + 5 + 5 \times 10^{-1}$
37. a.  $893.0001 = 8 \times 10^2 + 9 \times 10^1 + 3 + 1 \times 10^{-4}$   
b.  $8.00005 = 8 + 5 \times 10^{-5}$
39. 31      41. 10,905      43. 1,051,004
45.      47.      49.      51.



53. 5 yr, 7 mo + 6 yr, 8 mo = 11 yr, 15 mo or 12 years, 3 months  
(There are 12 months in one year.)
55. 10 ft, 7 in. + 7 ft, 10 in. = 17 ft, 17 in. or 18 ft, 5 in.  
(There are 12 in. in one ft.)

$$\begin{array}{r} 57. \quad 2 \text{ gross} + 3 \text{ dozen} + 4 \text{ units} \\ + 5 \text{ gross} + 9 \text{ dozen} + 10 \text{ units} \\ \hline \end{array}$$

$$7 \text{ gross} + 12 \text{ dozen} + 14 \text{ units}$$

Since 14 units = 1 dozen + 2 units and since 12 dozen = 1 gross,  
we have 7 gross + 12 dozen + 14 units = 8 gross, 1 dozen, 2 units

$$\begin{array}{r} 59. \quad 1 \text{ year} + 7 \text{ months} + 11 \text{ days} \\ + 1 \text{ year} + 6 \text{ months} + 26 \text{ days} \\ \hline \end{array}$$

$$2 \text{ years} + 13 \text{ months} + 37 \text{ days}$$

Since 37 days = 1 month, 7 days and since 13 months + 1 month = 14 months is 1 year and 2 months, we have the length of time to be:

3 years, 2 months, 7 days

## 1.9 Different Numeration System, page 63

**SURVIVAL HINT:** By “different” we mean any numeration system that is not the Hindu-Arabic system. There are four ESSENTIAL IDEAS for this section .... can you list them?

### New Terms Introduced in this Section

Decimal numeration system

Hexadecimal

Octal

Place-value chart

### Problem Set 1.9, page 67

5. To change from base eight to base ten write the base eight number in expanded notation, and then simplify.
6. To change from base sixteen to base ten write the base sixteen number in expanded notation, and then simplify.
7. To change from base ten to base eight use Table 1.3 or use repeated division by eight and save the remainders. Read the remainders down for base eight representation.
8. To change from base ten to base sixteen, we need to invent symbols for 12, 13, 14, and 15 objects. Then use repeated division by sixteen and save the remainders. Read the remainders down for base sixteen representation.
9.
  - a. In base 10, we count 9 people in line.
  - b. In base 5, we have 1 group of 5 with 4 left over; that is,  $14_{\text{five}}$ .
  - c. In base 3, there is one big group of 3 groups; that is,  $100_{\text{three}}$ .
  - d. In base 8 there is one group with 1 left over; that is,  $11_{\text{eight}}$ .
  - e. In base 2, there is one group of a group of groups, and one left over; that is,  $1001_{\text{two}}$ .
  - f. In base 9, there is one group; that is  $10_{\text{nine}}$ .

$$11. 643_{\text{eight}} = 6 \times 8^2 + 4 \times 8^1 + 3 \times 8^0$$

$$13. 110111.1001_{\text{two}} = 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} \\ + 0 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$$

**SURVIVAL HINT:** *It is usual not to show the terms that are 0 when writing the expanded notation of a number.*

$$15. 64200051_{\text{eight}} = 6 \times 8^7 + 4 \times 8^6 + 2 \times 8^5 + 5 \times 8^1 + 1 \times 8^0$$

$$17. 323000.2_{\text{four}} = 3 \times 4^5 + 2 \times 4^4 + 3 \times 4^3 + 2 \times 4^{-1}$$

$$19. 3.40231_{\text{five}} = 3 \times 5^0 + 4 \times 5^{-1} + 2 \times 5^{-2} + 3 \times 5^{-3} + 1 \times 5^{-4}$$

$$21. 527_{\text{eight}} = 5 \times 8^2 + 2 \times 8 + 7 = 343$$

$$23. 25TE_{\text{twelve}} = 2 \times 12^3 + 5 \times 12^2 + 10 \times 12^1 + 11 \times 12^0 \\ = 3,456 + 720 + 120 + 11 \\ = 4,307$$

$$25. 431_{\text{five}} = 4 \times 5^2 + 3 \times 5 + 1 \times 5^0 \\ = 100 + 15 + 1 \\ = 116$$

$$27. 1011.101_{\text{two}} = 1 \times 2^3 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-3} \\ = 8 + 2 + 1 + \frac{1}{2} + \frac{1}{8} \\ = 11.625$$

$$29. 2110_{\text{three}} = 2 \times 3^3 + 1 \times 3^2 + 1 \times 3^1 \\ = 54 + 9 + 3 \\ = 66$$

$$31. 537.1_{\text{eight}} = 5 \times 8^2 + 3 \times 8^1 + 7 \times 8^0 + 1 \times 8^{-1} \\ = 320 + 24 + 7 + \frac{1}{8} \\ = 351.125$$

33. Use repeated division by five.

0	remainder. 1
5) <u>1</u>	remainder: 0
5) <u>5</u>	remainder: 3
5) <u>28</u>	remainder: 4
5) <u>144</u>	remainder: 4
5) <u>724</u>	

Read down for the correct number:  $10344_{\text{five}}$ .

**35.** We recognize 256 as a power of two, namely  $2^8$ , so  $256 = 100000000_{two}$ .

**37.** Use repeated division by five.

$$\begin{array}{r} 0 \\ 5 \overline{) 3} \quad \text{remainder: 3} \\ 5 \overline{) 16} \quad \text{remainder: 1} \\ 5 \overline{) 82} \quad \text{remainder: 2} \\ 5 \overline{) 412} \end{array}$$

Read down for the correct number:  $3122_{five}$ .

**39.** Use repeated division by twelve.

$$\begin{array}{r} 0 \\ 12 \overline{) 2} \quad \text{remainder: 2} \\ 12 \overline{) 35} \quad \text{remainder: 11} \\ 12 \overline{) 427} \quad \text{remainder: 7} \\ 12 \overline{) 5133} \quad \text{remainder: 9} \end{array}$$

Read down for the correct number (don't forget to represent the remainder of 11 as E):

$2E79_{twelve}$ .

**41.** We recognize 512 as a power of two, namely  $2^9$ , so  $512 = 1000000000_{two}$ .

**43.** Use repeated division by three.

$$\begin{array}{r} 0 \\ 3 \overline{) 1} \quad \text{remainder: 1} \\ 3 \overline{) 5} \quad \text{remainder: 2} \\ 3 \overline{) 17} \quad \text{remainder: 2} \\ 3 \overline{) 52} \quad \text{remainder: 1} \end{array}$$

Read down for the correct number:  $1221_{three}$ .

**45.** Use repeated division by eight.

$$\begin{array}{r} 0 \\ 8 \overline{) 1} \quad \text{remainder: 1} \\ 8 \overline{) 9} \quad \text{remainder: 1} \\ 8 \overline{) 75} \quad \text{remainder: 3} \\ 8 \overline{) 602} \quad \text{remainder: 2} \end{array}$$

Read down for the correct number:  $1132_{eight}$ .

**47.** Covert 158 to base twenty-four.

$$\begin{array}{r} 0 \\ 24 \overline{) 6} \quad \text{remainder: 6} \\ 24 \overline{) 158} \quad \text{remainder: 14} \end{array}$$

Read down for the correct number: 6 days, 14 hours.

49. Convert 39 to base 16: 2 groups of 16 with 7 left over . Thus, 39 ounces is 2 lb, 7 oz.

51. Convert 459 to base five:

$$\begin{array}{r} 0 \\ 5 \overline{) 3} \quad \text{remainder: 3} \\ 5 \overline{) 18} \quad \text{remainder: 1} \\ 5 \overline{) 91} \quad \text{remainder: 4} \\ 5 \overline{) 459} \end{array}$$

In base five,  $459 = 3314_{\text{five}}$ . This means that we have  $3 \times 5^3 + 3 \times 5^2 + 1 \times 5 + 4$ . Now the unit of 5 is a nickel,  $5^2$  is a quarter and of  $5^3$  is five quarters. Thus, there are 18 quarters, 1 nickel, and 4 pennies.

53.  $242_{\text{five}}$ ; financial status is

$$\begin{aligned} 2 \times 5^2 + 4 \times 5 + 2 &= 50 + 20 + 2 \\ &= 72 \end{aligned}$$

The financial status is \$0.72.

55. We do repeated division by 5:

$$\begin{array}{r} 33 \\ 5 \overline{) 166} \quad \text{remainder: 1} \\ 5 \overline{) 834} \quad \text{remainder: 4} \end{array}$$

We see that we would have 33 quarters, 1 nickel, 4 pennies.

57.  $54 = 4 \times 12 + 6$ , so  $54 = 46_{\text{twelve}}$

This is 4 years, 6 months.

59.  $49 = 2 \times 24 + 1 = 21_{\text{twenty-four}}$

This is 2 days, 1 hour.

## Chapter 1 Review Questions, page 74



Studying for a chapter examination is a personal process, one which nobody else can do for you. Simply take the time to review what you have done.

**SURVIVAL HINT:** *The self-test is designed to review the material of this chapter. Notice that for each objective there is a corresponding question on the sample test. The complete solution for each problem in the self-test is given in the text immediately following the self-test. After you have studied the chapter, **then** take the practice test. Treat it like a classroom test. Work the problem without looking in the book and without looking at the answers. After you have spent an hour or two taking this test, correct the problem by checking your answers in the back of the book. If you miss any question, then that points to an additional area of study. If you concentrate as you are doing this, some good things will happen.*



$$\begin{aligned}\text{b. } 0.2\frac{2}{9} &= 2\frac{2}{9} \times \frac{1}{10} \\ &= \frac{20}{9} \times \frac{1}{10} \\ &= \frac{2}{9}\end{aligned}$$

$$\begin{aligned}\text{c. } 0.95 &= \frac{95}{100} \\ &= \frac{5 \times 19}{5 \times 20} \\ &= \frac{19}{20}\end{aligned}$$

$$\begin{aligned}\text{d. } 0.00\frac{1}{2} &= \frac{1}{2} \times \frac{1}{100} \\ &= \frac{1}{200}\end{aligned}$$

$$\begin{aligned}\text{15. a. } 12 + 20 \div 2 &= 12 + 10 \\ &= 22\end{aligned}$$

$$\begin{aligned}\text{b. } (12 + 20) \div 2 &= 32 \div 2 \\ &= 16\end{aligned}$$

This is a sum.

This is a quotient.

$$\begin{aligned}\text{c. } 8 + 3 \times 6 \div 2 &= 8 + 18 \div 2 \\ &= 8 + 9 \\ &= 17\end{aligned}$$

$$\begin{aligned}\text{d. } (8 + 3) - (6 \div 2) &= 11 - 3 \\ &= 8\end{aligned}$$

This is a difference.

$$\begin{aligned}\text{17. a. } \frac{5}{8} \div \frac{1}{2} &= \frac{5}{8} \times \frac{2}{1} \\ &= \frac{5 \times 2}{4 \times 2 \times 1} \\ &= \frac{5}{4}\end{aligned}$$

$$\begin{aligned}\text{b. } \frac{14}{25} \div \frac{7}{5} &= \frac{14}{25} \times \frac{5}{7} \\ &= \frac{2 \times 7 \times 5}{5 \times 5 \times 7} \\ &= \frac{2}{5}\end{aligned}$$

$$\begin{aligned}\text{c. } 1\frac{1}{2} \div \frac{3}{4} &= \frac{3}{2} \times \frac{4}{3} \\ &= \frac{3 \times 2 \times 2}{2 \times 3} \\ &= 2\end{aligned}$$

$$\begin{aligned}\text{d. } 6\frac{1}{2} \div 3\frac{3}{4} &= \frac{13}{2} \div \frac{15}{4} \\ &= \frac{13}{2} \times \frac{4}{15} \\ &= \frac{13 \times 2 \times 2}{2 \times 15} \\ &= \frac{26}{15}\end{aligned}$$

$$\begin{aligned}\text{19. a. } 8 &= 2^3 \\ 6 &= 2 \times 3 \\ \text{LCD} &= 2^3 \times 3 = 24\end{aligned}$$

$$\begin{aligned}\frac{3}{8} &= \frac{3 \times 3}{8 \times 3} = \frac{9}{24} \\ \frac{1}{6} &= \frac{1 \times 4}{6 \times 4} = \frac{4}{24} \\ + \quad & \\ \hline & \frac{13}{24}\end{aligned}$$

$$\begin{aligned}\text{b. } 12 &= 2^2 \times 3 \\ 15 &= 3 \times 5 \\ \text{LCD} &= 2^2 \times 3 \times 5 = 60\end{aligned}$$

$$\begin{aligned}\frac{7}{12} &= \frac{7 \times 5}{12 \times 5} = \frac{35}{60} \\ \frac{2}{15} &= \frac{2 \times 4}{15 \times 4} = \frac{8}{60} \\ - \quad & \\ \hline & \frac{27}{60}\end{aligned}$$

$$\frac{27}{60} = \frac{3 \times 9}{3 \times 20} = \frac{9}{20}$$

c. From part **b**, the LCD is 60.

$$7\frac{2}{15} = 7\frac{2 \times 4}{15 \times 4} = 7\frac{8}{60} = 6\frac{68}{60}$$

$$-3\frac{7}{12} = -3\frac{7 \times 5}{12 \times 5} = -3\frac{35}{60} = -3\frac{35}{60}$$

$$\begin{aligned} & 3\frac{33}{60} = 3\frac{11}{20} \\ \text{d. } \begin{array}{l} 10 = 2 \times 5 \\ 15 = 3 \times 5 \\ 6 = 2 \times 3 \\ \text{LCD} = 2 \times 3 \times 5 = 30 \end{array} & \quad \frac{4}{10} + \frac{7}{15} - \frac{5}{6} = \frac{4 \times 3}{10 \times 3} + \frac{7 \times 2}{15 \times 2} - \frac{5 \times 5}{6 \times 5} \\ & = \frac{12}{30} + \frac{14}{30} - \frac{25}{30} \\ & = \frac{1}{30} \end{aligned}$$

21. a.  $\boxed{2} \boxed{\div} \boxed{3} \boxed{+} \boxed{4} \boxed{\div} \boxed{5} \boxed{\div} \boxed{(} \boxed{1} \boxed{\div} \boxed{2} \boxed{)} \boxed{=} \boxed{}$ ; 2.266666667; sum

b.  $\boxed{(} \boxed{2} \boxed{\times} \boxed{8} \boxed{+} \boxed{3} \boxed{\times} \boxed{5} \boxed{)} \boxed{\div} \boxed{(} \boxed{3} \boxed{\times} \boxed{8} \boxed{)} \boxed{=} \boxed{}$ ;  
1.291666667; quotient

c.  $\boxed{4} \boxed{\div} \boxed{5} \boxed{\times} \boxed{12} \boxed{\div} \boxed{23} \boxed{-} \boxed{4} \boxed{\div} \boxed{5} \boxed{\times} \boxed{2} \boxed{\times} \boxed{23} \boxed{=} \boxed{}$   
0.342826087; difference

d.  $\boxed{(} \boxed{4} \boxed{\div} \boxed{5} \boxed{)} \boxed{\times} \boxed{(} \boxed{12} \boxed{\div} \boxed{23} \boxed{-} \boxed{2} \boxed{\div} \boxed{23} \boxed{)} \boxed{=} \boxed{}$   
0.342826087; product

*Note:* compare parts **c** and **d**; they represent the same number (distributive property), but **c** is a difference and **d** is a product.

23. a.  $4 \times 10^3 + 6 \times 10^1 + 3 \times 10^0 + 2 \times 10^{-2} = 4,063.02$

b.  $4 \times 8^3 + 6 \times 8^1 + 3 \times 8^0 + 2 \times 8^{-2} = 2,099.03125$

c.  $1 \times 2^3 + 1 \times 2^0 + 1 \times 2^{-1} = 9.5$

d.  $3 \times 12^2 + 4 \times 12^1 + 3 \times 12^0 = 483$

25. Answers vary; it is your favorite digit repeated six times.