Decimals and Equations

Key Vocabulary

- compatible numbers (p. 133)
- formula (p. 143)
- mean (p. 137)
- measures of central tendency (p. 137)
- median (p. 137)
- mode (p. 137)
- outlier (p. 138)
- perimeter (p. 144)

Where You're Going

In this chapter, you will learn how to

- Estimate with decimals.
- Solve equations with decimals.
- Convert metric units of measure.
- Solve a problem by simplifying the problem.

Real-World Snapshots Applying what you learn, on pages 174–175 you will solve problems about price comparisons.

Each digit in a decimal has both a place and a value. The value of any place is one-tenth the value of the place to its left. A place-value chart like the one at the right can help you read and write decimals.

ones	.	tenths	hundredths	thousandths	ten thousandths
0	.	4	2	6	

1 EXAMPLE

a. Express 0.426 using words.

The last digit, 6, is in the thousandths place. So, 0.426 ends with the word *thousandths*.

0.426 is four hundred twenty-six thousandths.

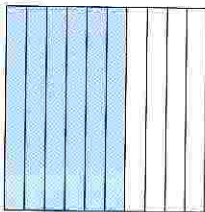**b. Write *two and three hundredths* as a decimal.**

And represents the decimal point. The hundredths place is the second place to the right of the decimal point.
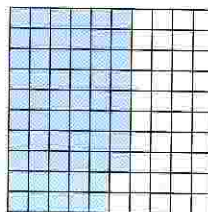
Two and three hundredths is 2.03.

You can use decimal squares to model and compare decimals.

2 EXAMPLE

a. Model 0.6.

b. Model 0.58.

c. Model 1.05.
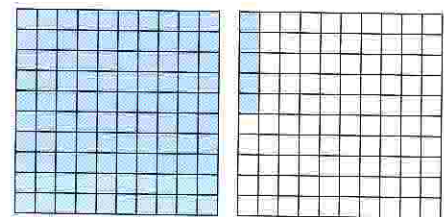
d. Compare 0.6 and 0.58. The models show that 0.6 > 0.58.

EXERCISES

Express each decimal using words.

1. 0.23

2. 0.624

3. 3.081

4. 58.36

Write each as a decimal.

5. three and two tenths

6. five and forty-one hundredths

7. fourteen ten-thousandths

Model and compare each pair of decimals.

8. 0.2 and 0.12

9. 0.89 and 0.9

10. 0.53 and 0.5

11. 1.35 and 1.4

Rounding and Estimating

OBJECTIVE

1 Rounding Decimals

Investigation

Estimating in the Real World

Some real-world problems require only an estimate for an answer. Others require an exact answer. Decide whether each situation needs an estimate or an exact answer. Explain your reasoning.

1. a headline noting the number of people living in China

2. the amount of money a baby sitter charges per hour

3. the width of a window screen

4. the distance from Earth to the moon

5. the hours at soccer practice in one month
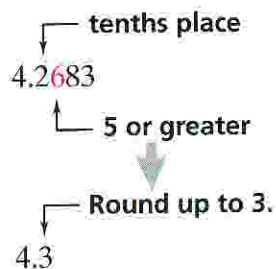
6. the number of tickets to sell for a play

✔ **Check Skills You'll Need**

Use the number 27.3865. Write the value of the given digit.

1. 2   2. 3

3. 8   4. 6

❓ For help, go to Skills Handbook, p. 761 .

You can round decimal numbers when you don't need exact values.

1 EXAMPLE   Rounding Decimals

a. **Round 4.2683 to the nearest tenth.**

┌─ tenths place
4.2683
└─ 5 or greater

⬇

┌─ Round up to 3.
4.3

b. **Round 4.2683 to the nearest one.**

┌─ ones place
4.2683
└─ less than 5

⬇

┌─ Do not change.
4
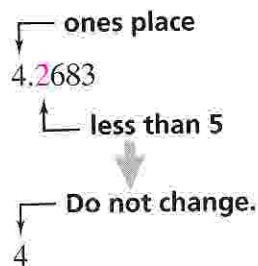
✔ **Check Understanding**   Example 1

1. Identify the underlined place. Then round each number to that place.

   a. 38.41   b. 0.7772   c. 7,098.56

   d. 274.9434   e. 5.025   f. 9.851

ℹ **TEXT** Interactive lesson includes instant self-check, tutorials, and activities.

2 Estimating Sums and Differences

You can estimate a result before you calculate. Then, if your answer is close to your estimate, you know that it probably is correct.

Write $126   ≈ $130

Read $126 is approximately equal to $130.

One way to estimate is to round all numbers to the same place.

2 EXAMPLE   Rounding to Estimate

Estimate to find whether each answer is reasonable.

a. Calculation   Estimate

$$
\begin{array}{rcr}
\$135.95 & \approx & \$140 \\
\$15.90 & \approx & \$20 \\
+ \ \$24.05 & \approx & + \ \$20 \\
\hline
\$275.90 & & \$180
\end{array}
$$

The answer is not close to the estimate. It is *not* reasonable.

b. Calculation   Estimate

$$
\begin{array}{rcr}
464.90 & \approx & 460 \\
- \ 125.73 & \approx & - \ 130 \\
\hline
339.17 & & 330
\end{array}
$$

The answer is close to the estimate. It is reasonable.

✔ Check Understanding Example 2

2. Estimate by rounding.

   a. $355.302 + 204.889$ **b.** $453.56 - 230.07$

A *front-end estimate* is often closer to the exact sum than an estimate you find by rounding. First add the front-end digits. Round to estimate the sum of the remaining digits. Then combine estimates.

3 EXAMPLE   Real-World 🌎 Problem Solving

$1.73

$1.10

$2.71

Grocery Shopping Carrots cost **$2.71**, peppers cost **$1.73**, and broccoli costs **$1.10**. Estimate the total cost of the vegetables.

Add the
front-end digits. ⟶

$$
\begin{array}{rcl}
2.71 & \longrightarrow & .70 \\
1.73 & \longrightarrow & .70 \\
+ \ 1.10 & \longrightarrow & + \ .10 \\
\hline
4 & + & 1.50 = 5.50
\end{array}
\Big\} \text{Estimate by rounding.}
$$

The total cost is about $5.50.

✔ Check Understanding Example 3

3. Estimate using front-end estimation.

   a. $6.75 + 2.2 + 9.58$ **b.** $\$1.07 + \$2.49 + \$7.40$

You can also use *clustering* to estimate the sum of several numbers that are all close to the same value.

4 EXAMPLE **Real-World Problem Solving**

Telephone Service Estimate the total long-distance charge for the months of May, June, July, and August shown at the right.

four months
↓
The values cluster around $15. ⟶ $15 \cdot 4 = 60$

● The total long-distance charge is about $60.00.

✔ **Check Understanding** Example 4

4. Estimate using clustering.
   a. $4.50 + $5.20 + $5.55
   b. $26.7 + 26.2 + 24.52 + 25.25 + 23.9$

In this lesson, you have seen several methods for finding a reasonable estimate. Here are two methods used for the same situation.

More Than One Way

Estimate the total cost of four items priced at $4.39, $3.75, $4.96, and $2.40.

Nicole's Method

Round each price to the nearest dollar. Then add.

$4.39 + $3.75 + $4.96 + $2.40
$4   + $4   + $5   + $2   = $15

Eric's Method

Use front-end estimation.

$4.39 ⟶ $.40
3.75 ⟶ .80
4.96 ⟶ 1.00
+2.40 ⟶ +.40
$13   + $2.60 = $15.60

Choose a Method

1. Which method would you use to estimate the cost of the items? Explain.

2. Find the exact cost. Which estimate is nearer the exact cost?

EXERCISES

Practice and Problem Solving

A Practice by Example
Example 1
(page 127)

Identify the underlined place. Then round each number to that place.

1. 27.3856   **2.** 0.9122   **3.** 1,045.98   **4.** 74.879

Round to the underlined place.

5. 345.678   **6.** 3.14159   **7.** 214.76   **8.** 2.9437

Example 2
(page 128)

Estimate by rounding.

9. $37.99 − $27.32   **10.** 1.58 + 17.0244   **11.** 172.98 − 128.301

12. $4.89 + $3.87   **13.** $16.81 + $11.49   **14.** $565 − $225

Example 3
(page 128)

Estimate using front-end estimation.

15. $6.04 + $3.45 + $4.43   **16.** $5.92 + $4.07

17. 9.89 + 2.43 + 8.37   **18.** 14.39 + 79.12

19. Fitness Kim ran 2.76 miles on Monday, 2.34 miles on Tuesday, and 1.97 miles on Wednesday. Use front-end estimation to estimate the total distance Kim ran.

Example 4
(page 129)

Estimate using clustering.

20. 44.87 + 42.712 + 43.5   **21.** $9.50 + $8.45 + $9.08

22. $21.37 + $22.99 + $22.15   **23.** 15.4 + 16 + 15.9 + 16.25 + 15.7

24. Pets Rico's dog has a litter of four puppies. The puppies weigh 2.33 lb, 2.70 lb, 2.27 lb, and 2.64 lb. Use clustering to estimate the total weight of the puppies.

B Apply Your Skills

Estimate. Use a method of your choice.

25. 8.974 + 2.154   **26.** 102.44 + 48.35   **27.** 600 − 209.52

28. $38.59 + $15.28   **29.** $50.00 − $28.89   **30.** $412.44 + $72.23

31. 800 + 810.5 + 807.3 + 791.1   **32.** 54.23 + 56.12 + 57.98 + 55.55
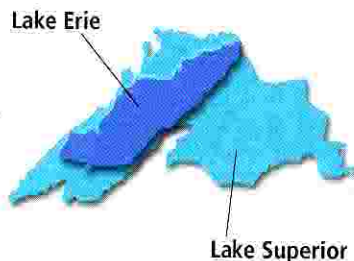
Lake Erie

33. Geography Lake Superior, the largest of the Great Lakes, has an area of about 31,760 mi². Lake Erie, the smallest of the Great Lakes, has an area of about 9,920 mi². About how much larger is Lake Superior than Lake Erie?

Lake Superior

Estimate. State the method you used.

34. $8.99 + $8.01   **35.** 2.3 + 2.3 + 4.56   **36.** $89.90 − $49.29

37. 102.54 − 74.75   **38.** 20.55 − 1.48   **39.** 78.87 + 11.49

🌎 **40. Weather** Mobile, Alabama, has an average annual rainfall of 63.96 in. The average annual rainfall in San Francisco, California, is 19.70 in. About how much more rain falls each year in Mobile than in San Francisco?

C Challenge

41. Open-Ended Describe a situation in which a rounded answer is appropriate. Describe one in which an exact answer is necessary.

42. Writing in Math You have $11.50 to buy two presents. You find one item that costs $7.43. Another item costs $4.41. What estimation strategy will help you decide whether you have enough money to buy both? Explain.

43. Error Analysis You used a calculator to find 383.8 − 21.9. Your estimate was 360, but your display reads 164.8. How could you have gotten 164.8 on your calculator?

Test Prep

Multiple Choice

44. Which phrase best completes the statement?
The sum of $12.75 and $7.65 is   ? .
A. less than $20.00   **B.** greater than $20.00
C. an integer   **D.** greater than $25.00

45. When you estimate 320.18 + 46 + 8.68 by rounding to tens, what value do you get?
F 370   **G.** 374.9   **H.** 375   **I.** 380

Short Response

46. In 2000, the population of the state of Georgia was about 8.19 million. In 1950, the population was about 3.44 million.
  a. About how much greater was Georgia's population in 2000 than in 1950?
  b. Explain how you found your answer for part (a).

Mixed Review

Lesson 2-10   Solve each inequality.

47. $9x \le 27$ **48.** $4x < 16$ **49.** $-3y \le 0$ **50.** $-6k > -24$

Lesson 2-7 🌎 **51. Collections** Ming's model vehicle collection contains 4-wheeled trucks and 2-wheeled bikes. She owns an even number of vehicles, and they have 26 wheels in all. If Ming has a little more than twice as many bikes as trucks, how many of each does she own?

Lesson 1-9   Simplify.

52. $(-2)(-2)$ **53.** $4(-3)$ **54.** $-8 \div 2$ **55.** $6(-5)$

Estimating Decimal Products and Quotients

...And Why

To determine the reasonableness of answers to real-world problems involving mass

✓ **Check Skills You'll Need**

Round to the nearest one.

1. 145.89   **2.** 199.27

3. 101.06   **4.** 28.45

🌱 For help, go to Lesson 3-1.

New Vocabulary

• compatible numbers

OBJECTIVE

1 **Estimating Products**

You can use mental math to estimate products and quotients. It is a good idea to estimate answers to check your calculations.

1 EXAMPLE   **Estimating the Product**

Estimate 7.65 · 3.2.

$7.65 \approx 8$ $3.2 \approx 3$ **Round to the nearest one.**

$8 \cdot 3 = 24$ **Multiply.**

$7.65 \cdot 3.2 \approx 24$

✓ **Check Understanding**   **Example 1**

1. Estimate each product.

a. $4.72 \cdot 1.8$ **b.** $17.02 \cdot 3.78$ **c.** $8.25 \cdot 19.8$

2 EXAMPLE   **Real-World 🌐 Problem Solving**

Quilting Arlene bought 6 yd of fabric to make this Lone Star quilt. The fabric cost $6.75/yd. The sales clerk charged Arlene $45.90 before tax. Did the clerk make a mistake? Explain.

$6.75 \approx 7$ **Round to the nearest dollar.**

$7 \cdot 6 = 42$ **Multiply 7 times 6, the number of yards of fabric.**

The sales clerk made a mistake. Since $6.75 < 7$, the actual cost should be less than the estimate. The clerk should have charged Arlene less than $42.00 before tax.

✓ **Check Understanding**   **Example 2**

2. Photography You buy 8 rolls of film for your camera. Each roll costs $4.79. Estimate the cost of the film before tax.

ⓘ **TEXT** Interactive lesson includes instant self-check, tutorials, and activities.

2 Estimating Quotients

When dividing, remember these names for the parts of a division sentence.

```
          ┌── dividend
          ↓
6 ÷ 3 = 2 ←── quotient
    ↑
    └── divisor
```

When dividing, you can use *compatible numbers* to estimate quotients. **Compatible numbers** are numbers that are easy to divide mentally. When you estimate a quotient, first round the divisor, and then round the dividend to a compatible number.

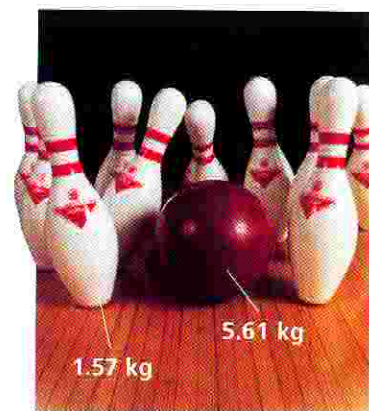### 3 EXAMPLE   Real-World 🌐 Problem Solving

Measurement A bowling ball has a mass of 5.61 kg. Each bowling pin has a mass of 1.57 kg. How many bowling pins are about equal to the bowling ball in mass? Estimate $5.61 \div 1.57$.

$1.57 \approx 2$ Round the divisor.

$5.61 \approx 6$ Round the dividend to a multiple of **2** that is close to 5.61.

$6 \div 2 = 3$ Divide.

The mass of three bowling pins is about equal to that of the bowling ball.

✔ **Check Understanding**   Example 3

3. Estimate each quotient.

   a. $38.9 \div 1.79$ b. $11.95 \div 2.1$ c. $82.52 \div 4.25$

You can estimate to determine the reasonableness of results.

4 EXAMPLE   Estimating to Determine Reasonableness

Number Sense Is 2.15 a reasonable quotient for $17.931 \div 8.34$?

$8.34 \approx 8$ Round the divisor.

$17.931 \approx 16$ Round the dividend to a multiple of **8** that is close to 17.931.

$16 \div 8 = 2$ Divide.

Since 2.15 is close to the estimate 2, it is reasonable.

✔ **Check Understanding**   Example 4

4. Use estimation. Is each quotient reasonable? Explain.

   a. $1.564 \div 2.3 = 0.68$ b. $26.0454 \div 4.98 = 52.3$

Real-World 🌐 Connection

The masses of ten-pin bowling balls range from 3.63 kg to 7.26 kg.

5.61 kg

1.57 kg

Test-Taking Tip

You can sometimes use estimation to eliminate answer choices on a multiple choice test.

What is $8.19 \div 2.1$?

A. 39   B. 4.1

C. 3.9   D. 0.41

If you estimate $8 \div 2 \approx 4$, then you know you can eliminate choices A and D.

EXERCISES

Practice and Problem Solving

A Practice by Example

Estimate each product.

Example 1
(page 132)

1. $4.56 \cdot 7.02$ **2.** $11.15 \cdot 4.44$ **3.** $6.3 \cdot 9.2$

4. $24.5 \cdot 4.2$ **5.** $3.29 \cdot 58$ **6.** $0.08 \cdot 40.05$

Example 2
(page 132)

Estimate the cost of each purchase.

7. Food Tom bought 6 hamburgers for $2.89 each.

8. Sports Equipment The athletic director bought 5 soccer balls for $12.29 each.

Example 3
(page 133)

Estimate each quotient using compatible numbers.

9. $3.9 \div 2.1$ **10.** $3.86 \div 1.95$ **11.** $19.56 \div 0.71$

12. $585 \div 11.75$ **13.** $18.2 \div 3.4$ **14.** $57.1 \div 7.2$

15. Unit Pricing Marshall buys a sack of peaches for $5.98. If the peaches weigh 2.77 pounds, about what price per pound did Marshall pay?

Example 4
(page 133)

Use estimation. Is each quotient reasonable? Explain.

16. $102.6 \div 22.5 = 45.6$ **17.** $\$32.40 \div 4.80 = \$67.50$

18. Number Sense Explain how you would find a reasonable estimate for $14.90 \div 4.56$.

B Apply Your Skills

Estimate each product or quotient.

19. $193.7 \cdot 1.78$ **20.** $7.95 \div 2.1$ **21.** $9.392 \div 2.9$

22. $876.66 \cdot 39.64$ **23.** $\$75.45 \div 12.48$ **24.** $16.33 \cdot 3.5$

Data Analysis Use the table below for Exercises 25–27.

Hospital Staff Wages (40-h week)

Occupation	Dallas, TX	Washington, DC
Physical Therapist	$733.20	$655.20
Pharmacist	$793.60	$851.60
Nurse	$606.80	$714.80

SOURCE: *The American Almanac of Jobs and Salaries*

Reading Math
For help with reading and solving Exercise 27, see page 136.

25. Estimate the hourly wage for each staff position.

26. Estimate the yearly (52 weeks) salary for each staff position.

27. How much more per hour does a physical therapist in Dallas, Texas, make than a physical therapist in Washington, D.C.?

Use estimation. Is each product or quotient reasonable? Explain.

28. $-46.82(-1.5) = 702.3$ **29.** $-71.5071 \div (-11.9) = 6.009$

30. Gas Mileage Shari is planning a 450-mi car trip. Her car can travel about 39 mi on a gallon of gasoline. Gasoline costs $1.89/gal. About how much will the gas cost for her trip?

Challenge

Estimate each quotient.

31. $-483.09 \div 7.29$ **32.** $-362,400 \div (-4.2)$

33. Health Humans breathe about 15 breaths in a minute. The average breath at rest contains 0.76 liter of air. About how many liters of air will you breathe while at rest for 25 minutes?

34. Writing in Math You estimate $21.2 \div 3.75$ to be 5. Your friend estimates the quotient to be 7. Explain how the two estimates can be different and yet both be reasonable.

Test Prep

Multiple Choice

35. Greta ran the 400-m dash in 49.07 s. If Greta ran at a constant rate, how many meters did she run in one second?
A. between 8 m and 9 m   B. between 9 m and 10 m
C. between 10 m and 11 m   D. between 11 m and 12 m

36. A shrew, the world's smallest mammal, has a heart rate of 790 beats per minute. About how many times does a shrew's heart beat in 5 minutes?
F. 3,500   G. 4,000   H. 4,500   I. 4,790

Short Response

37. Two people estimate the product $1.99 \cdot 8.5$.
a. Will they necessarily get the same estimate?
b. Explain your answer.

38. You review your sales slip after buying 4 CDs that cost $14.95 each. Before tax, the total was $77.80. Is this total correct? Explain.

Mixed Review

Lesson 3-1

Estimate each sum or difference.

39. $2.99 + $6.01   **40.** $25.90 − $5.79   **41.** $12.3 + 12.3 + 14.56$

42. $1,242.24 − 24.05$ **43.** $18.95 − 7.48$ **44.** $7.47 − $5.50

Lesson 1-10

In which quadrant or on which axis of a coordinate plane does each point lie?

45. $(2, 4)$ **46.** $(-5, 0)$ **47.** $(8, -6)$ **48.** $(0, 8)$ **49.** $(-5, -3)$

Lesson 1-8

50. Travel A bus trip from Sacramento to Los Angeles takes 7 h 40 min. You depart at 11:40 A.M. At what time will you arrive in Los Angeles?

Read the exercise below and then read how the needed data are found in the table. Follow along as the problem is solved. Check your understanding by solving the exercise at the bottom of the page.

Use the table. How much more per hour does a physical therapist in Dallas, Texas, make than a physical therapist in Washington, D.C.?

The title of the table tells you that the table entries are wages for a 40-h week.

Occupations: Look down for physical therapist.

Cities: Look across for Dallas and Washington.

The table tells you that in a 40-h week:
A physical therapist in Dallas makes $733.20.
A physical therapist in Washington makes $655.20.

Hospital Staff Wages (40-h week)

Occupation	Dallas, TX	Washington, DC
Physical Therapist	$733.20	$655.20
Pharmacist	$793.60	$851.60
Nurse	$606.80	$714.80

SOURCE: *The American Almanac of Jobs and Salaries*

Estimate:

A Dallas physical therapist makes about $730 − $650 = $80 more in a 40-h week.

That's about $80 ÷ 40 = $2 more per hour.

Calculate — Method 1

733.20 − 655.20 = 78.00   Subtract to find the difference in weekly wages.

78.00 ÷ 40 = 1.95   Divide to find the difference in hourly wages.

Calculate — Method 2

733.20 ÷ 40 = 18.33   Divide to find the Dallas hourly wage.

655.20 ÷ 40 = 16.38   Divide to find the Washington hourly wage.

18.33 − 16.38 = 1.95   Subtract to find the difference in hourly wages.

A Dallas physical therapist makes $1.95/h more than one in Washington.

This is close to the estimate of $2/h.

EXERCISES

1. How much less per hour does a nurse in Dallas make than a nurse in Washington?

2. How much more per hour does a pharmacist in Dallas make than a nurse in Dallas?

Mean, Median, and Mode

OBJECTIVE 1 | Finding Mean, Median, and Mode

Mean, median, and *mode* are **measures of central tendency** of a collection of data. Consider the data 2, 3, 4, 5, 8, 8, and 12.

The **mean** is the sum of the data values divided by the number of data values.

$$\text{mean} = \frac{2 + 3 + 4 + 5 + 8 + 8 + 12}{7}$$
$$= \frac{42}{7}$$
$$\text{mean} = 6$$

The **median** is the middle number when data values are written in order and there is an odd number of data values. For an even number of data values, the median is the mean of the two middle numbers.

2   3   4   5   8   8   12

median

The **mode** is the data item that occurs most often. There can be one mode, more than one mode, or no mode.

2   3   4   5   8   8   12

mode

EXAMPLE 1 | Real-World Problem Solving

Fundraising Six elementary students are participating in a one-week Readathon to raise money for a good cause. Use the graph. Find the (a) mean, (b) median, and (c) mode.

Nick 40, Bettina 45, Kyle 48, Larry 50, Marita 50, Latana 59

READATHON (PAGES READ)

a. Mean: $\dfrac{\text{sum of data values}}{\text{number of data values}}$

$= \dfrac{40 + 45 + 48 + 50 + 50 + 59}{6}$

$= \dfrac{292}{6}$

$= 48.666\ldots$

Rounded to the nearest tenth, the mean is 48.7.

b. Median: 40   45   48   50   50   59   **Write the data in order.**

$\dfrac{48 + 50}{2} = 49$ **Find the mean of the two middle numbers.**

The median is 49.

c. Mode: Find the data value that occurs most often.
The mode is 50.

TEXT Interactive lesson includes instant self-check, tutorials, and activities.

✔ **Check Understanding**   Example 1

1. Find the mean, median, and mode: 2.3 4.3 3.2 2.9 2.7 2.3

2 EXAMPLE   **Identifying Modes**

How many modes, if any, does each have?

a. $1.50 $2.00 $2.25 $2.40 $3.50 $4.00

No values are the same, so there is no mode.

b. 2 3 6 **8 8** 10 **11** 12 **14 14** 18 20

Both 8 and 14 appear the same number of times, and most often. There are two modes.

c. grape, grape, banana, nectarine, <u>strawberry, strawberry,</u> <u>strawberry,</u> orange, watermelon

Strawberry appears most often. There is one mode.

✔ **Check Understanding**   Example 2

2. Find the number of modes.

a. 11 9 7 7 8 8 13 11   b. 38.5 55.4 45.3 38.5 68.4

An **outlier** is a data value that is much greater or less than the other data values. An outlier can affect the mean of a group of data.

3 EXAMPLE   **Real-World 🌎 Problem Solving**

Approximate Land Areas That Can Be Farmed in Central American Countries

Guatemala 5,000 mi^2
Belize 200 mi^2
Honduras 6,500 mi^2
Nicaragua 4,500 mi^2
El Salvador 2,200 mi^2
Costa Rica 1,200 mi^2
Panama 2,100 mi^2

SOURCE: *The New York Times Almanac*

Geography   Use the map of Central America at the left.

a. **Which data value is an outlier?**

The data value for Honduras, 6,500 mi^2, is an outlier. It is an outlier because it is 1,500 mi^2 away from the closest data value.

b. **How does the outlier affect the mean?**

$\frac{21,700}{7} = 3,100$ **Find the mean with the outlier.**

$\frac{15,200}{6} \approx 2,500$ **Find the mean without the outlier.**

$3,100 - 2,500 = 600$

The outlier raises the mean by about 600 mi^2.

✔ **Check Understanding**   Example 3

3. Find an outlier in each group of data below and tell how it affects the mean. Round to the nearest tenth.

a. 9 10 12 13 8 9 31 9   b. 1 17.5 18 19.5 16 17.5

2 Choosing the Best Measure

One measure of central tendency may be better than another to describe data. For example, consider the eight hourly wage rates shown at the right. Here are the measures of central tendency.

Employees' Hourly Wages	
$5.50	$6.20
$5.50	$6.30
$5.50	$8.00
$6.00	$17.00

Mode: $5.50
Mean: $7.50
Median: $6.10

The mode is the lowest wage listed. So the mode does not describe the data well.

The mean is above the hourly wage of all but two workers. The mean is influenced by the outlier, $17.

The median is the best measure of central tendency here since it is not influenced by the size of the outlier.

4 EXAMPLE Identifying the Best Measure

Which measure of central tendency best describes each situation? Explain.

a. the favorite movies of students in the eighth grade
Mode; since the data are not numerical, the mode is the appropriate measure. When determining the most frequently chosen item, or when the data are not numerical, use the mode.

b. the daily high temperatures during a week in July
Mean; since daily high temperatures in July are not likely to have an outlier, mean is the appropriate measure. When the data have no outliers, use the mean.

c. the distances students in your class travel to school
Median; since one student may live much farther from school than the majority of students, the median is the appropriate measure. When an outlier may significantly influence the mean, use the median.

Reading Math
To help you recall that *median* means "middle number," think of the green, grassy median strip in the middle of a divided highway.

✓ Check Understanding   Example 4

4. **a. Comparison Shopping** Toshio found the following prices for sport shirts:
$20, $26, $27, $28, $21, $42, $18, and $20.
Find the mean, median, and mode for the shirt prices.
b. Reasoning Which measure of central tendency best describes the data? Justify your reasoning.

EXERCISES

Practice and Problem Solving

A Practice by Example

Example 1
(page 137)

Find the mean, median, and mode of each group of data. If an answer is not a whole number, round to the nearest tenth.

1. 47 56 57 63 89 44 56

2. 4 5 2 3 2 3 3 3 1 1 3

3. 1 2 4 5 5 6 9

4. 2.8 3.6 3.8 4.1 2.8 3.7 4.3

5. Fitness Mia's workouts lasted 1.0 h, 1.5 h, 2.25 h, 1.5 h, 2.4 h, and 2.1 h. Find the mean, median, and mode of these times. If the answer is not an integer, round to the nearest tenth.

Example 2
(page 138)

How many modes, if any, does each group of data have?

6. 31 44 44 31 38

7. 4.3 4.9 4.9 5.2

8. 64 68 64 65 68 65 72 61

9. Bob, Ana, Ron, Bob, Kay

Example 3
(page 138)

Find the outlier in each group of data and tell how it affects the mean.

10. 37 4 7 3 11 9 13 5

11. 126 123 115 125 123

12. Grades Rita's quiz scores are 72, 96, 74, 80, and 79. Find the outlier and tell how it affects Rita's mean quiz score.

Example 4
(page 139)

Which measure of central tendency best describes each situation? Explain.

13. numbers of apples in 2-lb bags

14. favorite brands of jeans of 14-year-olds

15. ages of students in a fifth-grade classroom

Which measure of central tendency best describes each group of data? Explain.

16. minutes on the Internet
50 63 59 85 367 48

17. heights of students in inches
51 45 47 48 50 50 50 52

B Apply Your Skills

For Exercises 18–22, find mean, median, and mode. Which measure of central tendency best describes each group of data? Explain.

18. 3,456 560 435 456

19. 5.6 6.8 1.2 6.5 7.9 6.5

20. 33 76 86 92 86

21. 8 2 4 9 16

22. resting heart rate in beats per minute: 79 72 80 81 40 72

Which measure of central tendency best describes each situation? Explain.

23. shoe colors in a classroom

24. widths of computer screens at a bank

25. numbers of pets owned by classmates

For Exercises 26–28, use the table at the left. Round answers to the nearest tenth.

Fat and Calorie Content
(per 2-tablespoon serving)

Seed or Nut	Fat (g)	Calories
Peanut	8.9	104
Pecan	9.1	90
Pistachio	7.9	92
Pumpkin	7.9	93
Sunflower	8.9	102
Walnut	7.7	80

26. Data Analysis You make a mixture using the same amount of each kind of seed and nut.
   a. What is the mean number of grams of fat in a 2-tablespoon serving of the mixture?
   b. What is the mean number of calories in a 2-tablespoon serving of the mixture?

27. Writing in Math Describe two mixtures that each use a total of 8 tablespoons. Do the two parts of Exercise 26 for your mixtures.

28. Nutrition A mixture of equal amounts of pumpkin seeds, sunflower seeds, and pistachios contains 12 tablespoons in all. How many grams of fat and how many calories does the mixture have?

Test Prep

Multiple Choice

29. The average cost of a meal at the Grand Plaza is $20. Which one of the following statements *cannot* be true?
  A. The cost of four meals is greater than $20.
  B. Some meals cost less than $10.
  C. Each meal costs exactly $20.
  D. Each meal costs more than $20.

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30. Kayla's first three quiz scores are 90, 85, and 88. Which score on her next quiz will raise Kayla's mean quiz score to 90?
  F. 97   **G.** 95   **H.** 92   **I.** 90

31. Ten out of 20 students score a perfect 100 on a math test. Which of the following describes the score of 100 for the 20 students?
  A. mean   **B.** median   **C.** mode   **D.** outlier

Short Response

32. In a neighborhood with 46 homes, two are more than 6,000 ft^2 in area, and the rest are less than 2,500 ft^2 in area.
  a. Would the mean or the median provide a better measure of the typical home size?
  b. Explain your reasoning.

Mixed Review

Lesson 3-2   **Estimate each product or quotient.**
33. $9.01 ÷ $1.42   **34.** 7.5 · 89.1   **35.** 12.6 · $2.99

Lesson 2-7 **36. Retail Sales** Karen sells children's hats for $4 and adults' hats for $7. On Saturday, she sold 120 hats, and she collected $720. How many adults' hats did she sell?

Lesson 2-3   **Simplify each expression.**
37. $6x + 8 + 2$ **38.** $5z + 4x + 3z$ **39.** $x - 4t + 2t + 5$

Mean and Median on a Graphing Calculator

For Use With Lesson 3-3

You can use a graphing calculator to find means and medians.

EXAMPLE

Find (a) the mean and (b) the median number of acres in Ohio zoos.

Zoos in Ohio

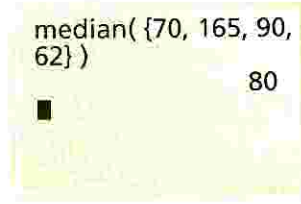| Zoo	Number of Acres	Number of Species
Cincinnati Zoo	70	712
Cleveland Metroparks Zoo	165	599
Columbus Zoo	90	650
Toledo Zoological Gardens	62	633

SOURCE: *The World Almanac*

a. Use the mean function. In **STAT**, select **MATH** and **mean**, then ENTER. Enter the data between braces { } using commas. Press ENTER to find the mean.

```
mean( {70, 165, 90,
62} )
            96.75
■
```
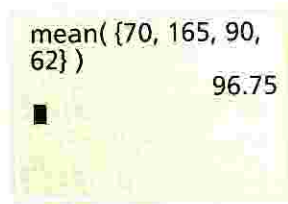
The mean is about 97 acres.

b. Use the median function. In **STAT**, select **MATH** and **median**, then ENTER. Enter the data between braces { } using commas. Press ENTER to find the mean.

```
median( {70, 165, 90,
62} )
            80
■
```

The median is 80 acres.

EXERCISES

Use a calculator to find the mean and median.

1. number of species in Ohio zoos

2. 85°F, 79°F, 80°F, 75°F, 82°F

3. $3.75, $4.50, $9.25, $4.70, $5.90

4. 100, 95, 82, 102, 78, 76

5.

Miles of Atlantic Coastline by State

State	DE	FL	GA	ME	MD	MA	NH	NJ	NY	NC	RI	SC	VA
Miles	28	580	100	228	31	192	13	130	127	301	40	187	112

SOURCE: National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce

6. Investigate entering the data in a list, L_1, and then using L_1 as the data list in parts (a) and (b) of the Example.

Using Formulas

3-4

OBJECTIVE 1 — Substituting Into Formulas

A **formula** is an equation that shows a relationship between quantities that are represented by variables.

An important formula in math and science is $d = rt$, where d is the distance, r is the rate, or speed, and t is the time spent traveling.

1 EXAMPLE   Real-World Problem Solving

Travel Suppose you travel 162 miles in 3 hours. Use the formula $d = rt$ to find your average speed.

$d = rt$	Write the formula.
$162 = (r)(3)$	Substitute 162 for d and 3 for t.
$\dfrac{162}{3} = \dfrac{3r}{3}$	Divide each side by 3.
$54 = r$	Simplify.

● Your average speed is 54 mi/h.

✔ Check Understanding   Example 1

1. Use the formula $d = rt$. Find d, r, or t.

    a. $d = 273$ mi, $t = 9.75$ h   **b.** $d = 540.75$ in., $r = 10.5$ in./yr

2 EXAMPLE   Real-World Problem Solving

Insects You can estimate the temperature outside using the chirps of a cricket. Use the formula $F = \frac{n}{4} + 37$, where n is the number of times a cricket chirps in one minute, and F is the temperature in degrees Fahrenheit. Estimate the temperature when a cricket chirps 100 times in a minute.

$F = \dfrac{n}{4} + 37$	Write the formula.
$F = \dfrac{100}{4} + 37$	Replace n with 100.
$F = 25 + 37$	Divide.
$F = 62$	Add.

● The temperature is about 62°F.

2. Use the formula $F = \frac{n}{4} + 37$ to estimate the temperature in degrees Fahrenheit for each situation.

   a. 96 chirps/min   **b.** 88 chirps/min   **c.** 66 chirps/min

OBJECTIVE

2 Using a Perimeter Formula

The **perimeter** of a figure is the distance around the figure. You can find the perimeter of a rectangle by adding the lengths of the four sides, or by using the formula $P = 2\ell + 2w$, where ℓ is the length and w is the width. For rectangles, it does not matter which dimension you choose to be the length or the width.

3 EXAMPLE   Finding Perimeter

Reading Math

Think of *peRIMeter* as the distance around the "rim" of a figure.

Measurement Find the perimeter of the room. Use the formula for the perimeter of a rectangle, $P = 2\ell + 2w$.

12.5 ft

18.5 ft
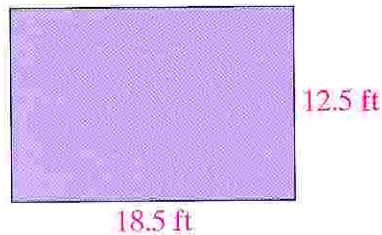
$P = 2\ell + 2w$	Write the formula.
$P = 2(18.5) + 2(12.5)$	Replace ℓ with 18.5 and w with 12.5.
$P = 37 + 25$	Multiply.
$P = 62$	Add.

● The perimeter of the room is 62 ft.

✓ **Check Understanding** Example 3

3. Find the perimeter of each rectangle.

   a. 27.3 cm 16.8 cm   **b.** 17.4 in. 8.6 in.

EXERCISES

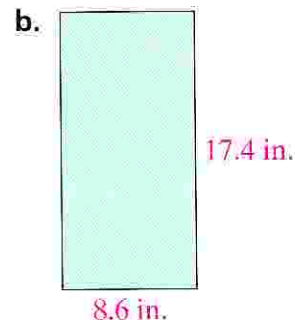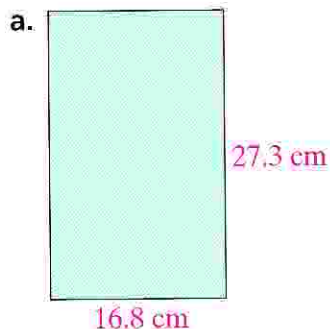## Practice and Problem Solving

A Practice by Example

Example 1
(page 143)

Use the formula $d = rt$. Find d, r, or t.

1. $r = 38.5$ m/h, $t = 12.5$ h

2. $d = 2,730$ mi, $t = 9.75$ h

3. $d = 596.39$ cm, $r = 2.3$ cm/s
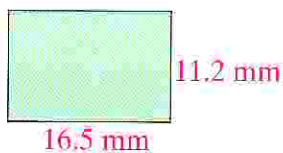
4. $d = 10.2$ ft, $r = 0.5$ ft/h

Example 2
(page 143)

Use the formula $F = \frac{n}{4} + 37$ to estimate each temperature.

5. 120 chirps/min

6. 80 chirps/min

7. 92 chirps/min

8. 64 chirps/min

Example 3
(page 144)

Use the formula $P = 2\ell + 2w$. Find the perimeter of each rectangle.

9.

11.2 mm

16.5 mm

10.

6.2 m

7.3 m
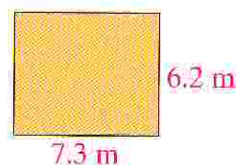
B Apply Your Skills

Given that C is the temperature in degrees Celsius, use the formula $F = 1.8C + 32$ to find each temperature F in degrees Fahrenheit.

11. $C = 58$ **12.** $C = -4$ **13.** $C = 72$ **14.** $C = 56$ **15.** $C = -89$

16. a. Estimation You can *estimate* a temperature in degrees Fahrenheit using the formula $F = 2 \cdot C + 30$, where C is the temperature in degrees Celsius (°C). What is the approximate temperature in degrees Fahrenheit when it is 3°C? 5°C? 25°C?

b. Writing in Math Is this formula better for estimating higher temperatures or lower temperatures? Explain.

Geometry Use the formula $P = 2\ell + 2w$. Find the perimeter of each rectangle. Then use the formula $A = \ell w$ to find each area.

17.

3.5 m

7 m

18.

11.2 cm

25.8 cm

C Challenge

19. The top surface of a world-record rectangular strawberry shortcake was 175.33 ft long and 48 in. wide. Use the formula for perimeter. Find the approximate perimeter of the cake.

20. Find the approximate area of the top of the cake in Exercise 19.

21. The state of Colorado is nearly rectangular in shape. Use the formula for area. Find the approximate area of Colorado.

22. Use the formula for perimeter. Find the approximate perimeter of Colorado.

Denver

Colorado

270 mi

390 mi

Multiple Choice

23. What is the perimeter of a rectangle that measures 32 cm by 11 cm?
 A. 352 cm **B.** 86 cm **C.** 54 cm **D.** 43 cm

24. Suppose you travel 320 mi in 5 h. What is your average speed?
 F. 58 mi/h **G.** 60 mi/h **H.** 64 mi/h **I.** 75 mi/h

25. A giant tortoise travels about 0.17 mi/h on land. If a tortoise travels at a constant speed, how far can it travel in 2.5 h?
 A. 0.0425 mi **B.** 0.267 mi **C.** 0.425 mi **D.** 4.25 mi

Short Response

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26. A rectangular yard has width w and length ℓ. **(a)** What is a formula for its perimeter, P? **(b)** Find P when w is 16.4 m and ℓ is 28.2 m.

27. The pronghorn antelope can run 0.73 mi/min. **(a)** At this speed, how far can this animal travel in 30 seconds? **(b)** In 1.5 minutes?

Mixed Review

Lesson 3-3

Find the mean, median, and mode. Round to the nearest whole number where necessary. Which measure of central tendency best describes the data?

28. minutes of homework
 8 125 154 120 105 125

29. milliliters per container
 250 250 355 355 375 250

Lesson 2-5

Solve each equation.

30. $c + 8 = 41$ **31.** $b + 32 = 19$ **32.** $98 = n + 42$

Lesson 1-7

33. Patterns Which equation, $n = 2t$ or $t = n \cdot 2$, describes the relationship between the variables in the table? Explain.

n	14	16	18	20
t	7	8	9	10

Checkpoint Quiz 1 Lessons 3-1 through 3-4

TEXT Instant self-check quiz online and on CD-ROM

Round each number to the underlined place value.

1. 15.6<u>5</u>71 **2.** 0.89<u>1</u>4 **3.** 7,0<u>2</u>2.56 **4.** 345.<u>6</u>78

Estimate.

5. $3.7 \cdot 8.06$ **6.** $17.25 + 6.66$ **7.** $8.7 - 9.6$ **8.** $11.7 \div 1.8$

Find the mean, median, and mode.

9. 47, 56, 58, 63 **10.** 1, 4, 1, 3, 1, 2, 3, 2, 1, 2

11. Jennifer drives at an average speed of 54 mi/h. At this rate, how long does it take Jennifer to drive 459 miles?

You can use a computer spreadsheet to evaluate formulas. Look at the spreadsheet below. In the spreadsheet, the algebraic formula $d = rt$ is evaluated for $r = 50$ mi/h and $t = 3$ h.

The spreadsheet formula "=A2*B2" is used in cell C2 to calculate $d = rt$. The spreadsheet formula means that the value in cell C2 equals the value in cell A2 times the value in cell B2.

	A	B	C
1	r	t	d
2	50	3	150

In spreadsheet formulas the asterisk symbol * means multiply. The slash symbol / means divide.

EXAMPLE

Use a spreadsheet and the formula $P = 2L + 2W$ to find the perimeter P of a rectangle. Evaluate the formula for a length L of 7.8 in. and a width W of 2.6 in.

	A	B	C
1	L	W	P
2	7.8	2.6	20.8

← Use the spreadsheet formula "=2*A2+2*B2."

● The perimeter is about 21 in.

EXERCISES

Use a spreadsheet to find each perimeter.

1. $L = 5.6$ in., $W = 7.9$ in.　　**2.** $L = 12.7$ in., $W = 15.6$ in.　　**3.** $L = 0.2$ in., $W = 1.3$ in.

Use a spreadsheet to evaluate the formula $t = d \div r$ for the given values of d and r.

4. $d = 250$ mi, $r = 5$ mi/h　　**5.** $d = 1,400$ mi, $r = 50$ mi/h　　**6.** $d = 4,500$ mi, $r = 250$ mi/h

Write a spreadsheet formula for each algebraic formula.

7. to find A, using $A = 0.5bh$　　**8.** to find P, using $P = 4a$　　**9.** to find y, using $y = mx + b$

10. a. Open-Ended Use a spreadsheet to evaluate the formula $A = \ell w$. How does the value of A change as you double the value of ℓ while keeping w unchanged?

b. How does the value of A change as you double the values of both ℓ and w?

Solving Equations by Adding or Subtracting Decimals

✔ **Check Skills You'll Need**

Simplify.

1. $2.8 + 7.06$

2. $0.65 + 1.8$

3. $4.52 - 2.48$

4. $3.7 - 0.62$

OBJECTIVE

1 | **Using Subtraction to Solve Equations**

In Lesson 2-5, you used the Subtraction Property of Equality to solve equations involving integers. You can also use this property to solve equations with decimals. Remember to subtract the same number from each side of the equation.

1 EXAMPLE **Subtracting to Solve an Equation**

Solve $n + 4.5 = -9.7$.

$$n + 4.5 = -9.7$$
$$n + 4.5 - 4.5 = -9.7 - 4.5 \quad \text{Subtract 4.5 from each side.}$$
$$n = -14.2 \quad \text{Simplify.}$$

Check $\quad n + 4.5 = -9.7$
$$-14.2 + 4.5 \overset{?}{=} -9.7 \quad \text{Replace } n \text{ with } -14.2.$$
$$-9.7 = -9.7 ✔$$

✔ **Check Understanding** Example 1

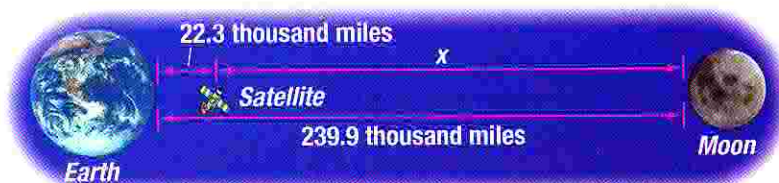1. Solve each equation.

   a. $x + 4.9 = 18.8$ **b.** $14.73 = -24.23 + b$

2 EXAMPLE **Real-World 🌎 Problem Solving**

Astronomy A communications satellite is circling Earth. Use the diagram below to find the approximate distance from the satellite to the moon.

22.3 thousand miles | x
Satellite
239.9 thousand miles
Earth | Moon
Not drawn to scale

$$22.3 + x = 239.9$$
$$22.3 + x - 22.3 = 239.9 - 22.3 \quad \text{Subtract 22.3 from each side.}$$
$$x = 217.6 \quad \text{Simplify.}$$
$$x \approx 218 \quad \text{Round to the nearest one.}$$

The approximate distance from the satellite to the moon is 218 thousand miles.

2. **Analyzing Markup** A store's cost plus markup is the price you pay for an item. Suppose a pair of shoes costs a store $35.48. You pay $70. Write and solve an equation to find the store's markup.

OBJECTIVE

2 **Using Addition to Solve Equations**

You can also use the Addition Property of Equality to solve an equation involving decimals. Remember to add the same number to each side of the equation.

3 EXAMPLE   **Adding to Solve an Equation**

Solve $k - 14.4 = -18.39$.

$$k - 14.4 = -18.39$$
$$k - 14.4 + 14.4 = -18.39 + 14.4 \quad \text{Add 14.4 to each side.}$$
$$k = -3.99 \quad \text{Simplify.}$$

> **Need Help?**
> For help with adding and subtracting decimals, see Skills Handbook, page 764.

3. Solve each equation.

   a. $n - 5.85 = 15.25$ **b.** $-10 = c - 2.6$

4 EXAMPLE   **Real-World 🌎 Problem Solving**

Personal Finance Danzel wrote a check for $76.85. His new account balance is $235.00. What was his previous balance?

Words   previous balance   minus   check   is   new balance

           Let p = previous balance.

Equation p $-$ 76.85 $=$ 235

$$p - 76.85 = 235$$
$$p - 76.85 + 76.85 = 235 + 76.85 \quad \text{Add 76.85 to each side.}$$
$$p = 311.85 \quad \text{Simplify.}$$

Danzel's previous balance was $311.85.

4. **Shopping** You spent $14.95 for a new shirt. You now have $12.48. Write and solve an equation to find how much money you had before you bought the shirt.

EXERCISES

Practice and Problem Solving

A **Practice by Example**

Examples 1 and 2
(page 148)

Solve each equation.

1. $c + 9 = 3.7$ **2.** $b + 7.6 = 23$ **3.** $43.6 = n + 17.5$

4. $6.35 + b = 9.89$ **5.** $12.13 = n + 1.4$ **6.** $x + 0.35 = 9.15$

🌐 **7. Astronomy** The planet Mars takes 599.01 days longer than Mercury to orbit the sun. In all, the Mars orbit takes 686.98 days. Write and solve an equation to find how long it takes Mercury to orbit the sun.

🌐 **8. Car Sales** Julia trades in her small car for a large pickup truck that weighs 1,855.3 lb more than the car. If the truck weighs 4,360.3 lb, what is the weight of the car?

Examples 3 and 4
(page 149)

Solve each equation.

9. $d - 4.9 = 18.8$ **10.** $c - 19.2 = 24$ **11.** $-2.5 = q - 1.7$

12. $-5.6 = y - 8$ **13.** $4.3 = g - 1$ **14.** $a - 108.8 = -203$

🌐 **15. Personal Finance** You spent $13.50 for movie tickets. You now have $26.50. Write and solve an equation to find out how much money you had before buying the tickets.

16. Rachel wrote a check for $161.15. Her new account balance is $423.28. What was her previous account balance?

B **Apply Your Skills**

Complete the steps for each equation. Justify each step.

17. $x + 1.2 = 15$
       $x + 1.2 - \blacksquare = 15 - \blacksquare$
              $x = \blacksquare$

18. $y - 3.33 = 12.42$
       $y - 3.33 + \blacksquare = 12.42 + \blacksquare$
              $y = \blacksquare$

🌐 **19. Running** Michael Johnson's world record in the 200-m sprint is 19.32 s. His 400-m world record is 23.86 s slower than his 200-m record. Write and solve an equation to find Johnson's 400-m record.

🌐 **20. Biology** A hare travels about 17.83 mi/h faster on land than a giant tortoise. A hare can hop at about 18 mi/h. Write and solve an equation to find how fast a giant tortoise can travel on land.

Solve each equation.

21. $4.035 = a - 3.25$ **22.** $h - (-1.5) = 1.5$ **23.** $e + (-7.8) = -6.7$

24. $r - 0.832 = 8.67$ **25.** $b - (-1.5) = -9$ **26.** $-32 = x + (-8.05)$

Real-World 🌐 Connection

Giant tortoises can weigh up to 500 lb.

Mental Math Use mental math to solve each equation.

27. $1.60 = 0.40 + s$ **28.** $x + 8.8 = 9.9$ **29.** $5.5 = x - 5.5$

$$x - 1.6 = -6$$
$$x - 1.6 + 1.6 = -6 - 1.6$$
$$x = -7.6$$

30. Error Analysis A student solved an equation as shown at the left. Explain the student's error.

31. Writing in Math Explain how you would use the Addition (not Subtraction) Property of Equality to solve $x + 1.8 = -4.7$.

C Challenge

Solve each equation.

32. $143.587 + x - 22.96 = 156.4$ **33.** $-924.87 - 1,237 + b = 86.125$

34. Reasoning Without solving, tell how the solutions of the equations $x + 14 = 15, x + 1.4 = 1.5,$ and $x + 0.14 = 0.15$ compare. Explain.
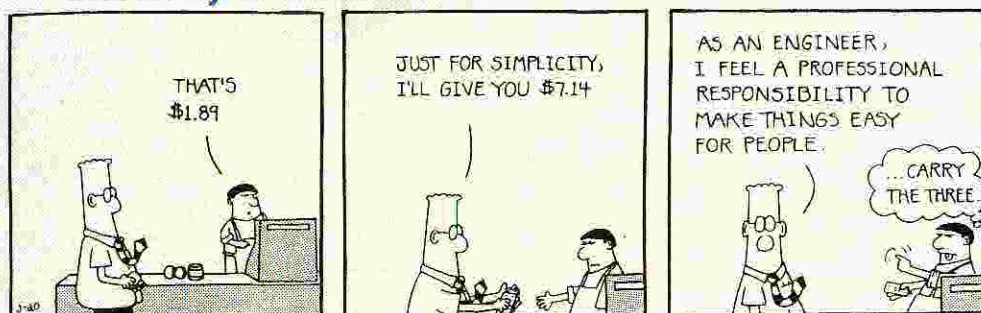
Test Prep

Multiple Choice

35. Which statement describes how to solve $x + 0.042 = 0.826$?
  A. Add 0.042 to each side.   **B.** Subtract 0.042 from each side.
  C. Add 0.826 to each side.   **D.** Subtract 0.826 from each side.

Reading Comprehension

Read the cartoon below before doing Exercises 36 and 37.

Dilbert by Scott Adams

THAT'S $1.89

JUST FOR SIMPLICITY, I'LL GIVE YOU $7.14

AS AN ENGINEER, I FEEL A PROFESSIONAL RESPONSIBILITY TO MAKE THINGS EASY FOR PEOPLE.

...CARRY THE THREE.

SOURCE: ©1993 United Features Syndicate, Inc.

36. How much money does the clerk owe Dilbert?

37. Dilbert does not want any pennies. What other amount of money could Dilbert have given the cashier? Justify your answer.

Mixed Review

Lesson 3-4

Use the formula $A = \ell w$. Find A.

38. $\ell = 23.4$ in., $w = 15.8$ in.   **39.** $\ell = 5.5$ cm, $w = 7$ cm

Lesson 2-6

Solve each equation.

40. $6a = 24$ **41.** $-2b = 60$ **42.** $-81 = 9a$

Lesson 2-2

43. A large juice costs $.83. A small juice costs $.57. Ida buys one juice each school day. If Ida buys small juices instead of large juices, how much money will she save each week?

Solving Equations by Multiplying or Dividing Decimals

✔ Check Skills You'll Need

Find each product.

1. $2.6(4.5)$

2. $3.2(0.15)$

3. $11.03(0.6)$

4. $8.003(0.6)$

OBJECTIVE

1 Using Division to Solve Equations

In Lesson 2-6, you used the Division Property of Equality to solve equations involving integers. You can also use this property to solve equations with decimals. Remember to divide each side of the equation by the same nonzero number.

1 EXAMPLE Dividing to Solve an Equation

Solve $0.9r = -5.4$.

$$0.9r = -5.4$$
$$\frac{0.9r}{0.9} = \frac{-5.4}{0.9} \qquad \text{Divide each side by 0.9.}$$
$$r = -6 \qquad \text{Simplify.}$$

Check
$$0.9r = -5.4$$
$$0.9(-6) \stackrel{?}{=} -5.4 \qquad \text{Replace } r \text{ with } -6.$$
$$-5.4 = -5.4 \checkmark$$

✔ Check Understanding Example 1

1. Solve each equation.

    a. $0.8x = -1.6$ **b.** $1.15 = 2.3x$ **c.** $-81.81 = -0.9n$

2 EXAMPLE Real-World 🌎 Problem Solving

Petroleum An oil field produces an average of 16.8 thousand barrels of crude oil per day. About how many days will it take to produce 200 thousand barrels?

Words daily barrel production times number of days equals 200 thousand barrels

Let d = number of days.

Equation 16.8 · d = 200

$$16.8d = 200$$
$$\frac{16.8d}{16.8} = \frac{200}{16.8} \qquad \text{Divide each side by 16.8.}$$
$$d = 11.904 \ldots \qquad \text{Simplify.}$$
$$d \approx 12 \qquad \text{Round to the nearest whole number.}$$

It will take about 12 days to produce 200 thousand barrels.

2. Postage You paid $7.70 to mail a package that weighed 5.5 lb. Write and solve an equation to find the cost per pound.

OBJECTIVE

2 Using Multiplication to Solve Equations

To solve an equation involving division, multiply each side by the same nonzero number.

3 EXAMPLE   Multiplying to Solve an Equation

Solve $\frac{m}{-7.2} = -12.5$.

$$\frac{m}{-7.2} = -12.5$$

$$\frac{m}{-7.2}(-7.2) = -12.5(-7.2) \qquad \text{Multiply each side by } -7.2.$$

$$m = 90 \qquad\qquad\qquad \text{Simplify.}$$

✓ **Check Understanding**   Example 3

3. Solve each equation.

 a. $\frac{r}{-6.0} = 0.5$ **b.** $\frac{s}{2.5} = 5$ **c.** $-80 = \frac{t}{4.5}$

4 EXAMPLE   Real-World 🌐 Problem Solving

Batting Averages The 1923 baseball season was one of Babe Ruth's best. He was at bat 522 times and had a batting average of 0.393, rounded to the nearest thousandth. The batting average formula is $a = \frac{h}{n}$, where a is the batting average, h is the number of hits, and n is the number of times at bat. Use the formula to find the number of hits Babe Ruth made.

$$a = \frac{h}{n}$$

$$0.393 = \frac{h}{522} \qquad\qquad \text{Replace } a \text{ with 0.393 and } n \text{ with 522.}$$

$$(0.393)(522) = \frac{h}{522}(522) \qquad \text{Multiply each side by 522.}$$

$$h = 205.146 \qquad\qquad \text{Simplify.}$$

$$h \approx 205 \qquad\qquad\quad \text{Since } h \text{ (hits) represents an integer,}$$
$$\qquad\qquad\qquad\qquad\quad \text{round to the nearest integer.}$$

Babe Ruth made 205 hits.

✓ **Check Understanding**   Example 4

4. Suppose your batting average is 0.222. You have batted 54 times. How many hits do you have?
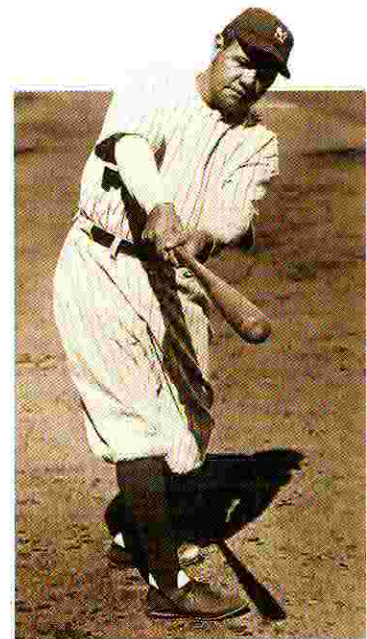
Real-World 🌐 Connection

During his professional career, Babe Ruth was at bat 8,399 times and had a batting average of 0.342.

EXERCISES

Practice and Problem Solving

A Practice by Example

Examples 1 and 2
(page 152)

Solve each equation.

1. $0.8s = -6.4$ **2.** $0.8x = 0.48$ **3.** $-0.5y = -0.73$

4. $2x = -4.88$ **5.** $-0.3y = 7.53$ **6.** $2.21 = 1.7w$

7. $1.92 = 1.6s$ **8.** $3.2n = 27.52$ **9.** $0.7x = 2.8$

10. Manufacturing A factory produces an average of seven thousand televisions per day. About how many days will it take to produce 63.5 thousand televisions?

11. Postage You paid $5.30 to mail a package that weighed 2.5 lb. Write and solve an equation to find the mailing cost per pound.

Examples 3 and 4
(page 153)

Solve each equation.

12. $\frac{n}{2.3} = -4.8$ **13.** $0.97 = \frac{c}{-2}$ **14.** $\frac{h}{7} = -8$

15. $\frac{n}{1.7} = 0.22$ **16.** $\frac{k}{2.01} = 0.04$ **17.** $120 = \frac{v}{3.8}$

18. $9 = \frac{a}{1.5}$ **19.** $\frac{m}{7.08} = -100$ **20.** $-200 = \frac{f}{4}$

21. Batting Averages During the 1954 baseball season with the New York Yankees, Yogi Berra was at bat 584 times and had a batting average of 0.307. Use the batting-average formula in Example 4 to find the number of hits Berra made.

B Apply Your Skills

Solve each equation.

22. $6.4x = 0.2816$ **23.** $-5.1z = -11.73$

24. $0.004m = 0.12$ **25.** $4.5 = m \div (-3.3)$

26. $-33.04 = \frac{z}{-0.03}$ **27.** $-0.45 = x \div 12$

28. a. Error Analysis Harry found 324.8 as a solution for the equation $4x = 81.2$. What was Harry's error?

   b. Estimation How could Harry have used estimation to check whether his answer was reasonable?

Write an equation for each sentence. Solve for the variable.

29. The product of a number n and -7.3 is 30.66.

30. The quotient of a number n divided by -4.5 equals 200.6.

31. A number n divided by -2.35 equals 400.9.

32. a. Batting Averages Your batting average is 0.244, and you have been at bat 82 times. How many hits do you have?

   b. Writing in Math Why is it necessary to round your answer in part (a) to the nearest integer?

33. Utilities Jan pays $.08 per kilowatt-hour for electricity. Her electric bill is $59.22. Write and solve an equation to find how many kilowatt-hours of electricity Jan used.

34. Number Sense The weight of a record-setting onion was 12.25 lb. An average-sized onion weighs 0.5 lb. About how many average-sized onions have a total weight equal to the record-setting onion?

C Challenge

35. Measurement If you know a length ℓ in meters, you can multiply the length by 3.28 to find the length in feet f.
 a. Write an equation to model this situation.
 b. A tree is 7.5 m tall. Use your equation to find this height in feet.
 c. A bookshelf is 6 ft tall. What is this height in meters?
 d. A room is 12 ft long and 15 ft wide. Use your equation and the formula for the area of a rectangle to find the area of the room in square meters. Round to the nearest tenth.

36. Reasoning Find values for x and y that satisfy $xy = 0.42$ and $x + y = 1.3$.

37. Batting Averages About how many hits did Babe Ruth have during his professional career? (*Hint:* See page 153.)

Test Prep

Multiple Choice

38. A group of friends goes out for dinner. The bill is $36.81. If they share the cost equally and each person's share is about $7.35, how many people are in the group?
 A. 4   **B.** 5   **C.** 6   **D.** 7

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39. Which equation has 3.2 as its solution?
 F. $20x = 6.4$ **G.** $6.4 = 2x$ **H.** $\frac{x}{2} = 6.4$ **I.** $\frac{x}{6.4} = 2$

Short Response

40. A barber gave enough haircuts in one day to earn $337.50. Each haircut cost $12.50. **(a)** How many haircuts did the barber give that day? **(b)** Estimate the amount of money the barber can make in a week.

Mixed Review

Lesson 3-5

Solve each equation.

41. $c + 9 = 3.7$ **42.** $-5.6 = y - 8$ **43.** $4.035 = a - 3.25$

Lesson 2-4

Is the given number a solution of the equation? Show why.

44. $20 - c = 12; c = 8$ **45.** $8 = 2a + 3; a = 0$

Lesson 1-7

46. a. Patterns Multiply $99 \cdot 24, 99 \cdot 25$, and $99 \cdot 26$.
 b. Describe the pattern you found in part (a).
 c. Use the pattern to evaluate $99 \cdot 27$.

3-6 Solving Equations by Multiplying or Dividing Decimals   **155**

Using the Metric System

✓ Check Skills You'll Need

Find each product or quotient.

1. 5×100

2. $14.06 \div 1{,}000$

3. 0.294×10

4. $0.9 \div 100$

OBJECTIVE

1 | **Identifying Appropriate Metric Measures**

Knowing the approximate size of each metric unit of measure will allow you to choose an appropriate unit.

Key Concepts | **Metric Units of Measurement**

	Unit	Reference Example
Length	millimeter (mm)	about the thickness of a dime
	centimeter (cm)	about the width of a thumbnail
	meter (m)	about the distance from a doorknob to the floor
	kilometer (km)	a little more than one half mile
Capacity	milliliter (mL)	about 5 drops of water
	liter (L)	a little more than a quart of milk
Mass	milligram (mg)	about the mass of a speck of sawdust
	gram(g)	about the mass of a paper clip
	kilogram (kg)	about one half the mass of this math book

---

1 EXAMPLE **Choosing an Appropriate Unit**

Choose an appropriate metric unit. Explain your choice.

a. height of a classroom chalkboard

Meter; the height of a chalkboard is about twice the distance from the floor to a doorknob.

b. mass of a backpack filled with books

Kilogram; the mass of a backpack filled with books is many times the mass of this textbook.

c. capacity of a birdbath

Liter; several quart bottles of water would fill a birdbath.

✓ Check Understanding   Example 1

1. Choose an appropriate metric unit. Explain your choice.

a. length of a broom   **b.** the mass of an energy bar

c. mass of a horse   **d.** capacity of a car's gas tank

EXAMPLE   **Estimating With Metric Units**

Estimation Choose a reasonable estimate. Explain your choice.

a. capacity of a juice box: 200 mL or 200 L

200 mL; the juice box holds less than a quart of milk.

b. length of a new pencil: 15 cm or 15 m

15 cm; the length of a pencil would be about 15 widths of a thumbnail.

c. mass of a small tube of toothpaste: 100 g or 100 kg

100 g; the mass is about the same as a box of paper clips.

✔ **Check Understanding**   **Example 2**

2. Choose a reasonable estimate. Explain your choice.

   a. distance between two cities: 50 mm or 50 km
   **b.** amount of liquid that an eyedropper holds: 10 mL or 10 L

OBJECTIVE

2 **Converting Metric Units**

The metric system uses a decimal system to relate different units to each other. Look at the metric-units chart below. The units highlighted in yellow are the units most often used. From left to right, each unit is 10 times the size of the unit before it.

	milli-	centi-	deci-	UNIT	deka-	hecto-	kilo-
Length	millimeter (mm)	centimeter (cm)	decimeter (dm)	meter (m)	dekameter (dam)	hectometer (hm)	kilometer (km)
Capacity	milliliter (mL)	centiliter (cL)	deciliter (dL)	liter (L)	dekaliter (daL)	hectoliter (hL)	kiloliter (kL)
Mass	milligram (mg)	centigram (cg)	decigram (dg)	gram (g)	dekagram (dag)	hectogram (hg)	kilogram (kg)

You can convert from one unit to another by multiplying or dividing by 10; 100; 1,000; and so on.
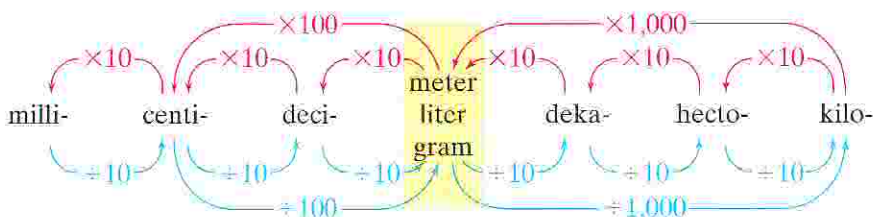
Reading Math

The prefixes, such as *milli, centi,* and *deci,* denote the relative sizes of the units.

To convert from one unit to another in the metric system, find the relationship between the two units.

Remember:
- Multiply if you are going from a larger unit to a smaller unit since there will be more of the smaller units.
- Divide if you are going from a smaller unit to a larger unit since there will be fewer of the larger units.

3 EXAMPLE **Converting Between Metric Units**

Mental Math Complete each statement.

a. 4.35 L = ▦ mL

$4.35 \cdot 1{,}000 = 4{,}350$

To convert liters to milliliters, multiply by 1,000.

$4.35 \text{ L} = 4{,}350 \text{ mL}$

b. 914 cm = ▦ m

$914 \div 100 = 9.14$

To convert centimeters to meters, divide by 100.

$914 \text{ cm} = 9.14 \text{ m}$

✔ **Check Understanding** **Example 3**

3. Complete each statement.

 a. 35 mL = ▦ L   **b.** ▦ g = 250 kg   **c.** ▦ cm = 60 m

4 EXAMPLE **Real-World 🌐 Problem Solving**

Geography The ancient Incan city of Machu Picchu is located in Peru. Its altitude is about 2,300 m above sea level. What is Machu Picchu's altitude in kilometers?

Words	altitude in meters	÷	meters per kilometer	=	altitude in kilometers
Equation	2,300	÷	1,000	=	2.3

• Machu Picchu is about 2.3 km above sea level.

✔ **Check Understanding** **Example 4**

4. **a.** The record for the highest a kite has flown is 3.8 km. Find the height of the kite in meters.
 b. **Number Sense** You have a recipe that requires 0.25 L of milk. Your measuring cup is marked only in milliliters. How many milliliters of milk do you need?

EXERCISES

Practice and Problem Solving

A Practice by Example

Example 1
(page 156)

Match each quantity with an appropriate metric unit. Explain your choice.

1. length of your thumb
2. mass of a book
3. length of a soccer field
4. amount of water in a fishbowl
5. mass of an eraser
6. amount of fluid in a straw

A. gram
B. meter
C. centimeter
D. milliliter
E. liter
F. kilogram

Example 2
(page 157)

Choose a reasonable estimate. Explain your choice.

7. the mass of a small dog: 5 g or 5 kg
8. amount of liquid you should drink daily: 2,000 mL or 2,000 L
9. the mass of a box of cereal: 350 mg or 350 g

Example 3
(page 158)

Mental Math Complete each statement.

10. 54 m = ▦ cm
11. ▦ L = 234 mL
12. 12 g = ▦ kg
13. ▦ m = 3.01 km
14. 0.25 m = ▦ cm
15. ▦ mL = 7.3 L
16. 595 g = ▦ kg
17. 35 m = ▦ km
18. ▦ mg = 0.27 g

Example 4
(page 158)

19. **Geography** The shortest street in the world is Elgin Street, in Bacup, England. It is 518 cm long. How many meters long is it?

20. **Biology** A shrew, the mammal with the fastest metabolism, has a mass of only 0.004 kg. What is its mass in grams?

B Apply Your Skills

Choose an appropriate metric unit of measure. Explain your choice.

21. mass of a banana
22. depth of Lake Michigan
23. length of a small calculator
24. mass of a car
25. width of a highway
26. quantity of water in a spoon

27. **Error Analysis** One of the world's largest pearls had a mass of 6,392 g. Camille wrote in her report that the pearl had a mass of 6,392,000 kg. What was her error?

28. **Model Trains** The world's longest model train has 650 cars and is 0.695 km long. How many meters long is the train?

Write the metric unit that makes each statement true.

29. 9.03 m = 9,030 ▦
30. 890 cm = 8.9 ▦
31. 130,000 ▦ = 1.3 km

32. Earth Science The flow of water over Niagara Falls averages 6,008,835,000 mL/s.
  a. On the average, about how many liters of water flow over Niagara Falls each second?
  b. About how many liters flow over the falls in a minute?

Estimation Choose a reasonable estimate. Explain your choice.

33. the width of a sidewalk: 150 cm or 150 m

34. the length of 24 city blocks: 2 m or 2 km

35. the mass of a thumbtack: 1 mg or 1 g

Mental Math Complete each statement.

36. 90,050 mL = ▦ L   **37.** ▦ m = 875 cm   **38.** 620 m = ▦ km

39. 9,120 mg = ▦ g   **40.** 900 km = ▦ m   **41.** 5 g = ▦ kg

42. ▦ cm = 13 km   **43.** 301 kg = ▦ mg   **44.** ▦ km = 562,300 cm

45. Nutrition A world-record grapefruit had a mass of 3,068 g. What was its mass in kilograms?

46. Zoology A hippopotamus is so large that it has a stomach 304.8 cm long, yet it is agile enough to outrun a human. How long is the stomach of a hippopotamus in meters?

Number Sense Match each measurement with its equivalent measurement from the table.

47. 0.015 km   **48.** 1,500 cm   **49.** 150,000 mg

50. 0.15 L   **51.** 15 L   **52.** 1,500 g

A. 15,000 mL	B. 150 cm	C. 150 g
D. 1.5 kg	E. 15 m	F. 150 mL
G. 150 kg	H. 0.15 mL	I. 1,500 mm

53. Marine Biology The blue whale is the largest of all known animals. The largest known blue whale measured 33.58 meters in length.
  a. How many millimeters long was this whale?
  b. How many kilometers long was this whale?

C Challenge 54. Writing in Math The prefix kilo- means "one thousand," and the prefix milli- means "one thousandth." What do the prefixes tell you about kilometer and kilogram, and milliliter and milligram?

55. Physical Fitness You walk about 3 mi/h.
  a. Approximately how many kilometers can you walk in an hour?
  b. How many meters can you walk in an hour?

Real-World 🌐 Connection

A hydroelectric power plant at Niagara Falls can produce 2,100,000 kilowatts of electricity.

Gridded Reponse

56. The albatross has a wingspan of 3,350 mm, the largest wingspan of any bird. What is the wingspan of an albatross in meters?

57. What part of a second is a millisecond?

58. A worm is about 143 mm long. What is the length of the worm in meters?

59. A pitcher threw a baseball 95 mi/h at a baseball game. Rounded to the nearest tenth, how many feet per second is this?

60. Sean tries to drink $2\frac{1}{2}$ qt of water every day. How many gallons does he average in a week?

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Mixed Review

Lesson 3-6 🌐 **61. Knot Tying** Clinton Bailey, Sr., holds the record for knot tying. He tied six different rope knots in 8.1 s. Write and solve an equation to find his average time per knot.

Lesson 3-2 **Estimate each product or quotient.**

62. $28.134 \div 3.75$ **63.** $8.517 \cdot 9.82$ **64.** $101.49 \div 9.51$

Lessons 2-9 and 2-10 **Solve each inequality.**

65. $a - 5 \geq 16$ **66.** $n + 8 < -7$ **67.** $-3r \leq 21$

✓ Checkpoint Quiz 2   Lessons 3-5 through 3-7

TEXT Instant self-check quiz online and on CD-ROM

Solve each equation.

1. $0.5m = 0.125$ **2.** $d \div 0.3 = 28.5$ **3.** $y - 135.43 = -5.43$

4. $12.2 = 4x$ **5.** $29.25 = 4.5w$ **6.** $k + 870.9 = 1,000.5$

Choose the most reasonable estimate. Explain your choice.

7. height of a standard house window: 1.5 cm or 1.5 m

8. capacity of a shampoo bottle: 500 mL or 500 L

Complete each statement.

9. 95 mL = ▪ L   **10.** ▪ cm = 76.5 km

11. ▪ km = 675 m   **12.** 7.1 kg = ▪ g

🌐 **13. Horses** The world's smallest horse had a mass of only 9.1 kg. What was the mass of the horse in grams?

Precision and Significant Digits

The pin at the right measures about 5 cm. A more precise measurement is 4.5 cm. An even more precise measurement is 46 mm. The smaller the units on the scale of a measuring instrument, the more precise the measurement is.

1 EXAMPLE

Choose the more precise measurement.

a. 5 g or 8 mg
Since a milligram is a smaller unit of measure than a gram, 8 mg is more precise than 5 g.

b. 2.72 m or 3.5 m
A hundredth of a meter is a smaller unit of measure than a tenth of a meter. So 2.72 m is more precise than 3.5 m.

A calculation will be only as precise as the least precise measurement used in the calculation. So, round your results to match the precision of the least precise measurement.

2 EXAMPLE

Add the lengths 6.31 m, 5.447 m, and 2.8 m.

$6.31 + 5.447 + 2.8 = 14.557$

Rounded to tenths ≈ 14.6 m

The least precise measurement is 2.8 m. Round the sum to the nearest tenth of a meter.

Digits that represent an actual measurement are *significant digits*. Nonzero digits (1–9) are always significant. The rules below will help you decide whether a zero is a significant digit.

Type of Number	Which Zeros Are Significant	Example
decimal numbers between 0 and 1	Zeros to the left of *all* the nonzero digits are not significant. All other zeros are significant.	significant digits 0.006040 not significant digits
positive integers	Zeros to the right of *all* the nonzero digits are not significant (unless specifically known to be). Zeros between nonzero digits are significant.	significant digits 203,400 not significant digits
noninteger decimal numbers greater than 1	All zeros are significant.	significant digits 350.07050

3 EXAMPLE

How many significant digits are in 0.0504 m?

The 5 and the 4 are significant. The zero between them is significant.
The other zeros are not significant. There are three significant digits.

When you multiply or divide measurements, round your answer to match the least number of significant digits in the problem.

4 EXAMPLE

A plot for a new house measures 152.6 m by 121 m.
What is the area of the plot? Use significant digits.

┌─── 3 significant digits

$152.6 \cdot 121 = 18{,}464.6$ ◄──── Multiply.

└─── 4 significant digits

The area is 18,500 m². ◄──── Round the area to 3 significant digits.

EXERCISES

Choose the more precise measurement.

1. 3 m or 5.2 m   **2.** 8 mL or 9.5 L   **3.** 1.89 km or 8.7 cm   **4.** 1.9 kg or 1.87 kg

5. Error Analysis Your friend says that 4.35 km is more precise than 5.2 cm because a hundredths unit is a smaller unit than a tenths unit. What mistake did your friend make?

Find each sum or difference. Round to the place value of the less precise measurement.

6. 5.6 g + 8 g   **7.** 8.35 kg + 6.2 kg   **8.** 8.2 km − 1.75 km   **9.** 9 cm − 2.3 cm

Determine the number of significant digits in each measurement.

10. 0.069 m   **11.** 100.5 L   **12.** 3,400 kL   **13.** 5.2100 km

Find each product or quotient. Use significant digits.

14. 1,234 in. · 31 in.   **15.** 0.0702 ft · 227 ft   **16.** 16,250 m ÷ 14.5 s   **17.** 132.5 cm · 43.2 cm

Simplify the Problem

✔ Check Skills You'll Need

Write a rule for each number pattern. Find the next three numbers in the pattern.

1. 0, 6, 12, 18, . . .

2. −18, −9, 0, 9, . . .

3. 0, 2, 1, 3, 2, 4, 3, . . .

4. 7, 6, 8, 7, 9, 8, 10, . . .

OBJECTIVE

1 Simplify the Problem

Math Strategies in Action

Scientists often encounter problems that are very complicated. When they work to develop a new vaccine or develop a new method to fight disease, they usually work on smaller or simpler pieces of the problem first. Sometimes when you solve a problem, it helps to solve other problems that have similar conditions. Here is a well-known problem that shows you how to use this strategy.

1 EXAMPLE Real-World 🌐 Problem Solving

A snail is trying to escape from a well 10 ft deep. The snail can climb 2 ft each day, but each night it slides back 1 ft. How many days will the snail take to climb out of the well?

Read and Understand

A snail needs to climb 10 ft to escape from a well. It can climb 2 ft per day. At night the snail slides back 1 ft.

  1. How far up the well will the snail be after the first day and the first night?

  2. How far up the well will the snail be after the second day?

  3. How far up the well will the snail be after the second day and the second night?

Plan and Solve

At first you might think that the snail progresses 1 ft each day and will therefore take 10 days to escape. This answer is wrong, however, because it leaves out an important part of the problem.

Try to solve a simpler problem. Change the problem to a simpler one based on a 3-ft well, and then try a 4-ft well to see if there is a pattern.

Time	3-ft Well	4-ft Well
Day 1	Up 2 ft from bottom	Up 2 ft from bottom
Night 1	Up 1 ft from bottom	Up 1 ft from bottom
Day 2	Up 3 ft from bottom; OUT!	Up 3 ft from bottom
Night 2		Up 2 ft from bottom
Day 3		Up 4 ft from bottom; OUT!

4. Using the information from the simpler 3-ft-well and 4-ft-well problems, describe the pattern.

5. How many days will the snail take to escape from the 10-ft well?

Look Back and Check

You can check your answer by drawing a diagram.
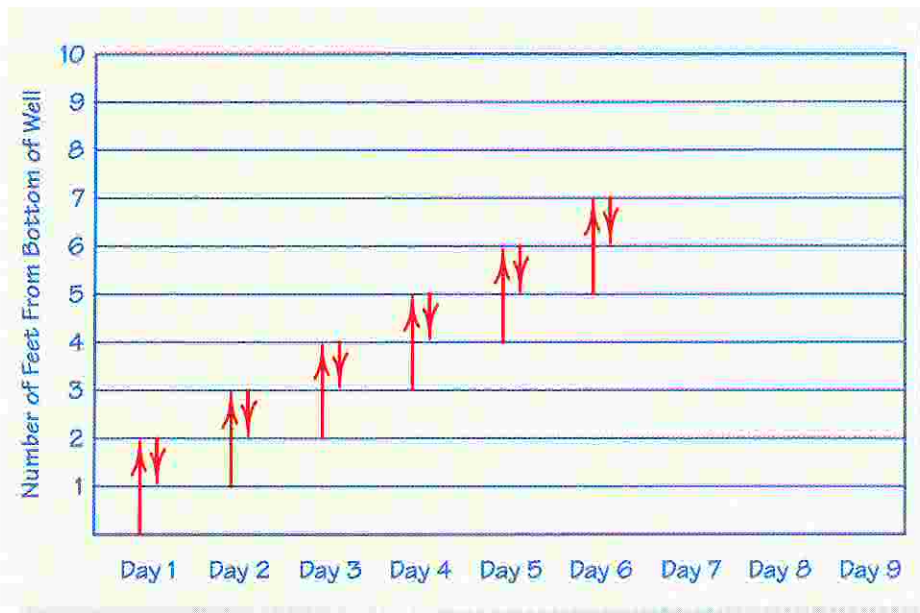
✔ Check Understanding

6. Copy and complete the diagram to check your answer.

EXERCISES

Practice and Problem Solving

A **Practice by Example**

Solve by simplifying each problem.

Example 1
(page 164)

1. You decide to number the 58 pages in your journal from 1 to 58. How many digits do you have to write?

2. Sports In a tennis tournament, each athlete plays one match against each of the other athletes. There are 12 athletes scheduled to play in the tournament. How many matches will be played?

3. Geometry What is the total number of triangles in the figure at the right?
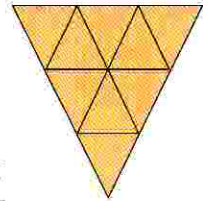
B **Apply Your Skills**

Solve using any strategy.

4. The school store buys pencils for $.20 each. It sells the pencils for $.25 each. How much profit does the store make if it sells five dozen pencils?

Strategies

- Account for All Possibilities
- Draw a Diagram
- Look for a Pattern
- Make a Model
- Make a Table
- Simplify the Problem
- Simulate the Problem
- Solve by Graphing
- Try, Test, Revise
- Use Multiple Strategies
- Work Backward
- Write an Equation
- Write a Proportion

5. Construction To accommodate a wheelchair, a builder installed countertops that are 0.75 ft lower than the original ones. The new countertops are 2.5 ft high. How high were the original countertops?

6. What is the total number of squares in the figure at the right?
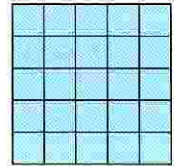
7. There are 10 girls and 8 boys at a party. A cartoonist wants to sketch a picture of each boy with each girl. How many sketches are required?

8. Fencing A rancher wants to build a fence for a square lot with dimensions of 50 yd by 50 yd. He wants to install a fence post every 5 yd with a post at each corner. How many fence posts will he need?

9. Writing in Math The houses on your street are numbered 1 to 120. No numbers are skipped. How many house numbers contain at least one 5? Explain your strategy.

C **Challenge**

10. Typesetting Before the use of computers, typesetters used metal pieces of type to print each letter in a word and each digit in a number. For example, three pieces of type—1, 4, and 8—were used to create the page number 148. How many pieces of type would be needed to set the page numbers 1 through 476?

11. Population The population of Rancho Cucamonga, California, is 117,000 people. The area of Rancho Cucamonga is 37.8 mi^2. Find the population density—the number of people per square mile. Show your work.

12. You are hiking with three friends. You pass a group of six hikers going the other way. Each person in one group greets each person in the other group. How many greetings are there? Explain.

Multiple Choice

What is the solution of each equation?

13. $x - 8 = -4.8$
   A. -12.8 B. -3.2 C. 3.2 D. 12.8

14. $8 + c = -2.3$
   F. -10.3 G. -5.7 H. 5.7 I. 10.3

15. $7.53 = -0.3y$
   A. 25.1 B. 2.26 C. -2.26 D. -25.1

Short Response

16. A corral is ringed by 60 ft of fencing with posts every 4 ft. How many fence posts are there? Show your work.

Mixed Review

Lesson 3-7 **Measurement** **Complete each statement.**

17. $27 \text{ cm} = \blacksquare \text{ m}$ 18. $5{,}200 \text{ km} = \blacksquare \text{ m}$ 19. $2{,}000 \text{ mg} = \blacksquare \text{ g}$

20. $0.5 \text{ L} = \blacksquare \text{ mL}$ 21. $3 \text{ m} = \blacksquare \text{ cm}$ 22. $6 \text{ kg} = \blacksquare \text{ mg}$

Lesson 3-3 23. **Test Scores** Your test scores so far this semester are 100, 90, 82, 96, and 78. You have one more 100-point test to take. After you complete the last test, what is your highest possible average?

Lesson 3-1 **Estimate using front-end estimation.**

24. $\$9.54 + \$1.25$ 25. $\$6.72 + \$5.28$ 26. $\$12.19 + \$5.66$

Math at Work

Woodworker

Woodworkers cut, shape, assemble, and finish wood to create tables, chairs, and other types of furniture. To create these items, woodworkers must plan and carry out many individual steps in sequence.

Machines used in professional woodworking shops cut and shape wood with great precision. The most sophisticated machines are controlled by computer programs. Woodworkers can enhance their skills by taking mathematics and computer courses that develop their ability to think three-dimensionally.

An extended-response question can be worth as many as four points. It often has multiple parts. To get full credit, you need to answer each part and show all of your work or justify your thinking.

EXAMPLE

To get a 90 for this grading period, Jerilyn needs a test average of 94.5. She had a 93.2 average on her first three tests and scored 97 on the fourth test. **(a)** Explain in words how to find the next score she needs. **(b)** Write an equation to find the fifth test score. **(c)** Solve your equation.

Here are three responses with the points each received.

4 points	3 points	1 point
There are 5 tests. For a test average of 94.5, the sum of the test scores must be 5 times 94.5, or 472.5 points.	There are 5 tests. For a test average of 94.5, the sum of the test scores must be 5 times 94.5, or 472.5 points.	Let g = grade on fifth test. $93.2 + 97 + g = 90$ $190.2 + g = 90$ $g = 90 - 190.2$ $g = 100.2$
Let g = grade on fifth test. $3(93.2) + 97 + g = 472.5$ $376.6 + g = 472.5$ $g = 472.5 - 376.6$ $g = 95.9$ Jerilyn must score 95.9 or higher on her fifth test.	Let g = grade on fifth test. $3(93.2) + 97 + g = 472.5$ $276.9 + 97 + g = 472.5$ $373.9 + g = 472.5$ $g = 472.5 - 373.9$ $g = 98.6$ Jerilyn must score 98.6.	

The 4-point response shows the work and gives a written answer to the problem. Note that it identifies the variable before writing the equation. The 3-point response contains a computational error, but the student completed all parts. The 1-point response shows an incorrect equation, and it does not explain the process.

EXERCISES

Use the Example above to do each exercise.

1. **Error Analysis** What is the error in the 3-point response?

2. Write a possible 2-point response for the problem. Explain why it is worth 2 points.

Chapter Review

Vocabulary

compatible numbers (p. 133)	mean (p. 137)	median (p. 137)	outlier (p. 138)
formula (p. 143)	measures of central tendency (p. 137)	mode (p. 137)	perimeter (p. 144)

Reading Math
Understanding
Vocabulary

Choose the vocabulary word that completes each sentence.

1. The sum of a group of data items divided by the number of data items is the _?_ .

2. Numbers that are easy to divide are called _?_ .

3. The data item that occurs most often in a group is the _?_ .

4. A data item that is much greater or much less than the rest of the data items in a group is a(n) _?_ .

5. When an odd number of data items are written in order, the middle item is the _?_ .

6. An equation that shows a relationship between quantities that are represented by variables is a(n) _?_ .

7. Numbers that describe groups of data items are called _?_ .

8. The distance around a figure is the _?_ .

Take It to the NET
Online vocabulary quiz
at www.PHSchool.com
Web Code: adj-0351

Skills and Concepts

3-1 Objectives

▼ To round decimals (p. 127)

▼ To estimate sums and differences (p. 128)

You can estimate the sum of decimals by rounding, front-end estimating, or clustering.

You can estimate the difference of decimals by rounding.

Estimate each sum or difference. State which method you used.

9. $3.14 + 6.952$

10. $10.2538 - 6.095$

11. $14.451 + 9.736$

12. $14.27 - 4.268$

13. $20.681 + 19.39 + 20.56$

14. $12.814 - 6.3791$

15. $9.0426 + 2.7182$

16. $21.9384 - 15.639$

17. $6.257 + 6.129 + 6.34$

18. $19.83 - 14.268$

19. Explain when you would use each estimation method named above to estimate a sum of decimals. Use examples.

20. **Weather** Last year Lake Jones rose to 672.42 feet during the spring floods. This year Lake Jones rose to 711.36 feet. About how much higher did the lake rise this year?

You can estimate a product by rounding. You can estimate a quotient of two decimals by using **compatible numbers.**

Estimate each product or quotient.

21. 8.15(6.04)   **22.** $19.28 \div 5.439$ **23.** $1.9 \cdot 4.92$

24. $25.1 \div 4.87$ **25.** $12.497 \cdot 0.894$ **26.** $59.3581 \div 11.5304$

27. 3.59(−2.3291)   **28.** $-17.45 \div 3.059$ **29.** (−2.0936)(−5.6892)

You can use a **measure of central tendency** to describe a collection of data. The **mean** is the sum of the data items divided by the number of data items. The **median** is the middle value or the mean of the two middle values when the data are written in order. The **mode** is the data item that occurs most often. An **outlier** is a data item that is much greater or much less than the rest of the data items.

Find the mean, median, and mode. When an answer is not an integer, round to the nearest tenth. Identify any outliers.

30. 2, 3, 6, 2, 8, 9, 5, 10, 4, 5   **31.** 16.1, 16.3, 15.9, 16.2, 16.3, 16.3, 15.8

32. 32, 35, 31, 57, 33, 30, 34   **33.** 0.1, 7.9, 0.2, 0.3, 0.1, 0.2, 0.1, 0.1, 0.3

Which measure of central tendency best describes each situation? Explain.

34. the favorite radio stations of teenagers in your neighborhood

35. the numbers of videos owned by students in your class

36. the prices of 8-oz containers of yogurt at six local grocery stores

A **formula** is an equation that shows a relationship between quantities that are represented by variables. You can use formulas to find such things as **perimeter,** area, and distance.

Evaluate each formula for the values given.

37. distance: $d = rt$
when $r = 35$ mi/h and
$t = 2$ h

38. area of a rectangle: $A = \ell w$
when $\ell = 16$ mm and
$w = 24$ mm

39. Circumference: $C = 2\pi r$
when $r = 6$ in. Use 3.14 for π.

40. perimeter of a square: $P = 4s$
when $s = 13$ cm

▼ To solve one-step decimal equations involving subtraction (p. 148)

▼ To solve one-step decimal equations involving addition (p. 149)

▼ To solve one-step decimal equations involving division (p. 152)

▼ To solve one-step decimal equations involving multiplication (p. 153)

To solve a one-step equation, use an inverse operation and a property of equality to get the variable alone on one side of the equation.

Solve each equation.

41. $n + 3.8 = 10.9$ **42.** $y - 6.72 = 2.53$ **43.** $h + 0.67 = -1.34$

44. $t - 2.7 = 23.5$ **45.** $12.9 + x = 3.8$ **46.** $5.7 = b - 4.9$

47. $6.3m = 15.75$ **48.** $a \div 4.9 = 8.33$ **49.** $v \cdot 7.1 = 80.23$

50. $c \div 12.5 = 77.5$ **51.** $-5.7z = 110.58$ **52.** $d \div 4.75 = -38.95$

🌐 **53. Finance** On Monday a stock is worth $3.20 per share. By Friday the stock is worth $2.64 per share.
  a. Write an equation to model the change in price.
  b. Solve the equation to find the amount by which the price changed.

3-7 Objectives

▼ To identify appropriate metric measures (p. 156)

▼ To convert metric units (p. 157)

The **metric system** of measurement uses a decimal system to relate units to one another. To measure, you must choose an appropriate unit of measure.

Choose an appropriate metric unit of measure. Explain each choice.

54. height of a building   **55.** mass of a bicycle   **56.** amount of milk in a glass

Mental Math **Complete each statement.**

57. $0.85 \text{ m} = \blacksquare \text{ cm}$ **58.** $160 \text{ mL} = \blacksquare \text{ L}$ **59.** $2.3 \text{ m} = \blacksquare \text{ cm}$

60. $1.6 \text{ kg} = \blacksquare \text{ g}$ **61.** $0.62 \text{ L} = \blacksquare \text{ mL}$ **62.** $80 \text{ g} = \blacksquare \text{ kg}$

63. Explain why centimeters would be an inappropriate unit to measure the height of a mature oak tree.

3-8 Objectives

▼ To solve complex problems by first solving simpler cases (p. 164)

When a problem is complicated, you can solve related simpler problems to better understand the problem.

64. Reasoning A school's lockers are numbered 1 to 100. One hundred students enter the school one at a time. The first student opens the lockers. The second student closes the even-numbered lockers. The third student either closes or opens every third locker. The remaining students continue the pattern. After all the students have passed the lockers, which lockers are open?

Chapter Test

Estimate each value.

1. $6.43 - 4.079$ **2.** $2.06 + 3.91$

3. $5.97 - 1.674$ **4.** $6.025 + 0.35$

5. $8.54 + 2.3$ **6.** $6.25 \cdot 9.87$

7. $12.89 \div 3.04$ **8.** $1.76 \cdot 3.93$

9. $4.96 \div 2.49$ **10.** $3.2 \cdot 14.69$

Find the mean, median, and mode. When an answer is not an integer, round to the nearest tenth. Identify any outliers.

11. 11, 12, 9, 13, 10, 12, 11, 14, 12

12. 5.3, 5.6, 5.2, 5.0, 5.4, 5.6, 5.1, 5.0

13. 10.6, 9.8, 11.6, 29.1, 3.4, 11.4, 12.7

14. 8.7, 8.5, 8.7, 8.5, 8.6, 8.5, 8.7, 8.6

Evaluate each formula for the given values.

15. area of a rectangle: $A = \ell w$
when $\ell = 3.8$ in. and $w = 1.5$ in.

16. perimeter of a square: $P = 4s$
when $s = 4.7$ cm

17. perimeter of a rectangle: $P = 2\ell + 2w$
when $\ell = 2.9$ m and $w = 6.05$ m

Solve each equation.

18. $x + 7.8 = 12.5$

19. $n - 5.9 = 0.5$

20. $4.1 + c = -1.2$

21. $d - 6.3 = 11$

22. $-9.7 + h = 10.3$

23. $m \div 2.7 = 14.58$

24. $h \cdot 4.7 = 30.55$

25. $b \div (-7.8) = -79.56$

26. $-3.4t = 30.94$

Write an appropriate metric unit of measure for each quantity.

27. the height of a truck

28. the capacity of a standard shampoo bottle

29. the mass of a pineapple

30. the width of a paperback book

Complete.

31. 4.5 m = ▮ cm   **32.** 68 mL = ▮ L

33. 90 kg = ▮ g   **34.** $6,700$ cm = ▮ m

35. 4 L = ▮ mL   **36.** 50.2 g = ▮ kg

For Exercises 37 and 38, write an equation, and then solve.

37. Shopping You spend $6.50 on a pair of gloves. You now have $7.00. How much money did you have originally?

38. Reptiles The fastest speed recorded for a reptile on land is 9.7 m/s for a spiny-tailed iguana. At this rate, how long would it take this iguana to travel 116.4 m?

39. Geography Madrid and Barcelona are cities in Spain. The distance between them is 636,000 m. What is this in kilometers?

40. You have an 18-ft metal pipe. How many cuts must you make to cut the pipe into 2-ft-long pieces?

41. Data Analysis Which measure of central tendency best describes the weights of the dogs in one neighborhood?

15 lb, 20 lb, 18 lb, 27 lb, 15 lb, 70 lb

A. mean   **B.** median
C. mode   **D.** all of the above

42. Writing in Math Explain how the outlier in the data set affects the mean.

3, 2, 6, 3, 5, 4, 15, 4, 3

Reading Comprehension Read the passages below. Then answer the questions on the basis of what is stated or implied in each passage.

Milk and Calcium Doctors and dieticians agree that calcium is an important part of good nutrition as calcium helps to build and maintain strong bones. The recommended daily intake of calcium for adults is 1,000 mg. The National Academy of Sciences recommends that people from 9 to 18 years of age get at least 1,300 mg of calcium per day. Milk, perhaps the best-known source for calcium, has 300 mg of calcium per cup.

1. Which is true about n, the number of milligrams of calcium recommended daily for an adult?
   A. $n > 1,000$ B. $n < 1,000$
   C. $n = 1,000$ D. $n = 10,000$

2. Which is true about c, the number of milligrams of calcium recommended daily for people ages 9 to 18?
   F. $c = 1,000$ G. $c > 1,300$
   H. $c < 1,300$ I. $c \geq 1,300$

3. How many more milligrams of calcium per day does a young person need than an adult?
   A. 300 mg   B. 1,000 mg
   C. 1,300 mg   D. 10,000 mg

4. How many full cups of milk does 14-year-old Janet have to drink if she is going to get her daily-recommended amount of calcium from milk?

Other Sources of Calcium Although one slice of cheese pizza supplies 220 milligrams of calcium, dairy products are not the only source of calcium. For example, $\frac{3}{4}$ cup of a certain brand of cereal supplies 330 mg of calcium, 1 cup of broccoli supplies 90 mg of calcium, and 3 oz of canned salmon with bones supplies 180 mg of calcium. You can get 300 mg from one cup of calcium-fortified orange juice. However, it is important to know that exercising can do as much to help you build strong bones as calcium in your diet.

5. Which of these foods has the most calcium per portion?
   F. cheese pizza   G. cereal
   H. broccoli   I. salmon

6. How many cups of broccoli give you 45 mg of calcium?
   A. 0.25 cup   B. 0.5 cup
   C. 1 cup   D. 2 cups

7. How many cups of orange juice would supply exactly 1,000 mg of calcium?

8. How else can you build strong bones besides getting enough calcium from food?

9. From the items in the passage, plan what you could eat that would give you exactly 1,300 mg of calcium in a day. Make a list to show your one-day diet.

What's $10 Worth?

Applying Decimals If you shop with an older adult, you may have heard the statement, "Ten dollars isn't worth what it used to be!" Of course, $10 is always worth ten $1 bills, or 40 quarters, or 100 dimes. That doesn't change. What does change is the price of items. For example, a stamp for a letter cost $.03 back in 1950. The 2002 cost of a stamp, $.37, is more than twelve times that price. Back in 1950, you could buy 333 first-class stamps with a $10 bill. Today, that same $10 bill will get you only 27 stamps!

A $10 bill in 1950 looked like this.

A $10 bill today looks like this.

$10 Bills

Federal Reserve Notes began circulating in 1913. The design remained virtually unchanged until May 2000.

1975 $.13 Commercial Aviation

2002 $.37

1932 $.03

1995 $.32

1991 $.29

Averages — Then and Now		
Item	**1950**	**2002**
New home	$9,422	$169,000
Weekly income	$29	$572
Washing machine	$64.95	$379

MOVIE

Movie Tickets — Then and Now

In 1950, it cost 46¢ to go to a movie in the United States. The average price in 2002 was $5.81—more than 12 times as much.
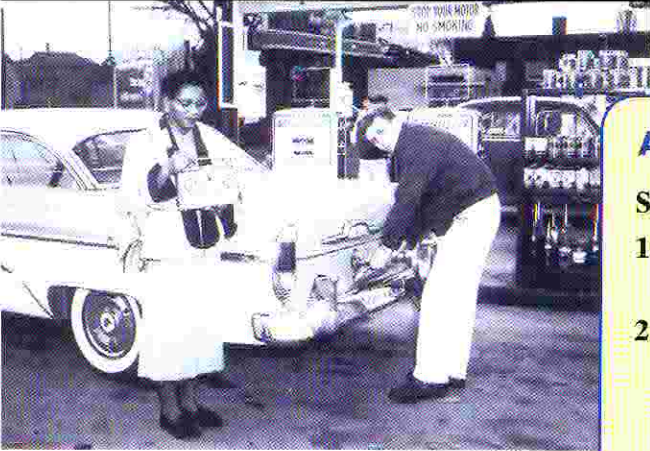
Activity

Suppose you have a $10 bill.

1. How many pounds of steak could you buy in 1950? In 2002?

2. **a.** How many gallons of gas could you buy in 1950?
   b. How much would that same gas have cost you in 2002?

3. Compare the prices of milk.
   a. What fraction of the 2002 price is the 1950 price?
   b. How many times the 1950 price is the 2002 price?

4. Suppose you earn the average weekly income and you buy the items on the shopping list.
   a. What is your total cost in 1950? In 2002?
   b. What part of your weekly income is this in 1950? In 2002?
   c. **Writing in Math** In which year is the average worker better off, 1950 or 2002? Explain.

Shopping List

2 loaves bread
1 lb coffee
2 gal milk
1 dozen muffins
2 bars soap
1 lb steak
3 cans tuna

Prices of Common Items

Item	Cost in 1950	Cost in 2002
Bread (1 loaf)	$.18	$1.49
Coffee (1 lb)	$.93	$3.29
Cookies (12-oz package)	$.39	$2.59
Gas (1 gal)	$.20	$1.35
Milk (1 gal)	$.92	$3.05
Muffins (6)	$.24	$2.89
Soap (2 bars)	$.29	$1.79
Steak (1 lb)	$.77	$3.89
Tuna (1 large can)	$.25	$1.39

Take It to the NET For more information about the 1950s, go to **www.PHSchool.com**.
Web Code: ade-0353

Where You've Been

- In Chapter 1, you learned how to add, subtract, multiply, and divide integers.

- In Chapter 2, you solved equations by adding, subtracting, multiplying, and dividing.

- In Chapter 3, you estimated solutions and solved equations with decimals.

Diagnosing Readiness

(For help, go to the lesson in green.)

Multiplying Three or More Factors (Lesson 1-9)

Find each product.

1. $12 \cdot 12 \cdot 12$ **2.** $(-4)(-4)(-4)$ **3.** $9 \cdot 9 \cdot 9 \cdot 9$

4. $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$ **5.** $8 \cdot 8 \cdot 8$ **6.** $(-2)(-2)(-2)(-2)(-2)(-2)$

Recalling Multiplication Facts (Previous Course)

Write two numbers that, when multiplied, result in each product.

7. 12	**8.** 45	**9.** 18	**10.** 63	**11.** 24
12. 50	**13.** 32	**14.** 81	**15.** 54	**16.** 60
17. 28	**18.** 56	**19.** 44	**20.** 36	**21.** 72

Dividing Whole Numbers (Skills Handbook, p. 760)

Find each quotient.

22. $720 \div 8$ **23.** $7{,}200 \div 8$ **24.** $6 \overline{)132}$

25. $3 \overline{)147}$ **26.** $\frac{189}{9}$ **27.** $\frac{450}{10}$

28. $424 \div 2$ **29.** $700 \div 5$ **30.** $92 \div 4$

31. $5 \overline{)135}$ **32.** $\frac{273}{3}$ **33.** $10 \overline{)1{,}300}$