Rational Number Operations

BEFORE

In previous chapters you've...

- Added, subtracted, multiplied, and divided integers
- Interpreted tables and graphs

Now

In Chapter 5 you'll study...

- Performing operations on fractions, mixed numbers, and decimals
- Rewriting fractions and decimals
- Describing data sets using mean, median, mode, and range

WHY?

So you can solve real-world problems about...

- snakes, p. 220
- sledding, p. 226
- rafting, p. 251
- deep sea jellies, p. 257

Internet Preview
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- eEdition Plus Online
- eWorkbook Plus Online
- eTutorial Plus Online
- State Test Practice
- More Examples

Chapter Warm-Up Games

Review skills you need for this chapter in these quick games.

$\frac{7}{32}$	$\frac{1}{3}$	$\frac{2}{7}$	$\frac{3}{11}$
$\frac{7}{17}$	$\frac{4}{9}$	$\frac{4}{15}$	$\frac{11}{25}$
$\frac{6}{11}$	$\frac{13}{21}$	$\frac{4}{7}$	$\frac{3}{8}$
$\frac{1}{2}$	$\frac{5}{8}$	$\frac{7}{11}$	$\frac{9}{14}$
$\frac{3}{4}$	$\frac{5}{6}$	$\frac{3}{5}$	$\frac{5}{7}$

$\frac{2}{3}$

Scale the Cliff

BrAIN GAME

Key Skill:
Comparing fractions

Find the handholds you can use to scale the cliff.

- Start at $\frac{2}{3}$ and move up, selecting a handhold in each row.

- The value of each handhold must be less than the value of the handhold below it.

Chapter Standardized Test

Test-Taking Strategy Be careful about choosing an answer that seems obvious. Carefully read the problem and all the choices before answering.

Multiple Choice

1. Which number is a prime number?

    A. 51   **B.** 67   **C.** 82   **D.** 93

2. What is the greatest common factor of 420 and 385?

    F. 5   **G.** 15   **H.** 35   **I.** 4620

3. Which fraction is written in simplest form?

    A. $\frac{3}{16}$ **B.** $\frac{4}{10}$ **C.** $\frac{9}{21}$ **D.** $\frac{15}{33}$

4. Two toy cars begin at the starting line of a circular track at the same time. Car A goes around the track every 20 seconds. Car B goes around the track every 8 seconds. In how many seconds will the two cars reach the starting line at the same time?

    F. 4 seconds   **G.** 24 seconds

    H. 40 seconds   **I.** 60 seconds

5. Which list is *not* in order from least to greatest?

    A. $\frac{1}{4}, \frac{3}{8}, \frac{7}{12}, \frac{2}{3}$

    B. $\frac{1}{2}, \frac{3}{4}, \frac{13}{16}, \frac{7}{8}$

    C. $1\frac{5}{18}, 1\frac{7}{9}, \frac{17}{12}, \frac{11}{6}$

    D. $2\frac{4}{21}, 2\frac{5}{14}, \frac{18}{7}, \frac{17}{6}$

6. Which expression is *not* equal to 5^4?

    F. $5^3 \cdot 5$ **G.** $5^2 \cdot 5^2$

    H. $\frac{5^8}{5^4}$ **I.** $\frac{5^8}{5^2}$

7. Which number is equal to $\frac{2^9}{2^3}$?

    A. 8   **B.** 64   **C.** 520   **D.** 4096

8. Write $\frac{-5x^{-6}}{x^3}$ using only positive exponents.

    F. $\frac{-5}{x^9}$ **G.** $\frac{1}{5x^9}$ **H.** $-5x^6$ **I.** $30x^3$

9. Simplify $(5 \times 10^{-7}) \times (3.6 \times 10^4)$.

    A. 1.8×10^{-4} **B.** 1.8×10^{-3}

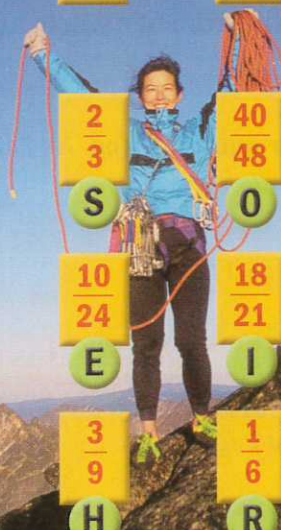   **C.** 1.8×10^{-2} **D.** 18×10^{-4}

Short Response

10. Planting Trees A conservation group wants to plant 48 trees in a rectangular arrangement so that each row has the same number of trees. How many trees can be planted in each row? List all possibilities. Of the possible arrangements, which one is closest to having a length three times its width?

Extended Response

11. History The Orb of 1661 is a gold sphere set with 365 diamonds, 363 pearls, 18 rubies, 9 emeralds, 9 sapphires, and 1 amethyst. What is the total number of jewels? What fraction of jewels are rubies? What fraction are emeralds? Write each fraction in simplest form. Jane estimates that about half of the jewels in the Orb are diamonds. Do you agree with this estimate? Explain.

Tangled Fractions

$\frac{6}{8}$	$\frac{7}{21}$	$\frac{15}{18}$	$\frac{6}{42}$	$\frac{35}{40}$
$\frac{12}{14}$	$\frac{2}{3}$	$\frac{40}{48}$	$\frac{3}{14}$	$\frac{30}{35}$
T	S	O	N	K
$\frac{9}{12}$	$\frac{10}{24}$	$\frac{18}{21}$	$\frac{4}{28}$	$\frac{5}{8}$
S	E	I	E	N
$\frac{2}{4}$	$\frac{3}{9}$	$\frac{1}{6}$	$\frac{2}{7}$	$\frac{14}{16}$
A	H	R	T	S

BrAIN GAME

Key Skill:
Identifying equivalent fractions

Susan is going rock climbing. Help her figure out what equipment she is missing.

- In each column, find a fraction equivalent to the top one to decode the name of the equipment Susan is missing.

Stop and Think

1. **Critical Thinking** A student thinks that a fraction cannot be smaller than another fraction if the first fraction's denominator is greater than the second fraction's denominator. Explain why the student is wrong.

2. **Writing** Explain how to tell whether fractions with different denominators are equivalent.

Getting Ready to Learn

Review What You Need to Know ↻

Using Vocabulary Copy and complete using a review word.

1. If 1 is the greatest common factor of the numerator and the denominator, then the fraction is in __?__.

2. A number like $3\frac{4}{7}$, whose value is the sum of a whole number part and a fraction part, is called a(n) __?__.

In Exercises 3–6, find the product or quotient. *(pp. 70, 74)*

3. $-125 \cdot 2$ **4.** $-4 \cdot (-23)$ **5.** $-39 \div 3$ **6.** $-136 \div (-17)$

Write the fraction in simplest form. *(p. 179)*

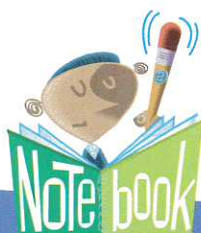**7.** $\frac{4}{12}$ **8.** $\frac{35}{50}$ **9.** $\frac{12}{32}$ **10.** $\frac{24}{52}$ **11.** $\frac{14}{49}$

12. You bought a sweater for $15.65 and a pair of jeans for $23.95. What was the total cost of your purchase? *(p. 709)*

Know How to Take Notes

Writing Helpful Hints In your notebook, write down any helpful hints your teacher or your textbook gives you for solving problems.

Equivalent Fractions

Write equivalent fractions by multiplying by a fraction that is equal to one.

$$\frac{3}{5} \times \frac{4}{4} = \frac{12}{20} \qquad \frac{3}{5} \times \frac{9}{9} = \frac{27}{45} \qquad \frac{3}{5} \times \frac{100}{100} = \frac{300}{500}$$

← A fraction has many equivalent forms.

You can rename a mixed number as an equivalent improper fraction.

$$3\frac{5}{6} = \frac{6 \cdot 3 + 5}{6} = \frac{23}{6}$$

In Lesson 5.1, you should write down helpful hints about subtracting with mixed numbers.

Fractions with Common Denominators

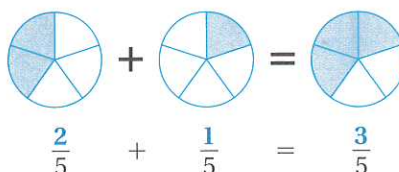| BEFORE	Now	WHY?
You added and subtracted whole numbers and integers.	You'll add and subtract fractions with common denominators.	So you can compare coin sizes, as in Ex. 28.

Word Watch

Review words

order of operations, p. 10
numerator, p. 707
denominator, p. 707

One way to add or subtract fractions with common denominators is to use a model.

$$\frac{2}{5} \quad + \quad \frac{1}{5} \quad = \quad \frac{3}{5}$$

The model suggests the following rule.

Adding and Subtracting Fractions

Words To add fractions or subtract fractions with a common denominator, write the sum or difference of the numerators over the denominator.

Numbers $\frac{3}{9} + \frac{5}{9} = \frac{8}{9}$ **Algebra** $\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$ $(c \neq 0)$

$\frac{3}{5} - \frac{2}{5} = \frac{1}{5}$ $\frac{a}{c} - \frac{b}{c} = \frac{a-b}{c}$ $(c \neq 0)$

To add or subtract mixed numbers, find the sum or difference of the whole numbers and the sum or difference of the fractions. Then combine these quantities.

EXAMPLE 1 **Fractions and Mixed Numbers**

HELP with Notetaking

Part (b) of Example 1 shows how to operate with negative mixed numbers. You may wish to copy this into your notebook.

a. $-\frac{11}{13} + \frac{8}{13} = \frac{-11+8}{13}$

$= -\frac{3}{13}$

b. $-5\frac{6}{7} + 3\frac{2}{7} = -5 - \frac{6}{7} + 3 + \frac{2}{7}$

$= -5 + 3 - \frac{6}{7} + \frac{2}{7}$

$= -2\frac{4}{7}$

EXAMPLE 2 **Simplifying Fractions with Variables**

a. $-\dfrac{a}{9} + \dfrac{7a}{9} = \dfrac{-a + 7a}{9}$ Write sum over common denominator.

$= \dfrac{6a}{9}$ Combine like terms.

$= \dfrac{\overset{2}{\cancel{6}}a}{\underset{3}{\cancel{9}}}$ Divide out common factor.

$= \dfrac{2a}{3}$ Simplify.

HELP with Solving

Remember that the following fractions are equivalent.

$\dfrac{-a}{b} = \dfrac{a}{-b} = -\dfrac{a}{b}$

b. $\dfrac{6x}{11y} - \dfrac{10x}{11y} = \dfrac{6x - 10x}{11y}$ Write difference over common denominator.

$= \dfrac{-4x}{11y}, \text{ or } -\dfrac{4x}{11y}$ Combine like terms.

Your turn now   Find the sum or difference. Then simplify if possible.

1. $\dfrac{1}{12} + \dfrac{5}{12}$ **2.** $\dfrac{3}{8} - 2\dfrac{1}{8}$ **3.** $-\dfrac{t}{3} - \dfrac{2t}{3}$ **4.** $\dfrac{y}{8a} + \dfrac{-5y}{8a}$

EXAMPLE 3   **Solving an Equation with Mixed Numbers**

Biology A corn snake that is $14\dfrac{3}{4}$ inches long grows g inches to a length of $27\dfrac{1}{4}$ inches. To find the amount of growth, subtract the original length from the current length.

$g = 27\dfrac{1}{4} - 14\dfrac{3}{4}$

$\dfrac{1}{4} < \dfrac{3}{4}$, so rename $27\dfrac{1}{4}$ so its fraction part is greater than $\dfrac{3}{4}$.

$= 26\dfrac{5}{4} - 14\dfrac{3}{4}$

$= \left(26 + \dfrac{5}{4}\right) - \left(14 + \dfrac{3}{4}\right)$

$= 26 + \dfrac{5}{4} - 14 - \dfrac{3}{4}$ Remember to distribute the subtraction.

$= (26 - 14) + \left(\dfrac{5}{4} - \dfrac{3}{4}\right)$

$= 12 + \dfrac{2}{4}$

$= 12\dfrac{1}{2}$ $\dfrac{2}{4} = \dfrac{1}{2}$

ANSWER The snake grows $12\dfrac{1}{2}$ inches.

Order of Operations The rules for adding and subtracting fractions can be applied to longer expressions. Remember to use the order of operations.

EXAMPLE 4 **Evaluating Longer Expressions**

a. $\dfrac{2}{11} - \dfrac{5}{11} + \dfrac{9}{11} = \dfrac{2 - 5 + 9}{11}$ Write 2 − 5 + 9 over common denominator.

    $= \dfrac{6}{11}$ Evaluate numerator from left to right.

b. $3\dfrac{6}{7} - 2\dfrac{3}{7} + 4\dfrac{5}{7} = (3 - 2 + 4) + \left(\dfrac{6}{7} - \dfrac{3}{7} + \dfrac{5}{7}\right)$ Group whole numbers and fractions.

    $= 5\dfrac{8}{7}$ Evaluate inside parentheses.

    $= 6\dfrac{1}{7}$ Rename.

Your turn now Evaluate. Then simplify if possible.

5. $\dfrac{3}{4} + \dfrac{7}{4} + \dfrac{5}{4}$ 6. $\dfrac{15}{8} - \dfrac{7}{8} + \dfrac{3}{8}$ 7. $2\dfrac{1}{3} - \dfrac{2}{3} + 3\dfrac{2}{3}$

5.1 **Exercises**

More Practice, p. 731

Getting Ready to Practice

1. **Vocabulary** Copy and complete: In the fraction $\dfrac{4}{9}$, 9 is the ? and 4 is the ? .

2. **Find the Error** Describe and correct the error.

    ✗ $\dfrac{3}{4} + \dfrac{3}{4} = \dfrac{3 + 3}{4 + 4} = \dfrac{6}{8}$

Find the sum or difference. Then simplify if possible.

3. $\dfrac{5}{18} + \dfrac{7}{18}$ 4. $\dfrac{3}{10} - \dfrac{7}{10}$ 5. $\dfrac{4}{15} - \dfrac{1}{15}$ 6. $1\dfrac{5}{9} + \dfrac{2}{9}$

7. $3\dfrac{1}{7} - 1\dfrac{5}{7}$ 8. $2\dfrac{7}{9} + \dfrac{8}{9}$ 9. $\dfrac{c}{6} + \dfrac{5c}{6}$ 10. $\dfrac{3d}{5} - \dfrac{2d}{5}$

11. **Knitting** When the scarf you are knitting is $21\dfrac{3}{8}$ inches long, you find a mistake and have to pull out $2\dfrac{5}{8}$ inches. How much scarf is left?

Practice and Problem Solving

Find the sum or difference.

12. $\dfrac{4}{17} + \dfrac{8}{17}$ **13.** $\dfrac{7}{18} - \dfrac{5}{18}$ **14.** $\dfrac{9}{14} - \dfrac{5}{14}$ **15.** $\dfrac{-13}{24} + \dfrac{-9}{24}$

16. $\dfrac{5}{21} + \dfrac{2}{21}$ **17.** $\dfrac{12}{25} + \dfrac{-7}{25}$ **18.** $\dfrac{1}{6} - \dfrac{11}{6}$ **19.** $-\dfrac{3}{4} - \left(-\dfrac{1}{4}\right)$

20. $-2\dfrac{5}{12} + 1\dfrac{11}{12}$ **21.** $1\dfrac{4}{15} + \left(-\dfrac{11}{15}\right)$ **22.** $-4\dfrac{2}{7} - 4\dfrac{2}{7}$ **23.** $-7\dfrac{3}{5} - \dfrac{4}{5}$

Algebra Simplify the expression.

24. $\dfrac{h}{13} + \dfrac{6h}{13}$ **25.** $-\dfrac{8n}{21} + \dfrac{5n}{21}$ **26.** $\dfrac{9a}{20b} - \dfrac{7a}{20b}$ **27.** $-\dfrac{5q}{18p} - \dfrac{13q}{18p}$

28. Euros A 2-euro coin is $25\dfrac{3}{4}$ millimeters at its widest. A 1-euro coin is $23\dfrac{1}{4}$ millimeters at its widest. How much wider is a 2-euro coin?

29. Volunteering You did volunteer work for $6\dfrac{1}{6}$ hours last week and $8\dfrac{5}{6}$ hours this week. For how many total hours have you volunteered? How many more hours did you volunteer this week than last week?

30. Auto Racing Some cars in a recent race were allowed to reduce the height of their rear spoilers by one fourth inch. After the change, one car's spoiler was $6\dfrac{1}{4}$ inches tall. How tall was the spoiler before the change in height?

Evaluate.

31. $\dfrac{13}{18} + \dfrac{5}{18} + \dfrac{11}{18}$ **32.** $-\dfrac{4}{5} - \dfrac{1}{5} - \dfrac{2}{5}$ **33.** $-\dfrac{4}{25} + \dfrac{3}{25} + \dfrac{9}{25}$

34. $\dfrac{5}{7} - 1\dfrac{3}{7} + \dfrac{4}{7}$ **35.** $-\dfrac{3}{16} + 2\dfrac{1}{16} - \dfrac{15}{16}$ **36.** $1\dfrac{3}{8} + \dfrac{5}{8} - 1\dfrac{7}{8}$

37. $-5\dfrac{4}{15} - 3\dfrac{7}{15} + \dfrac{8}{15}$ **38.** $-\dfrac{9}{20} + \dfrac{19}{20} - 1\dfrac{1}{20}$ **39.** $4\dfrac{5}{12} - \left(1\dfrac{11}{12} - \dfrac{7}{12}\right)$

40. Long Jump You want to match your school's long jump record of 17 feet $8\dfrac{1}{4}$ inches. Your best long jump so far is 15 feet $11\dfrac{3}{4}$ inches. How much farther do you need to jump to match the school record?

Algebra Solve the equation.

41. $x + \dfrac{5}{8} = \dfrac{7}{8}$ **42.** $\dfrac{10}{11} - y = \dfrac{2}{11}$ **43.** $z - \dfrac{9}{15} = \dfrac{11}{15}$

spoiler

What do you think?

Sports

■ **Auto Racing**
Decreasing the height of a race car's spoiler reduces *drag*, increasing speed. What do you think happens when the spoiler's height is increased?

44. Writing One hundred students try three new fruit juice blends, and each picks a favorite, as shown at the right.

Your friend says that if you make each number the numerator in a fraction with a denominator of 100, the sum of these fractions must be 1. Is your friend right? Explain.

Favorite Juice Blend

- Juice A 42
- Juice B 37
- Juice C 21
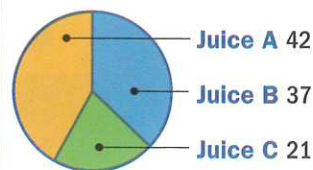
Challenge Find the value that makes the equation true.

45. $\dfrac{5}{11} + \dfrac{9}{11} - \dfrac{?}{} = -\dfrac{2}{11}$

46. $\dfrac{7}{16} + \dfrac{9}{16} - \dfrac{?}{} = \dfrac{5}{16}$

Mixed Review

Find the sum or difference. *(Lessons 2.2, 2.3)*

47. $22 + (-17)$ **48.** $-14 - 9$ **49.** $-7 + (-35)$ **50.** $16 - (-13)$

Find the least common multiple of the numbers. *(Lesson 4.4)*

51. $15, 35$ **52.** $19, 76$ **53.** $37, 50$ **54.** $27, 81$

Find the least common denominator of the fractions. *(Lesson 4.5)*

55. $\dfrac{2}{3}, \dfrac{4}{9}$ **56.** $\dfrac{1}{5}, \dfrac{9}{20}$ **57.** $\dfrac{3}{8}, \dfrac{7}{12}$ **58.** $\dfrac{1}{6}, \dfrac{4}{15}$

Basic Skills Find the quotient.

59. $32 \div 2$ **60.** $60 \div 5$ **61.** $10 \div 8$ **62.** $50 \div 4$
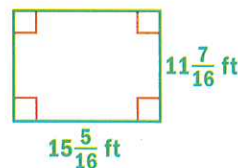
Test-Taking Practice

63. Multiple Choice You have $\dfrac{7}{8}$ of a box of pasta. If you serve $\dfrac{3}{8}$ of the box for dinner, how much of the box do you have left?

A. $\dfrac{1}{4}$ **B.** $\dfrac{1}{2}$ **C.** $\dfrac{5}{8}$ **D.** $\dfrac{3}{4}$

64. Multiple Choice You are fencing a rectangular plot of land. The plot and its dimensions are shown. How many feet of fencing do you need?

$11\frac{7}{16}$ ft

$15\frac{5}{16}$ ft

F. $26\frac{3}{4}$ feet   **G.** $52\frac{1}{2}$ feet

H. $53\frac{1}{4}$ feet   **I.** $53\frac{1}{2}$ feet

Fractions with Different Denominators

BEFORE	▶ Now	WHY?
You added and subtracted with common denominators.	You'll add and subtract with different denominators.	So you can find a sled length, as in Ex. 20.

In the Real World

Word Watch

Review Words

least common denominator (LCD), p. 192

Carpentry A board is $36\frac{5}{8}$ inches long. You cut off a piece $12\frac{3}{4}$ inches long. The saw blade destroys an additional $\frac{1}{16}$ inch of wood.

You will find the length of the remaining piece of wood in Example 3 on page 225.

Rewriting Fractions To add or subtract fractions with different denominators, first rewrite the fractions so the denominators are the same.

EXAMPLE 1 **Adding and Subtracting Fractions**

HELP with Review

For help with rewriting fractions with common denominators, see p. 192.

a. $\dfrac{7}{8} + \dfrac{-2}{5} = \dfrac{35}{40} + \dfrac{-16}{40}$ **Rewrite fractions using LCD of 40.**

$= \dfrac{35 + (-16)}{40}$ **Write sum over LCD.**

$= \dfrac{19}{40}$ **Evaluate numerator.**

b. $\dfrac{3}{10} - \dfrac{5}{6} = \dfrac{9}{30} - \dfrac{25}{30}$ **Rewrite fractions using LCD of 30.**

$= \dfrac{9 - 25}{30}$ **Write difference over LCD.**

$= \dfrac{-16}{30}$ **Evaluate numerator.**

$= -\dfrac{8}{15}$ **Simplify.**

Your turn now **Find the sum or difference. Then simplify if possible.**

1. $\dfrac{1}{3} + \dfrac{3}{8}$ **2.** $\dfrac{3}{4} - \dfrac{9}{10}$ **3.** $\dfrac{5}{12} + \dfrac{-7}{9}$ **4.** $\dfrac{1}{6} - \dfrac{11}{15}$

Simplifying Variable Expressions

Algebra Simplify the expression.

a. $\dfrac{2x}{5} - \dfrac{x}{6} = \dfrac{12x}{30} - \dfrac{5x}{30}$ **Rewrite fractions using LCD of 30.**

$= \dfrac{12x - 5x}{30}$ **Write difference over LCD.**

$= \dfrac{7x}{30}$ **Combine like terms.**

b. $\dfrac{5}{y} + \dfrac{7}{8} = \left(\dfrac{5}{y} \cdot \dfrac{\mathbf{8}}{\mathbf{8}}\right) + \left(\dfrac{7}{8} \cdot \dfrac{\mathbf{y}}{\mathbf{y}}\right)$ **Multiply $\dfrac{5}{y}$ by $\dfrac{8}{8}$ and $\dfrac{7}{8}$ by $\dfrac{y}{y}$ for LCD of 8y.**

$= \dfrac{40}{8y} + \dfrac{7y}{8y}$ **Multiply inside parentheses.**

$= \dfrac{40 + 7y}{8y}$ **Write sum over LCD.**

Watch Out!

In part (b) of Example 2, notice that
$$\dfrac{40 + 7y}{8y} \neq \dfrac{47y}{8y}$$
because 40 and 7y are not like terms. The expression is already in simplest form.

Modeling with Mixed Numbers

Carpentry To find the length of the remaining piece of wood from the problem at the top of page 224, write a verbal model.

Remaining length L	=	Original length	−	(Length cut off	+	Blade width)

$L = 36\dfrac{5}{8} - \left(12\dfrac{3}{4} + \dfrac{1}{16}\right)$ **Write an algebraic model.**

$= 36\dfrac{10}{16} - \left(12\dfrac{12}{16} + \dfrac{1}{16}\right)$ **Rewrite fractions using LCD of 16.**

$= 36\dfrac{10}{16} - 12\dfrac{13}{16}$ **Add inside parentheses.**

$= 35\dfrac{26}{16} - 12\dfrac{13}{16}$ **Rename $36\dfrac{10}{16}$ as $35\dfrac{26}{16}$.**

$= (35 - 12) + \left(\dfrac{26}{16} - \dfrac{13}{16}\right)$ **Group whole numbers and fractions.**

$= 23\dfrac{13}{16}$ **Subtract whole numbers and fractions.**

ANSWER The remaining piece of wood is $23\dfrac{13}{16}$ inches long.

Your turn now Find the sum or difference. Then simplify if possible.

5. $\dfrac{w}{3} + \dfrac{w}{12}$ **6.** $\dfrac{2}{5} - \dfrac{2}{z}$ **7.** $5\dfrac{3}{4} + 2\dfrac{3}{5}$ **8.** $7\dfrac{5}{6} - 3\dfrac{8}{9}$

Getting Ready to Practice

1. **Vocabulary** Copy and complete: To add two fractions with different denominators, rewrite the fractions using the _?_ of the fractions.

Find the sum or difference. Then simplify if possible.

2. $\frac{1}{2} + \frac{1}{3}$

3. $4\frac{5}{8} - 2\frac{2}{3}$

4. $\frac{2x}{7} - \frac{x}{2}$

5. $\frac{4}{x} + \frac{1}{9}$

6. **Guided Problem Solving** You are building a stone wall 13 feet long. You build $4\frac{1}{3}$ feet of wall on Monday and $5\frac{3}{4}$ feet on Tuesday. How much wall do you have left to build?

   ① Write a verbal model to describe the problem.

   ② Substitute the given values into the model.

   ③ Solve the equation to find the length left to build.

Practice and Problem Solving

Find the sum or difference.

7. $\frac{7}{8} - \frac{1}{4}$

8. $\frac{3}{7} + \frac{9}{14}$

9. $\frac{5}{9} + \frac{1}{6}$

10. $\frac{2}{3} - \frac{3}{10}$

11. $\frac{1}{8} - \frac{5}{32}$

12. $-\frac{7}{12} + \frac{4}{15}$

13. $\frac{-3}{8} + \frac{-9}{20}$

14. $5\frac{1}{2} - \frac{7}{10}$

15. $12\frac{5}{18} - \frac{3}{4}$

16. $-7\frac{3}{11} - (-8)$

17. $7\frac{4}{5} + 5\frac{3}{7}$

18. $12\frac{2}{9} - 16\frac{3}{7}$

19. **Tree Removal** A dead tree $25\frac{1}{2}$ feet tall is being cut down. On the first cut, $9\frac{1}{3}$ feet are cut off. On the next cut, $7\frac{5}{6}$ feet are cut off. How much of the tree remains to be cut down?

20. **Olympic Sledding** Olympic skeleton sleds range from $31\frac{1}{2}$ inches to $47\frac{1}{4}$ inches long. What is the difference in length of the longest and shortest sleds?

Tell whether the statement is *true* or *false*.

21. $\frac{1}{4} - \frac{6}{7} + \frac{3}{14} = -\frac{11}{28}$

22. $\frac{4}{5} + \frac{5}{8} - \frac{7}{10} = \frac{57}{80}$

23. $1\frac{1}{3} - \frac{2}{9} - \frac{5}{6} = \frac{7}{18}$

Algebra Simplify the expression.

**24.** $\dfrac{6t}{13} - \dfrac{6t}{7}$ **25.** $\dfrac{9s}{4} - \dfrac{7s}{5}$ **26.** $\dfrac{18}{7a} + \dfrac{11}{21}$ **27.** $\dfrac{16}{25n} + \dfrac{9}{10n}$

Equator In Exercises 28 and 29, use the following information.

Traveling east from the Galapagos Islands to Nairobi, Kenya, you go about $\dfrac{9}{25}$ of the way around Earth's equator. It is then about $\dfrac{9}{50}$ of the way around the equator from Nairobi traveling east to Singapore.

28. What fraction of the equator do you cover if you travel east from the Galapagos Islands to Singapore?
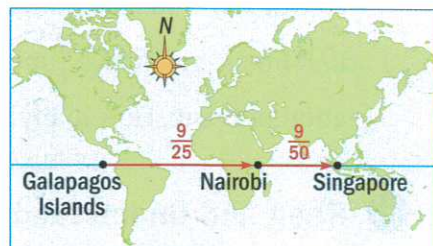
29. Writing Is traveling from the Galapagos Islands to Singapore a shorter trip if you travel *east* or *west*? Explain.

Algebra Solve the equation.

30. $6\dfrac{3}{8} + 2\dfrac{5}{12} - x = 4\dfrac{3}{4}$ **31.** $7\dfrac{7}{8} - 6\dfrac{5}{9} - y = \dfrac{1}{6}$ **32.** $z + 3\dfrac{4}{7} - 5\dfrac{2}{5} = 1\dfrac{1}{2}$

33. Challenge To evaluate $3\dfrac{1}{4} + 5\dfrac{3}{8}$, Cal groups the whole numbers and the fractions, and then rewrites the fractions with a common denominator. May rewrites the fractions with a common denominator first, and then groups the whole numbers and the fractions. Do Cal and May get the same sum? Explain.

Mixed Review ♻

Find the product. *(Lesson 2.4)*

34. $-9(7)$ **35.** $0(-5)$ **36.** $7(-3)(13)$ **37.** $-9(-7)(-2)$

Copy and complete the statement with $<$, $>$, or $=$. *(Lesson 4.5)*

38. $\dfrac{1}{7} \underline{\ ?\ } \dfrac{1}{8}$ **39.** $\dfrac{3}{8} \underline{\ ?\ } \dfrac{4}{9}$ **40.** $\dfrac{5}{12} \underline{\ ?\ } \dfrac{7}{16}$ **41.** $\dfrac{7}{10} \underline{\ ?\ } \dfrac{18}{25}$

Test-Taking Practice 🖊

42. Multiple Choice What is the value of $\dfrac{5}{6} + \dfrac{1}{9} - \dfrac{2}{3}$?

   A. $\dfrac{1}{6}$ **B.** $\dfrac{2}{9}$ **C.** $\dfrac{5}{18}$ **D.** $\dfrac{1}{3}$

43. Short Response You are getting ready for a backpacking trip. You pack $4\dfrac{2}{3}$ pounds of food and $5\dfrac{1}{8}$ pounds of equipment into a $2\dfrac{1}{4}$ pound backpack. What is the total weight you will carry?

Act It Out

Problem You are hiking a trail that is $7\frac{1}{2}$ miles long. Before your first break, you hike $2\frac{3}{4}$ miles. Then you hike $2\frac{1}{2}$ miles and take another break. How many miles do you have left to hike?

❶ Read and Understand

Read the problem carefully.

- You know that you are hiking a total distance of $7\frac{1}{2}$ miles, and that you have already hiked $2\frac{3}{4}$ miles and $2\frac{1}{2}$ miles.

- You want to find the remaining distance that you have left to hike.

❷ Make a Plan

Decide on a strategy to use.

One way to solve this problem is to use the act it out strategy. You can act out the hike by using a common item like floor tiles to represent distance traveled.

❸ Solve the Problem

Reread the problem and act it out.

The fractions have an LCD of 4, so let each floor tile represent $\frac{1}{4}$ of a mile. Use masking tape to mark off 30 tiles for $7\frac{1}{2}$ miles. Walk across 11 tiles to represent $2\frac{3}{4}$ miles hiked and 10 more tiles to represent $2\frac{1}{2}$ miles hiked. Notice that 9 tiles remain, which represent $2\frac{1}{4}$ miles left to hike.

ANSWER You have $2\frac{1}{4}$ miles left to hike.

❹ Look Back

Add your answer to the first two distances.

$2\frac{3}{4} + 2\frac{1}{2} + 2\frac{1}{4} = 7\frac{1}{2}$ ✓

Practice the Strategy

Use the strategy *act it out*. Tell how you acted out the problem to get your answer.

1. **Pets** There are 18 students in your class. Eight students have a cat and five students have a dog. Two students in your class have both a cat and a dog. How many students have neither a cat nor a dog?

2. **Money** You have 8 quarters, 10 dimes, and 7 nickels. You give half of your dimes and 2 nickels to a friend. Then you spend one fourth of your quarters and one nickel. How much money do you have left?

3. **Gifts** You buy a roll of ribbon 20 yards long. The amounts of ribbon you use to decorate a gift and to make a bow are shown below.

   $2\frac{1}{6}$ yards $2\frac{1}{2}$ yards

   You decorate 5 gifts. How many bows can you make with the ribbon you have left?

4. **Beads** There are 24 beads in a bowl. Anna takes $\frac{1}{6}$ of the beads. Then John takes two beads. Lena takes $\frac{1}{9}$ of what Anna and John left. Dawn takes $\frac{1}{4}$ of what Lena left, and then Jamal takes five beads. How many beads are left in the bowl?

5. **Lunch Line** You are in a lunch line with 4 students in front of you and 6 students behind you. You let a friend into the line in front of you, who then lets 2 students get in line behind her. Finally, 2 students join the end of the lunch line. How many students are in the lunch line? What is your new position in the lunch line?

Mixed Problem Solving

Use any strategy to solve the problem.

6. **Vacation** On each day of your three day vacation, you can choose one activity. The table below shows your choices. How many different groups of activities can you choose?

Day	Activities
Friday	museum, picnic, bus tour
Saturday	baseball game, bicycling
Sunday	hike, shopping, water park

7. **Fundraising** To raise money for a class trip, you are selling sweatshirts for $19 and T-shirts for $11. You have sold 17 items worth a total of $227. How many of each item have you sold?

8. **Floors** You are choosing a floor covering for the room shown below. It costs $3 per square foot for carpeting. It costs $8 per square foot for a wood floor.

   10 ft
   5 ft
   9 ft
   12 ft
   7 ft
   19 ft
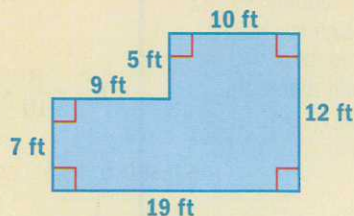
   What is the cost to cover the floor with each type of flooring?

Multiplying Fractions

BEFORE	▶ **Now**	**WHY?**
You added and subtracted fractions and mixed numbers.	You'll multiply fractions and mixed numbers.	So you can find a moon crater's depth, as in Ex. 19.

Word Watch

Review Words

numerator, p. 707
denominator, p. 707

In the Real World

Postcards A postcard is $5\frac{1}{2}$ inches long and $3\frac{3}{4}$ inches wide. What is the area of this postcard? In Example 2 on page 231, you will multiply mixed numbers to find the postcard's area.

Multiplication To multiply fractions, you can use the rule below.

NoTebook

Multiplying Fractions

Words The product of two or more fractions is equal to the product of the numerators divided by the product of the denominators.

Numbers $\dfrac{3}{4} \cdot \dfrac{5}{8} = \dfrac{3 \cdot 5}{4 \cdot 8} = \dfrac{15}{32}$

Algebra $\dfrac{a}{b} \cdot \dfrac{c}{d} = \dfrac{a \cdot c}{b \cdot d}$ $(b, d \neq 0)$

EXAMPLE 1 **Multiplying Fractions**

HELP with **Review**

Remember that the product of two numbers with the same sign is positive. The product of two numbers with different signs is negative.

a. $-\dfrac{2}{5} \cdot \left(-\dfrac{2}{3}\right) = \dfrac{-2 \cdot (-2)}{5 \cdot 3}$ **Use rule for multiplying fractions.**

$= \dfrac{4}{15}$ **Evaluate numerator and denominator.**

b. $-\dfrac{3}{10} \cdot \dfrac{5}{6} = \dfrac{-3 \cdot 5}{10 \cdot 6}$ **Use rule for multiplying fractions.**

$= \dfrac{\overset{-1}{-3} \cdot \overset{1}{5}}{\underset{2}{10} \cdot \underset{2}{6}}$ **Divide out common factors.**

$= -\dfrac{1}{4}$ **Multiply.**

Mixed Numbers To multiply mixed numbers, first write them as improper fractions.

EXAMPLE **2** **Multiplying Mixed Numbers**

To find the area of the postcard on page 230, use an area formula.

$$\text{Area} = \text{length} \cdot \text{width} \qquad \text{Write formula for area of a rectangle.}$$

$$= 5\tfrac{1}{2} \cdot 3\tfrac{3}{4} \qquad \text{Substitute values.}$$

$$= \frac{11}{2} \cdot \frac{15}{4} \qquad \text{Write as improper fractions.}$$

$$= \frac{11 \cdot 15}{2 \cdot 4} \qquad \text{Use rule for multiplying fractions.}$$

$$= \frac{165}{8}, \text{ or } 20\tfrac{5}{8} \qquad \text{Multiply.}$$

ANSWER The area of the postcard is $20\tfrac{5}{8}$ square inches.

Your turn now Find the product. Simplify if possible.

1. $\dfrac{5}{12} \cdot 15$

2. $-\dfrac{5}{12} \cdot \dfrac{9}{10}$
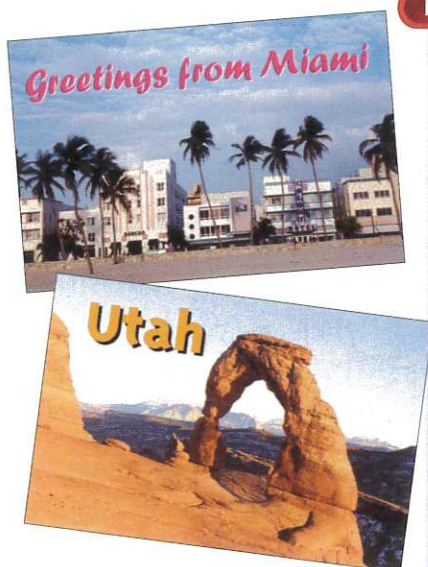
3. $1\tfrac{2}{5} \cdot 3\tfrac{1}{2}$

4. $-2\tfrac{1}{3} \cdot \left(-\dfrac{3}{4}\right)$

Watch Out!

Be careful when you write a negative mixed number as an improper fraction.

$$-4\tfrac{5}{6} = \frac{-4 \cdot 6 + (-5)}{6}$$

$$-4\tfrac{5}{6} \ne \frac{-4 \cdot 6 + 5}{6}$$

EXAMPLE **3** **Evaluating a Variable Expression**

Algebra Evaluate x^2y when $x = -\dfrac{4}{5}$ and $y = \dfrac{2}{3}$.

$$x^2y = \left(-\frac{4}{5}\right)^2 \cdot \frac{2}{3} \qquad \text{Substitute } -\frac{4}{5} \text{ for } x \text{ and } \frac{2}{3} \text{ for } y.$$

$$= \left(-\frac{4}{5}\right) \cdot \left(-\frac{4}{5}\right) \cdot \frac{2}{3} \qquad \text{Write } -\frac{4}{5} \text{ as a factor 2 times.}$$

$$= \frac{-4 \cdot (-4) \cdot 2}{5 \cdot 5 \cdot 3} \qquad \text{Use rule for multiplying fractions.}$$

$$= \frac{32}{75} \qquad \text{Multiply.}$$

Your turn now Evaluate the expression when $x = -\dfrac{3}{4}$ and $y = \dfrac{5}{6}$. Simplify if possible.

5. $\dfrac{1}{2}x$

6. $2y$

7. xy

8. xy^2

Getting Ready to Practice

1. **Vocabulary** Copy and complete: The product of two or more fractions is equal to the product of the fractions' ? divided by the product of the fractions' ? .

Find the product. Simplify if possible.

2. $\frac{5}{8} \cdot \frac{7}{16}$

3. $-\frac{9}{4} \cdot \frac{5}{6}$

4. $-4 \cdot \frac{3}{5}$

5. $5\frac{3}{4} \cdot \frac{1}{8}$

6. **Snack Mix** A serving of a snack mix is $\frac{7}{8}$ cup. You need to take 15 servings to your friend's party. How many cups of snack mix should you bring? Explain how you can use estimation to check your answer.

Practice and Problem Solving

HELP with **Homework**

Example	Exercises
1	7–13, 19
2	14–18
3	20–23

Online Resources
CLASSZONE.COM
· More Examples
· eTutorial Plus

Find the product.

7. $\frac{7}{11} \cdot \frac{1}{6}$

8. $\frac{4}{5} \cdot \frac{3}{10}$

9. $-\frac{3}{4} \cdot \left(-\frac{2}{9}\right)$

10. $-\frac{5}{6} \cdot \frac{5}{12}$

11. $12 \cdot \frac{3}{8}$

12. $-9 \cdot \frac{1}{9}$

13. $-5 \cdot \left(-\frac{7}{4}\right)$

14. $-4 \cdot 2\frac{9}{16}$

15. $6\frac{2}{3} \cdot 4\frac{1}{12}$

16. $-3\frac{3}{8} \cdot 7\frac{1}{5}$

17. $-8 \cdot \left(-1\frac{4}{5}\right)$

18. $6\frac{3}{16} \cdot \left(-3\frac{1}{5}\right)$

19. **Moon Craters** Simple impact craters on the moon are about $\frac{1}{5}$ as deep as they are wide. Moltke Crater is a simple impact crater on the moon that is 7 kilometers wide. About how deep is Moltke Crater?

Algebra Evaluate the expression when $a = \frac{5}{8}$ and $b = -\frac{7}{6}$.

20. $-\frac{1}{4}a$

21. $1\frac{1}{2} \cdot b$

22. $-8a$

23. ab

24. **Critical Thinking** A banana bread recipe uses 3 bananas and $\frac{1}{4}$ cup of butter. You need to make a smaller recipe because you have only 2 bananas. How much butter will you need? Explain.

25. **Act It Out** A section of the town beach is shrinking by $1\frac{3}{4}$ feet per year. Use the *act it out* strategy to find how much the beach will erode in 20 years. Explain how you used the strategy.

Find the area of the figure.

26.

$\frac{15}{16}$ in.
2 in.

27.

$\frac{4}{5}$ ft
$1\frac{2}{3}$ ft

28.

$3\frac{5}{11}$ m
$3\frac{5}{11}$ m
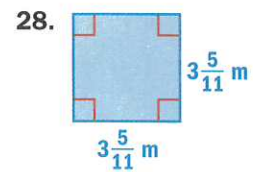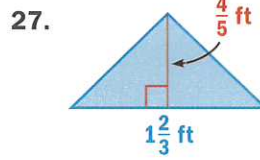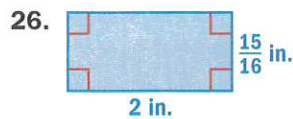
Find the product.

29. $\dfrac{1}{4} \cdot \left(-\dfrac{2}{5}\right) \cdot \dfrac{9}{10}$

30. $\dfrac{2}{5} \cdot 1\dfrac{1}{5} \cdot \left(-4\dfrac{7}{12}\right)$

31. $-9\dfrac{2}{7} \cdot 1\dfrac{2}{5} \cdot \dfrac{3}{4}$

32. Computers One of the first computers, the ENIAC, performed one operation in $\dfrac{1}{5000}$ second. How long would it take the ENIAC to perform 11,000 operations?

Evaluate the expression.

33. $-\dfrac{7}{8} + 5\dfrac{1}{2} \cdot \dfrac{11}{15}$

34. $\dfrac{5}{2} \cdot \left(\dfrac{8}{9} - \dfrac{5}{12}\right)$

35. $5 - \left(\dfrac{1}{3} + \dfrac{1}{6}\right)^2$

36. Challenge Mosaic tiles sometimes measure $\dfrac{2}{5}$ inch by $\dfrac{2}{5}$ inch. What area would 500 tiles cover?

Mixed Review

Multiply or divide. Write your answer as a power. *(Lesson 4.6)*

37. $7^3 \cdot 7^2$

38. $3^5 \cdot 3$

39. $\dfrac{8^6}{8^4}$

40. $\dfrac{5^{10}}{5^5}$

Find the sum or difference. *(Lesson 5.2)*

41. $\dfrac{4}{5} + \dfrac{7}{10}$

42. $-2\dfrac{4}{9} + \dfrac{5}{21}$

43. $\dfrac{13}{20} - \dfrac{1}{6}$

44. $-\dfrac{15}{22} - \dfrac{9}{16}$

Test-Taking Practice

45. Multiple Choice You have a poster that measures $8\dfrac{1}{2}$ inches by 11 inches. You want to multiply each dimension by $1\dfrac{1}{2}$. What is the area of the new poster?

A. $93\dfrac{1}{2}$ in.^{2} **B.** $140\dfrac{1}{4}$ in.^{2} **C.** $210\dfrac{3}{8}$ in.^{2} **D.** $280\dfrac{1}{2}$ in.^{2}

46. Short Response You run 1 mile in 8 minutes at a constant speed. How far do you run in 1 minute? Write an equation to represent how far you can run in m minutes. How far can you run in 11 minutes?

Mosaic tiling

Dividing Fractions

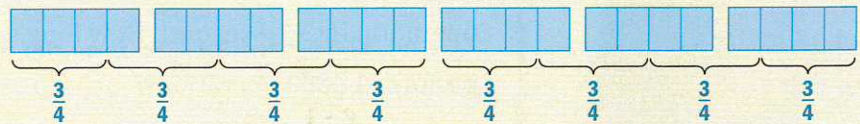| BEFORE	Now	WHY?
You added, subtracted, and multiplied fractions.	You'll divide fractions.	So you can find how long your batteries will last, as in Ex. 34.

Word Watch

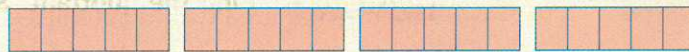reciprocal, p. 234
multiplicative inverse, p. 234

Activity You can use models to divide fractions.

1. The model shows that $\frac{3}{4}$ is a part of 6 eight times, so $6 \div \frac{3}{4} = 8$.

$\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$

2. Calculate $6 \cdot \frac{4}{3}$. Compare the values of $6 \div \frac{3}{4}$ and $6 \cdot \frac{4}{3}$.

3. Use the model below to evaluate $4 \div \frac{2}{5}$.

4. Calculate $4 \cdot \frac{5}{2}$. Compare the values of $4 \div \frac{2}{5}$ and $4 \cdot \frac{5}{2}$.

5. What fraction can you multiply by 5 to find the value of $5 \div \frac{2}{3}$?

Reciprocals As the activity suggests, dividing a number by a fraction and multiplying the number by the fraction's *reciprocal* give the same result. Two nonzero numbers are **reciprocals** if their product is 1.

Reciprocals, like $\frac{3}{7}$ and $\frac{7}{3}$, are also called **multiplicative inverses**.
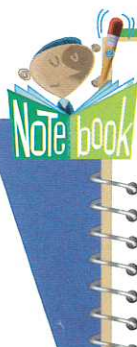
Dividing Fractions

Words To divide by a fraction, multiply by its reciprocal.

Numbers $\frac{3}{10} \div \frac{4}{7} = \frac{3}{10} \cdot \frac{7}{4} = \frac{21}{40}$

Algebra $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$ $(b, c, d \neq 0)$

EXAMPLE 1   **Dividing a Fraction by a Fraction**

a. $\dfrac{5}{6} \div \dfrac{10}{21} = \dfrac{5}{6} \cdot \dfrac{21}{10}$

$= \dfrac{\overset{1}{5} \cdot \overset{7}{21}}{\underset{2}{6} \cdot \underset{2}{10}}$

$= \dfrac{7}{4}$, or $1\dfrac{3}{4}$

b. $\dfrac{9}{14} \div \dfrac{-2}{7} = \dfrac{9}{14} \cdot \dfrac{7}{-2}$

$= \dfrac{9 \cdot \overset{1}{7}}{\underset{2}{14} \cdot (-2)}$

$= \dfrac{9}{-4}$, or $-2\dfrac{1}{4}$

EXAMPLE 2   **Dividing a Fraction by a Whole Number**

$\dfrac{6}{13} \div 3 = \dfrac{6}{13} \cdot \dfrac{1}{3}$ $3 \cdot \dfrac{1}{3} = 1$, so the reciprocal of 3 is $\dfrac{1}{3}$.

$= \dfrac{\overset{2}{6} \cdot 1}{13 \cdot \underset{1}{3}}$ **Multiply fractions. Divide out common factor.**

$= \dfrac{2}{13}$ **Multiply.**

Your turn now   **Find the quotient. Simplify if possible.**

1. $\dfrac{5}{8} \div \left(-\dfrac{7}{10}\right)$ **2.** $\dfrac{2}{15} \div \dfrac{8}{9}$ **3.** $-\dfrac{3}{4} \div \dfrac{-7}{12}$ **4.** $\dfrac{6}{7} \div 2$

EXAMPLE 3   **Dividing Mixed Numbers**

$6\dfrac{1}{3} \div \left(-2\dfrac{5}{6}\right) = \dfrac{19}{3} \div \left(-\dfrac{17}{6}\right)$ **Write $6\dfrac{1}{3}$ and $-2\dfrac{5}{6}$ as improper fractions.**

$= \dfrac{19}{3} \cdot \left(-\dfrac{6}{17}\right)$ **Multiply by $-\dfrac{6}{17}$, the reciprocal of $-\dfrac{17}{6}$.**

$= \dfrac{19 \cdot \overset{-2}{(-6)}}{\underset{1}{3} \cdot 17}$ **Multiply. Divide out common factor.**

$= -\dfrac{38}{17}$, or $-2\dfrac{4}{17}$ **Multiply.**

✓ **Check** Use estimation to check your answer. Because $6 \div (-3)$ is equal to -2, you know that $-2\dfrac{4}{17}$ is a reasonable answer.

Your turn now   **Find the quotient. Simplify if possible.**

5. $6\dfrac{2}{7} \div 4$ **6.** $-12\dfrac{1}{4} \div 7$ **7.** $7\dfrac{1}{3} \div 1\dfrac{4}{7}$ **8.** $15\dfrac{3}{4} \div \left(-2\dfrac{5}{8}\right)$

EXAMPLE 4 **Solving an Equation with a Fraction**

Photography You use 16 of the 24 pictures of a roll of film on your first day of vacation. At this rate, how long will 4 rolls of film last?

Solution

Write a verbal model to describe the problem. Let d = the number of days.

Number of rolls of film	=	Fraction of roll of film used each day	$\cdot$	Number of days

$4 = \dfrac{16}{24}d$ **Write an algebraic model.**

$4 \cdot \dfrac{24}{16} = \dfrac{24}{16} \cdot \dfrac{16}{24}d$ **The multiplicative inverse of $\dfrac{16}{24}$ is $\dfrac{24}{16}$.**

$\dfrac{\overset{1}{\cancel{4}}}{1} \cdot \dfrac{24}{\underset{4}{\cancel{16}}} = d$ **Divide out common factor.**

$6 = d$ **Divide.**

ANSWER Four rolls will last six days.

5.4 **Exercises**

More Practice, p. 731

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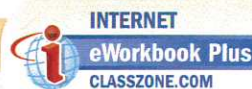
Getting Ready to Practice

1. Vocabulary What is the multiplicative inverse of a number?

2. Write the reciprocal of each of the numbers: $\dfrac{1}{2}, \dfrac{4}{7}, -8, 1\dfrac{1}{2}$.

Find the quotient. Simplify if possible.

3. $\dfrac{3}{4} \div \dfrac{1}{8}$ **4.** $\dfrac{5}{6} \div \left(-\dfrac{1}{3}\right)$ **5.** $\dfrac{11}{12} \div \dfrac{11}{16}$ **6.** $-\dfrac{5}{6} \div (-2)$

7. $\dfrac{2}{3} \div 3$ **8.** $2\dfrac{1}{2} \div \dfrac{-9}{14}$ **9.** $2\dfrac{2}{3} \div \left(-1\dfrac{3}{5}\right)$ **10.** $4\dfrac{1}{8} \div 1\dfrac{5}{6}$

11. Guided Problem Solving How many hamburgers can you make from 5 pounds of hamburger if you use $\dfrac{1}{4}$ pound of meat per hamburger?

(**1** Write a verbal model.

(**2** Substitute the given values into the model.

(**3** Solve the equation.

Practice and Problem Solving

Find the quotient.

12. $\dfrac{4}{9} \div \dfrac{4}{7}$ **13.** $-\dfrac{3}{8} \div \dfrac{7}{12}$ **14.** $\dfrac{9}{14} \div \left(-\dfrac{3}{26}\right)$ **15.** $-\dfrac{21}{22} \div \dfrac{-7}{11}$

16. $\dfrac{8}{11} \div 4$ **17.** $\dfrac{9}{10} \div (-12)$ **18.** $-\dfrac{5}{12} \div 10$ **19.** $\dfrac{63}{8} \div (-9)$

Find the quotient.

20. $5\dfrac{1}{4} \div 2\dfrac{1}{3}$ **21.** $7\dfrac{7}{8} \div \left(-2\dfrac{1}{4}\right)$ **22.** $12\dfrac{1}{7} \div 5\dfrac{5}{6}$ **23.** $-22\dfrac{2}{3} \div 3\dfrac{1}{5}$

24. $-9\dfrac{3}{5} \div (-8)$ **25.** $1\dfrac{5}{7} \div (-6)$ **26.** $8\dfrac{4}{13} \div 6\dfrac{3}{4}$ **27.** $9\dfrac{9}{14} \div 4\dfrac{1}{6}$

28. Writing Are the numbers $\dfrac{1}{9}$ and -9 reciprocals? Explain.

Use mental math to find the quotient.

29. $\dfrac{1}{2} \div 3$ **30.** $4 \div \dfrac{1}{2}$ **31.** $1 \div \dfrac{4}{7}$ **32.** $\dfrac{2}{3} \div \dfrac{3}{2}$

33. Dog Food Your dog Bodie eats about $\dfrac{3}{5}$ of a pound of dog food per day. How long will a five pound bag of dog food last?

34. CD Player Your CD player runs for about $6\dfrac{1}{2}$ hours on new batteries. If the average length of the CDs in your collection is about $\dfrac{5}{6}$ hour, how many CDs can you expect to listen to using one new set of batteries?

35. Critical Thinking Juan says, "To divide a fraction by another fraction, rewrite the fractions with common denominators. Then use the formula $\dfrac{a}{c} \div \dfrac{b}{c} = \dfrac{a}{b}$." Does Juan's method work? Explain.

Algebra Solve the equation.

36. $\dfrac{3}{4}a = 15$ **37.** $\dfrac{7}{10}b = 28$ **38.** $-\dfrac{9}{17}r = 3$ **39.** $-11 = -9\dfrac{1}{6}h$

40. Wages Haley earns \$180 working three days a week. On each of those days she works $7\dfrac{1}{2}$ hours. How much does Haley earn per hour?

41. Survey Two of every five people surveyed, or 350 people, said they prefer spring to fall. How many people were surveyed? Explain how you got your answer.

Algebra Evaluate the expression when $a = 4$ and $b = 9$.

42. $\dfrac{a}{5} \div \dfrac{8}{150}$ **43.** $\dfrac{3}{4}a \div \dfrac{5b}{6}$ **44.** $-\dfrac{18}{a} \div \dfrac{b}{16}$ **45.** $\dfrac{-4}{21} \div \dfrac{2a}{-b}$
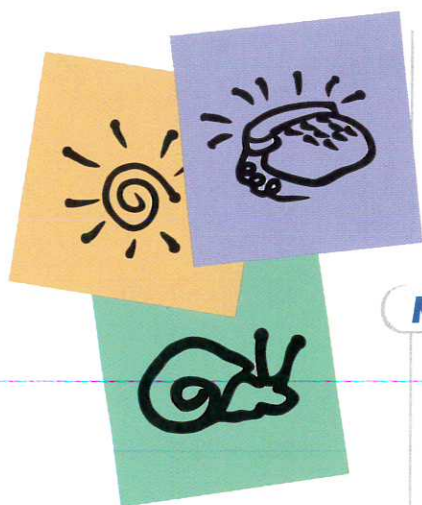
46. Challenge You are creating a board game. You want to cut square game pieces that measure $1\frac{1}{4}$ inches on each side from a piece of paper that measures $8\frac{1}{2}$ inches by 11 inches. How many game pieces can you cut from the paper? Explain.

Mixed Review

Simplify the variable expression. *(Lesson 4.3)*

47. $\dfrac{9x^2}{27x}$ **48.** $\dfrac{24y^4}{15y^2}$ **49.** $\dfrac{14x^3y}{18xy^3}$ **50.** $\dfrac{54yz^2}{81xz^2}$

Basic Skills **Write the improper fraction as a mixed number.**

51. $\dfrac{17}{9}$ **52.** $\dfrac{16}{5}$ **53.** $\dfrac{28}{3}$ **54.** $\dfrac{120}{7}$

Test-Taking Practice

55. Multiple Choice Solve $\dfrac{5}{6}a = -15$.

A. -18 **B.** $-\dfrac{25}{2}$ **C.** $\dfrac{25}{2}$ **D.** 18

56. Multiple Choice Use the formula $C = (F - 32) \div \dfrac{9}{5}$ to convert $77°F$ to $°C$, where C is degrees Celsius and F is degrees Fahrenheit.

F. $20°C$ **G.** $25°C$ **H.** $30°C$ **I.** $45°C$

BRAIN GAME

Who's in First?

The number that makes each equation true represents the place in which the runner finished the race. Find the order in which the runners finished.

Martin $1\dfrac{2}{?} \div \dfrac{1}{6} = 10$ Harriet $? \div \dfrac{2}{11} = 22$

Maya $\dfrac{5}{7} \div \dfrac{?}{3} = \dfrac{15}{14}$ Cornell $\dfrac{?}{5} \div \dfrac{7}{9} = \dfrac{9}{35}$

Technology Activity

Operations with Fractions

GOAL Use a fraction calculator to evaluate expressions with fractions.

You can use a calculator to evaluate expressions with fractions. First, set your calculator to display the answers as fractions or mixed numbers in simplest form.

Press **2nd** [FracMode]. Select $A \llcorner b/c$ and press **=** to set the calculator to mixed number mode.

Press **2nd** [FracMode]. Select *Auto* and press **=** to set the calculator to automatically simplify fractions.

Example Use a calculator to evaluate the expression.

		Keystrokes	Display	Answer
a.	$\dfrac{2}{3} - 4\dfrac{6}{7}$	2 **/** 3 **−** 4 **UNIT** 6 **/** 7 **=**	$-4\llcorner4/21$	$-4\dfrac{4}{21}$
b.	$-\dfrac{5}{17} \cdot \left(-\dfrac{8}{35}\right)$	**(−)** 5 **/** 17 **×** **(−)** 8 **/** 35 **=**	$8/119$	$\dfrac{8}{119}$
c.	$\dfrac{3}{10} \div \left(-1\dfrac{4}{5}\right)$	3 **/** 10 **÷** **(−)** 1 **UNIT** 4 **/** 5 **=**	$-1/6$	$-\dfrac{1}{6}$

Your turn now Use a calculator to evaluate the expression.

1. $\dfrac{5}{11} + \dfrac{2}{5}$ 2. $3\dfrac{1}{4} + \left(-\dfrac{6}{7}\right)$ 3. $7\dfrac{1}{2} - 6\dfrac{5}{6}$ 4. $\dfrac{2}{5} - \dfrac{2}{3}$

5. $\dfrac{7}{9} \cdot 1\dfrac{1}{3}$ 6. $\dfrac{2}{5} \cdot \left(-\dfrac{3}{4}\right)$ 7. $9\dfrac{4}{5} \div \dfrac{7}{8}$ 8. $-10\dfrac{2}{13} \div \left(-3\dfrac{1}{3}\right)$

9. **Car Care** Rosa's car needs $4\dfrac{1}{4}$ quarts of oil to run properly.

She notices her car has only three fourths of the amount of oil that it needs. How much oil should she add for her car to run properly?

Notebook Review

Check Your Definitions

reciprocal, p. 234   multiplicative inverse, p. 234

Use Your Vocabulary

1. What is the product of a number and its reciprocal?

5.1–5.2 Can you add and subtract fractions?

Review **EXAMPLES**

a. $\dfrac{2}{9} + 3\dfrac{4}{9} = 3 + \left(\dfrac{2}{9} + \dfrac{4}{9}\right)$

$= 3\dfrac{6}{9}$

$= 3\dfrac{2}{3}$

b. $\dfrac{9}{14} - \dfrac{6}{7} = \dfrac{9}{14} - \dfrac{12}{14}$

$= \dfrac{9-12}{14}$

$= -\dfrac{3}{14}$

✓ **Find the sum or difference.**

2. $-\dfrac{5}{12} + \dfrac{11}{12}$ **3.** $\dfrac{15}{16} - 2\dfrac{1}{16}$ **4.** $6\dfrac{1}{4} - 4\dfrac{3}{8}$ **5.** $\dfrac{2x}{3} + \dfrac{4x}{5}$

5.3 Can you multiply fractions and mixed numbers?

Review **EXAMPLES**

a. $-\dfrac{5}{8} \cdot \dfrac{3}{10} = -\dfrac{5 \cdot 3}{8 \cdot 10}$

$= -\dfrac{\overset{1}{\cancel{5}} \cdot 3}{8 \cdot \underset{2}{\cancel{10}}}$

$= -\dfrac{3}{16}$

b. $3\dfrac{2}{3} \cdot \dfrac{4}{9} = \dfrac{11}{3} \cdot \dfrac{4}{9}$

$= \dfrac{11 \cdot 4}{3 \cdot 9}$

$= \dfrac{44}{27}$, or $1\dfrac{17}{27}$

✓ **Find the product.**

6. $-\dfrac{6}{7} \cdot \left(-\dfrac{5}{12}\right)$ **7.** $2\dfrac{1}{2} \cdot \dfrac{4}{5}$ **8.** $-3 \cdot 2\dfrac{5}{6}$ **9.** $-3\dfrac{1}{3} \cdot \left(-3\dfrac{1}{4}\right)$

5.4 Can you divide fractions and mixed numbers?

Review **EXAMPLES**

a. $\dfrac{1}{3} \div \dfrac{5}{6} = \dfrac{1}{3} \cdot \dfrac{6}{5}$

$\qquad = \dfrac{1 \cdot \overset{2}{\cancel{6}}}{\underset{1}{\cancel{3}} \cdot 5}$

$\qquad = \dfrac{2}{5}$

b. $2\dfrac{1}{5} \div 2\dfrac{3}{4} = \dfrac{11}{5} \div \dfrac{11}{4}$

$\qquad = \dfrac{11}{5} \cdot \dfrac{4}{11}$

$\qquad = \dfrac{\overset{1}{\cancel{11}} \cdot 4}{5 \cdot \underset{1}{\cancel{11}}} = \dfrac{4}{5}$

☑ **Divide.**

10. $\dfrac{3}{4} \div \dfrac{1}{12}$

11. $-\dfrac{5}{9} \div \dfrac{7}{18}$

12. $-2\dfrac{1}{4} \div \left(-1\dfrac{2}{7}\right)$

Stop and Think about Lessons 5.1–5.4

13. Writing How can you check your answer to a division problem involving fractions? Use an example to explain.

14. Critical Thinking You divide a positive number by a fraction greater than 0 and less than 1. Will the result be *less than*, *equal to*, or *greater than* the original number? Explain.

Review Quiz 1

Find the sum or difference.

1. $1\dfrac{5}{8} - \dfrac{7}{8}$

2. $\dfrac{4}{9} + 3\dfrac{5}{9}$

3. $\dfrac{x}{12} + \dfrac{5x}{12}$

4. $\dfrac{4}{9} - \dfrac{8}{9} + \dfrac{5}{9}$

5. $\dfrac{2}{3} + \dfrac{9}{6}$

6. $5\dfrac{3}{4} - 2\dfrac{1}{3}$

7. $\dfrac{5}{6} + 2\dfrac{1}{8}$

8. $\dfrac{3}{10} + 4\dfrac{2}{5} - 1\dfrac{1}{2}$

9. Recipe A recipe uses $4\dfrac{2}{3}$ cups of flour. Another recipe uses $4\dfrac{1}{4}$ cups. If you have 9 cups of flour, can you make both recipes? Explain.

Find the product or quotient.

10. $\dfrac{7}{12} \cdot \dfrac{8}{21}$

11. $-\dfrac{11}{12} \cdot \left(-\dfrac{3}{10}\right)$

12. $-\dfrac{14}{5} \cdot 2\dfrac{6}{7}$

13. $1\dfrac{1}{8} \cdot (-3)$

14. $\dfrac{1}{2} \div \dfrac{5}{6}$

15. $\dfrac{4}{9} \div 8$

16. $-\dfrac{4}{5} \div \dfrac{3}{2}$

17. $-1\dfrac{3}{4} \div \left(-\dfrac{7}{12}\right)$

18. Hair Growth An average human hair grows about $\dfrac{1}{2}$ inch per month. How much does a human hair grow in $3\dfrac{1}{2}$ months?

Fractions and Decimals

| BEFORE	Now	WHY?
You divided whole numbers.	You'll write fractions as decimals and decimals as fractions.	So you can analyze breakfast food popularity, as in Exs. 46–48.

Word Watch

rational number, p. 242
terminating decimal, p. 242
repeating decimal, p. 242

A **rational number** is a number that can be written as a quotient $\frac{a}{b}$, where a and b are integers and $b \neq 0$. The diagram shows how rational numbers, integers, and whole numbers are related.

Integers include whole numbers. Rational numbers include integers.

Rational numbers

Integers

Whole numbers

← Numbers like 2, −6, $-5\frac{3}{5}$, and −8.73 are rational numbers.
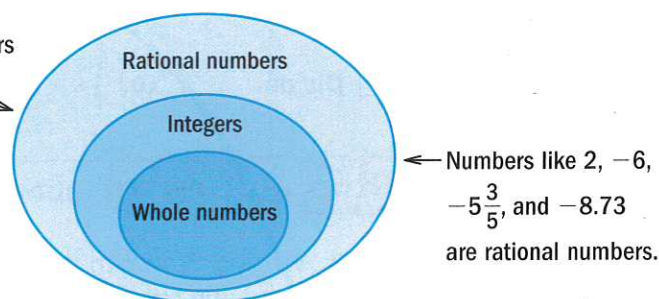
To write any rational number $\frac{a}{b}$ as a decimal, divide a by b. If the quotient has a remainder of zero, the result is a **terminating decimal**. If the quotient has a digit or group of digits that repeats without end, the result is a **repeating decimal**.

EXAMPLE 1 Writing Fractions as Decimals

To write a fraction as a decimal, divide the numerator by the denominator.

a. $\frac{5}{11} = 11\overline{)5.0000\ldots}$

$$
\begin{array}{r}
0.4545\ldots \\
\underline{44} \\
60 \\
\underline{55} \\
50 \\
\underline{44} \\
60 \\
\underline{55}
\end{array}
$$

b. $\frac{7}{20} = 20\overline{)7.00}$

$$
\begin{array}{r}
0.35 \\
\underline{60} \\
100 \\
\underline{100} \\
0
\end{array}
$$

ANSWER The quotient 0.4545. . . is a repeating decimal. To indicate this, place a bar over the repeating digits: $\frac{5}{11} = 0.\overline{45}$.

ANSWER The remainder is zero, so $\frac{7}{20} = 0.35$, a terminating decimal.

EXAMPLE **2**   **Ordering Rational Numbers**

Biology The table lists the lengths of five finches. Order the finches from shortest to longest.

Finch Species	Length (inches)
House finch	$5\frac{5}{8}$
Painted bunting	5.25
Lazuli bunting	$5\frac{7}{16}$
Purple finch	$5\frac{3}{4}$
Indigo bunting	5.5

Solution

Write mixed numbers as decimals.

$$5\frac{5}{8} = 5.625 \qquad 5\frac{7}{16} = 5.4375$$

$$5\frac{3}{4} = 5.75$$

Then graph all the finches' lengths on a number line.
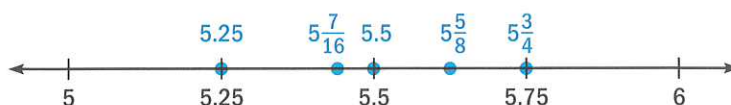
ANSWER From shortest to longest: painted bunting, lazuli bunting, indigo bunting, house finch, purple finch.

Your turn now   **Order the numbers from least to greatest.**

1. $0.51, \frac{3}{5}, \frac{11}{20}, \frac{2}{3}, 0.62$

2. $-1\frac{1}{8}, -1\frac{3}{7}, -1.1, -1.43, -1\frac{4}{15}$

Terminating Decimals To write a terminating decimal as a fraction or mixed number, use the place value of the decimal's last digit to determine the denominator. For example, you can write 0.37 as $\frac{37}{100}$, or thirty-seven hundredths, because 7 is in the hundredths' place.

EXAMPLE **3**   **Writing Terminating Decimals as Fractions**

Write the decimal as a fraction or mixed number.

a. 0.4

b. -1.905

Solution

a. $0.4 = \frac{4}{10}$ 4 is in the tenths' place.

$= \frac{2}{5}$

b. $-1.905 = -1\frac{905}{1000}$ 5 is in the thousandths' place.

$= -1\frac{\overset{181}{\cancel{905}}}{\underset{200}{\cancel{1000}}}$

$= -1\frac{181}{200}$

Indigo bunting

Repeating Decimals To write a repeating decimal as a fraction or mixed number, form two equivalent equations by multiplying by a power of 10. Then subtract the equations.

EXAMPLE 4 **Writing Repeating Decimals as Fractions**

To write $0.\overline{48}$ as a fraction, let $x = 0.\overline{48}$, or $0.484848\ldots$.

(1 The number has 2 repeating digits, so multiply by 100.
Let $100x = 48.\overline{48}$, or $48.484848\ldots$.

(2 Then subtract x from $100x$.

$$\begin{array}{r} 100x = 48.484848\ldots \\ -x = 0.484848\ldots \\ \hline 99x = 48.000000\ldots \end{array}$$

(3 Solve for x. Simplify. $x = \dfrac{48}{99}$, or $\dfrac{16}{33}$

ANSWER The decimal $0.\overline{48}$ is equivalent to the fraction $\dfrac{16}{33}$.

Your turn now Write the decimal as a fraction or mixed number.

3. 0.3 **4.** 0.62 **5.** -2.45 **6.** -1.24

7. $-0.\overline{7}$ **8.** $-10.\overline{1}$ **9.** $0.\overline{24}$ **10.** $0.8\overline{3}$

5.5 **Exercises**
More Practice, p. 731

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Getting Ready to Practice

Vocabulary Tell whether the number is included in each of the following number groups: *rational number, integer, whole number.*

1. 0 **2.** 0.55 **3.** -14 **4.** $0.\overline{3}$

Write the fraction or mixed number as a decimal.

5. $\dfrac{4}{5}$ **6.** $2\dfrac{1}{4}$ **7.** $\dfrac{1}{3}$ **8.** $1\dfrac{5}{8}$

Write the decimal as a fraction or mixed number.

9. 0.6 **10.** -1.02 **11.** $0.\overline{8}$ **12.** $0.\overline{53}$

13. Caterpillars Write the following lengths of caterpillars in order from least to greatest: $1\dfrac{7}{8}$ inches, 1.8 inches, $2\dfrac{1}{9}$ inches, 2.1 inches.

Practice and Problem Solving

Write the fraction or mixed number as a decimal.

14. $\frac{3}{4}$ **15.** $-\frac{1}{9}$ **16.** $-\frac{12}{25}$ **17.** $\frac{7}{12}$

18. $-\frac{4}{25}$ **19.** $\frac{27}{50}$ **20.** $3\frac{11}{16}$ **21.** $-\frac{33}{80}$

22. $\frac{8}{15}$ **23.** $-14\frac{7}{11}$ **24.** $-\frac{14}{33}$ **25.** $\frac{27}{44}$

Write the decimal as a fraction or mixed number.

26. -0.48 **27.** -0.56 **28.** 1.31 **29.** 2.79

30. 0.365 **31.** 7.253 **32.** -0.0012 **33.** -5.0032

34. $0.\overline{2}$ **35.** $0.\overline{8}$ **36.** $-0.1\overline{5}$ **37.** $0.\overline{15}$

38. $0.\overline{63}$ **39.** $0.0\overline{42}$ **40.** $-0.\overline{243}$ **41.** $20.2\overline{07}$

Order the numbers from least to greatest.

42. $-\frac{4}{5}, -\frac{3}{10}, -\frac{3}{8}, -0.2, -0.4$ **43.** $9\frac{3}{4}, 9.74, 9\frac{5}{7}, 9.72, 9\frac{9}{13}$

44. Stock Listings The New York Stock Exchange once used fractions to list the values of its stocks. It switched to decimals in 2001. Write the following stock prices as decimals rounded to the nearest cent.

$$\$5\frac{1}{4}, \$44\frac{1}{2}, \$53\frac{3}{8}, \$17\frac{7}{16}$$

45. Look for a Pattern Write the fractions $\frac{1}{11}, \frac{2}{11}$, and $\frac{3}{11}$ as decimals.

Use your results to predict the decimal forms of $\frac{4}{11}$ and $\frac{5}{11}$.

Extended Problem Solving In Exercises 46–48, use the table below. It tells the fraction of students in a survey that named each breakfast food as their favorite.

Breakfast food	Bagels	Bacon	Eggs	Cereal	Pancakes
Fraction of students	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{25}$

46. Order Write each fraction as a decimal and order the foods from most popular to least popular.

47. Compare How many more students picked the most popular food than the least popular food if 1200 students responded to the survey?

48. Analyze How many of the 1200 students did not choose any of the foods shown?

What do you think?

Geography
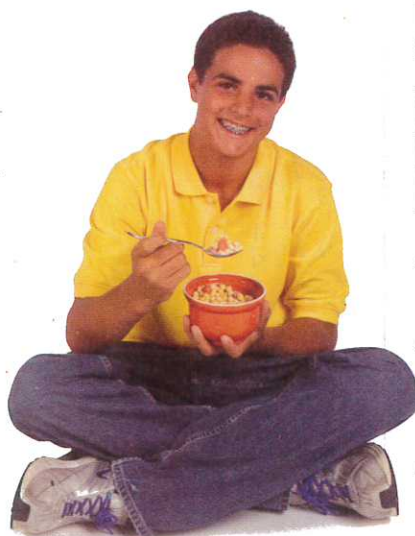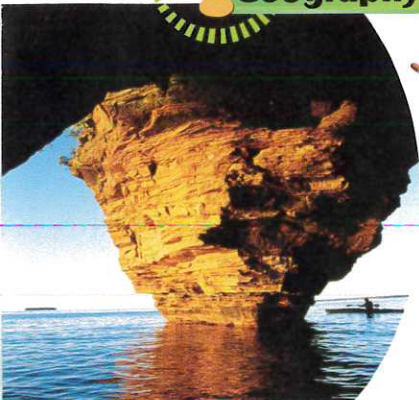
■ **Lake Superior**

Lake Superior has a surface area of about 32,000 square miles. About what fraction of the 182,000 square miles of U.S. water surface area is this? Write this fraction as a decimal.

49. Area The total area of the United States is about 3,718,000 square miles. The portion of this area that is covered by water is $\frac{182,000}{3,718,000}$. Express this fraction as a decimal rounded to three places. About what fraction of the area of the United States is covered by water?

50. Writing Jim says, "Write a mixed number as a decimal by writing it as an improper fraction, and then dividing." Estela says, "Just convert the fraction part of a mixed number to a decimal, and then you can add that to the whole number part." Do both methods work? Explain why or why not.

51. Challenge In the following expressions, $x > 0$. Order the expressions from least to greatest: $x, \frac{x}{5}, \frac{x}{3}, \frac{x}{7}, \frac{x}{8}, \frac{x}{6}, \frac{x}{2}, \frac{x}{4}$.

52. Critical Thinking Find a rational number between $\frac{1}{6}$ and $\frac{2}{9}$. Explain your reasoning.

Mixed Review

Solve the equation using mental math. *(Lesson 1.5)*

53. $s - 7 = 10$ **54.** $4d = 24$ **55.** $5 + t = 18$

Choose a Strategy Use a strategy from the list to solve the following problem. Explain your choice of strategy.

56. You are racing with Al, Sue, and Kim. In how many orders can you and your friends finish the race?

Problem Solving Strategies
- Guess, Check, and Revise
- Make a List
- Draw a Diagram

Basic Skills **Estimate the sum or difference.**

57. $129 + 42$ **58.** $457 + 301$ **59.** $91 - 28$ **60.** $217 - 188$

Test-Taking Practice

61. Multiple Choice Which list is in order from least to greatest?

A. $\frac{1}{7}, 0.125, 0.45, \frac{4}{9}$ **B.** $\frac{1}{7}, 0.125, \frac{4}{9}, 0.45$

C. $0.125, \frac{1}{7}, \frac{4}{9}, 0.45$ **D.** $0.125, \frac{1}{7}, 0.45, \frac{4}{9}$

62. Multiple Choice In a class, $\frac{22}{25}$ of the students are right-handed. What is another way to express this number?

F. 0.22 **G.** 0.25 **H.** 0.47 **I.** 0.88

LESSON 5.6

Adding and Subtracting Decimals

BEFORE	Now	WHY?
You added and subtracted fractions.	You'll add and subtract decimals.	So you can compare snowfall amounts, as in Ex. 34.

In the Real World

Word Watch

front-end estimation, p. 248

Dancing The table shows the amounts of money (in billions of dollars) that people in the United States spent on dance studios, schools, and halls. How much was spent in 1995 and 1996? How much more was spent in 1998 than in 1997?

Money Spent on Dancing	
Year	**Dollars (billions)**
1994	0.906
1995	0.947
1996	1.046
1997	1.08
1998	1.138

You can use a vertical format to add or subtract decimals. Begin by lining up the decimal points. Then add or subtract as with whole numbers. Be sure to include the decimal point in your answer.

EXAMPLE 1 Adding and Subtracting Decimals

a. To find how many billions of dollars were spent in 1995 and 1996, add the values from the table for 1995 and 1996.

$$\begin{array}{r} 0.947 \\ +\ 1.046 \\ \hline 1.993 \end{array}$$

ANSWER In 1995 and 1996, 1.993 billion dollars was spent.

b. To find how much more was spent in 1998 than in 1997, subtract the value for 1997 from the value for 1998.

$$\begin{array}{r} 1.138 \\ -\ 1.080 \\ \hline 0.058 \end{array}$$

Use a zero as a placeholder.

ANSWER In 1998, 0.058 billion dollars more was spent than in 1997.

Your turn now Find the sum or difference.

1. $-12.5 + (-4.55)$ **2.** $8.93 + 0.367$ **3.** $7.624 + (-0.05)$

4. $8.91 - 2.745$ **5.** $-5.3 - 11.49$ **6.** $5.376 - (-0.8)$

EXAMPLE 2 **Solving Equations with Decimals**

a.

$$y - 1.537 = 6.48 \qquad \text{Original equation}$$

$$y - 1.537 + \textbf{1.537} = 6.48 + \textbf{1.537} \qquad \text{Add 1.537 to each side.}$$

$$y = 8.017 \qquad \text{Simplify.}$$

b.

$$x + (-0.34) = 4.27 \qquad \text{Original equation}$$

$$x + (-0.34) + \textbf{0.34} = 4.27 + \textbf{0.34} \qquad \text{Add 0.34 to each side to undo adding } -0.34.$$

$$x = 4.61 \qquad \text{Simplify.}$$

Estimating You can estimate sums using **front-end estimation**. Add the front-end digits to get a low estimate. Then use the remaining digits to adjust the sum to a closer estimate.

EXAMPLE 3 **Using Front-End Estimation**

Theater You want to estimate the cost of supplies for a play. Is the cost of the items shown (excluding tax) more or less than your $50 budget?

Theater Supplies	
cowboy hat	$18.97
cotton fabric	$9.49
rope	$3.49
safety pins	$2.19
picnic basket	$16.77

Solution

Use front-end estimation.

(1 Add the **front-end digits**: the dollars.

$18.97
$9.49
$3.49
$2.19
$16.77
$48

(2 Estimate the sum of the **remaining digits**: the cents.

$18.97 — $1
$9.49
$3.49 —> $1
$2.19
$16.77 —> $1
$3

(3 Add your results.

$48
+ $3
$51

ANSWER The cost of the items is more than your $50 budget.

Your turn now Solve the equation.

7. $x + 1.38 = 2.55$　　　**8.** $z - 5.3 = 16.29$　　　**9.** $y - (-0.83) = 0.48$

10. Use front-end estimation to estimate the sum $1.95 + $7.49 + $3.50.

Getting Ready to Practice

1. **Vocabulary** Copy and complete: You can get a low estimate of $13.56 + 11.42 + 25.94$ by adding the front-end digits ? , ? , and ? .

2. **Find the Error** Describe and correct the error in the solution.

   $$\times \quad \begin{array}{r} 10.43 \\ +\ 7.521 \\ \hline 8.564 \end{array}$$

Find the sum or difference.

3. $1.35 + 6.02$ 4. $14.1 - 3.662$

Solve the equation.

5. $x + 2.9 = 5.3$ 6. $y - 4.15 = -4.26$ 7. $z - (-7.7) = 13.31$

Use front-end estimation to estimate the sum.

8. $2.32 + 6.69 + 8.50 + 4.46$ 9. $10.23 + 6.98 + 9.05 + 5.80$

10. **Sales Tax** Your purchase costs $9.87 plus sales tax of $.49. What is the total amount you pay?

Practice and Problem Solving

HELP with Homework

Example Exercises
1	11–25, 34, 36
2	26–31
3	32–33, 35

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Find the sum or difference.

11. $30.193 + 7.91$ 12. $2.507 + 0.586$ 13. $-6.08 + 2.661$

14. $-0.37 + (-1.8)$ 15. $6.8 + (-1.812)$ 16. $-12.09 + 1.20$

17. $3.28 + (-4.91)$ 18. $1.46 + (-1.564)$ 19. $1.57 - 9.28$

20. $68.79 - 9.18$ 21. $15.7 - (-6.4)$ 22. $-0.99 - 0.304$

23. $25.885 - 6.9$ 24. $29.1 - (-3.05)$ 25. $-4.22 - 0.807$

Algebra Solve the equation.

26. $y + 1.5 = 37$ 27. $-2.8 + x = 4.51$ 28. $10.4 = 12.46 + z$

29. $7.81 = 7.98 + y$ 30. $z + (-3.19) = 5.83$ 31. $x - 0.013 = -6.36$

Use front-end estimation to estimate the sum.

32. $5.62 + 4.89 + 3.44 + 9.98$ 33. $23.70 + 16.12 + 5.96 + 14.18$

34. **Snowfall** Chicago's average snowfall in December is 11.2 inches. In 2001, only 1.6 inches fell in December. In inches, how much below average was this?
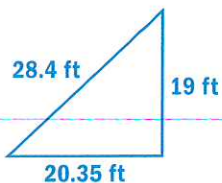
35. Critical Thinking The number 29.32 can be written as the sum $20 + 9 + 0.3 + 0.02$. Write 345.692 as a sum in this form.
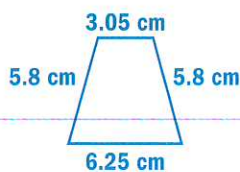
36. Track You run 400 meters in 58.01 seconds. What is the difference of your time and the school record of 55.49 seconds?

Geometry Find the perimeter of the figure.

37.

28.4 ft 19 ft 20.35 ft

38.

3.05 cm 5.8 cm 5.8 cm 6.25 cm

39.

3.2 m 7.41 m 3.2 m 3.2 m 9.41 m

40. Banking Use the bank record for the month of January. The beginning balance was $83.47. Estimate the balance at the end of the month. Then find the exact balance.

Date	Transaction	Deposit	Withdrawal
1/02	deposit	$50	
1/10	groceries		$75.35
1/16	bookstore		$12.95
1/22	deposit	$112.81	
1/29	video rentals		$13.08
1/31	computer game		$21.98

Challenge Find the sum or difference. Write your answer in decimal form.

41. $6.28 + \dfrac{5}{2}$ **42.** $\dfrac{3}{8} + 4.6$ **43.** $12.853 - \dfrac{3}{4}$ **44.** $\dfrac{9}{20} - 0.35$

Mixed Review

Simplify the expression using only positive exponents. *(Lesson 4.7)*

45. -12^0 **46.** $3^{-2} \cdot 3^5$ **47.** $\dfrac{b^{-4}}{b^{10}}$ **48.** $\dfrac{32m^{-8}}{8m^2}$

Find the product or quotient. Simplify if possible. *(Lessons 5.3, 5.4)*

49. $-\dfrac{8}{9} \cdot \left(\dfrac{-5}{7}\right)$ **50.** $5\dfrac{3}{7} \cdot \dfrac{21}{22}$ **51.** $-5 \div \left(\dfrac{-2}{3}\right)$ **52.** $6\dfrac{5}{12} \div 2\dfrac{3}{4}$

Test-Taking Practice

53. Multiple Choice When adding two positive decimals that are less than 1, the sum is always ___.

A. less than 1   **B.** negative   **C.** more than 1   **D.** positive

54. Short Response Plot the following points in a coordinate plane. Then connect the points to form a rectangle and find its perimeter.

$A(1.25, 3.5)$, $B(4.25, 3.5)$, $C(4.25, 6.75)$, $D(1.25, 6.75)$

Multiplying and Dividing Decimals

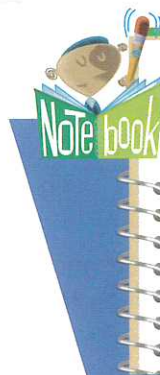| BEFORE	Now	WHY?
You multiplied and divided integers and fractions.	You'll multiply and divide decimals.	So you can find how many balloons you can buy, as in Ex. 24.

Word Watch

leading digit, p. 251

In the Real World

Rafting You travel downstream in a raft at a rate of about 4.3 miles per hour. How far will you travel in 2.5 hours?

Multiplying Decimals

Words Multiply decimals as you do whole numbers. Then place the decimal point. The number of decimal places in the product is the total number of decimal places in the factors.

Numbers

$$2.25 \times 8.9 = 20.025$$

2 places   1 place   3 places

EXAMPLE 1 **Multiplying Decimals**

To find how far you travel in the problem above about rafting, substitute the given values into the distance formula. Distance = rate • time, so distance = 4.3 • 2.5.

$$
\begin{array}{r}
4.3 \\
\times\ 2.5 \\
\hline
215 \\
86 \\
\hline
10.75
\end{array}
$$

1 decimal place
+1 decimal place

2 decimal places

ANSWER You will travel about 10.75 miles.
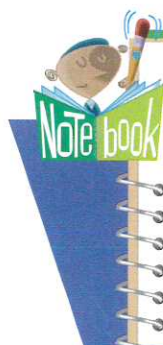
A number's **leading digit** is its leftmost nonzero digit. To check that a product is reasonable, round each factor to its leading digit and multiply.

4.3 • 2.5   **Round factors to leading digit.**   4 • 3 = 12 ✓

Your turn now Multiply. Show that your answer is reasonable.

1. $-7.39 \cdot 2.1$ **2.** $19.62 \cdot 5.07$ **3.** $1.13 \cdot 0.04$ **4.** $-0.85 \cdot (-8)$

Dividing Decimals

Words When you divide by a decimal, multiply both the divisor and the dividend by the power of ten that will make the divisor an integer. Then divide.

Numbers $2.75\overline{)15.125}$ Multiply by 100. $275\overline{)1512.5}$ with quotient 5.5

EXAMPLE 2   **Dividing Decimals**

To find the quotient $60.102 \div 6.3$, multiply the divisor and dividend by 10. Move the decimal points 1 place to the right.

$6.3\overline{)60.102}$ Move decimal points. $63\overline{)601.02}$

Then divide. $63\overline{)601.02}$ with quotient 9.54

✓ **Check** To check that the quotient is reasonable, round the quotient and the divisor to the leading digit. Then multiply. The result should be close in value to the dividend.

$9.54 \cdot 6.3$ Round. $10 \cdot 6 = 60$ ✓

EXAMPLE 3   **Using Zeros as Placeholders**

To find some quotients, you may need to use zeros as placeholders.

Placeholder in Dividend

$6 \div 1.2$

$1.2\overline{)6.0}$ Zero as placeholder

$\begin{array}{r} 5 \\ 12\overline{)60} \\ \underline{60} \\ 0 \end{array}$

Placeholder in Quotient

$0.0126 \div 1.8$

$1.8\overline{)0.0126}$

$\begin{array}{r} 0.007 \\ 18\overline{)0.126} \\ \underline{126} \\ 0 \end{array}$ Zeros as placeholders

---

Your turn now   Find the quotient.

5. $1.6 \div 0.04$ **6.** $0.632 \div 0.79$ **7.** $-13 \div (-0.65)$

8. $-4.365 \div (-4.5)$ **9.** $0.3744 \div 1.56$ **10.** $-0.0108 \div 2.7$

Getting Ready to Practice

1. **Vocabulary** Copy the division problem. Use the words *quotient*, *dividend*, and *divisor* to label each number.

$$0.8 \longleftarrow \underline{?}$$
$$\underline{?} \longrightarrow 9\overline{)7.2} \longleftarrow \underline{?}$$

Multiply or divide. Show that your answer is reasonable.

2. $7.8 \cdot 2.6$ 3. $3.75 \cdot 0.4$ 4. $13.2 \div 1.1$ 5. $0.5 \div 1.25$

6. **Guided Problem Solving** A mother rhinoceros weighs 3600 pounds. Her baby weighs 0.38 of her weight. How much does the baby weigh? Explain why your answer is reasonable.

(1 Write a verbal model to describe the problem.

(2 Substitute the given values and solve.

(3 Check to see that your answer is reasonable.

Practice and Problem Solving

Find the product or quotient.

7. $25 \cdot 0.2$ 8. $2.4 \cdot 0.3$ 9. $-8.2 \cdot 0.7$ 10. $13.65 \cdot 1.1$

11. $4.8 \div 1.2$ 12. $4.9 \div 0.07$ 13. $5 \div (-0.1)$ 14. $-8 \div (-3.2)$

15. $5.41 \cdot 0.35$ 16. $-0.57 \div 0.38$ 17. $4.844 \div 0.56$ 18. $-2.687 \cdot (-9)$

19. $37.41 \div 4.3$ 20. $0.098 \cdot 0.55$ 21. $6.025 \cdot 48.2$ 22. $1.11 \div 0.925$

23. **Find the Error** Describe and correct the error in the solution.

24. **Balloons** You are buying balloons that cost $.89 per package to decorate for a school dance. You have $14.75 to spend. How many packages of balloons can you buy?

$$\begin{array}{r} 9.78 \\ \times\ 3.4 \\ \hline 3912 \\ 2934 \\ \hline 332.52 \end{array}$$ ✗

25. **Look for a Pattern** Copy and complete the table by multiplying each number in the leftmost column by the number at the top of each other column. Describe the pattern.

×	1	0.1	0.01	0.001	0.0001
87	87	8.7	?	?	?
356	356	?	?	?	?
1200	?	?	?	?	?

26. Lava Flows A lava flow is a stream of molten rock that pours from an erupting vent. A lava flow travels 15.5 miles down a steep slope in 2.5 hours. Find the average rate at which the flow travels. Write your answer in miles per hour. Explain why your answer is reasonable.

Algebra Solve the equation.

27. $9 = \dfrac{a}{-0.9}$ **28.** $\dfrac{c}{4.5} = 0.16$ **29.** $1.2x = 0.321$ **30.** $-8.25y = -3.3$

Evaluate the expression.

31. $3.4^3 + 5.1 \div 1.7 - 4.89$ **32.** $6.2 \cdot (18.77 - 6.27) + 9.1^2$

33. Writing Explain how 4.6 divided by 0.23 is related to 460 divided by 23. Are the quotients the same? Why?

34. Postal Rates The table shows rates to mail a first class letter. How much does it cost to mail a first class letter that weighs 3.5 ounces?

First ounce or fraction of ounce	$.37
Each additional ounce or fraction	$.23

35. Critical Thinking How many decimal places does 1.3^1 have? 1.3^2? 1.3^3? 1.3^7? Explain your reasoning.

36. Challenge One micron is equal to 0.001 millimeter. If a bacteria is 4 microns wide, how many times would you have to magnify it for the bacteria to appear 1 millimeter wide?

Mixed Review

Write the number in standard form. *(Lesson 4.8)*

37. 6.89×10^9 **38.** 1.3×10^{-12} **39.** 7.405×10^{-6}

Order the numbers from least to greatest. *(Lesson 5.5)*

40. $2.32, \dfrac{9}{4}, 2.5, 2\dfrac{3}{10}, 2, \dfrac{11}{5}$ **41.** $-\dfrac{9}{20}, -0.46, -\dfrac{3}{8}, -\dfrac{5}{12}, -0.4$

Basic Skills Find the quotient.

42. $55 \div 6$ **43.** $127 \div 5$ **44.** $307 \div 29$ **45.** $8607 \div 42$

Test-Taking Practice

46. Multiple Choice The quotient $-0.57 \div 0.38$ is _?_.

A. an integer   **B.** negative   **C.** more than 1   **D.** positive

47. Short Response You have $75 to spend on party decorations that cost $4.89 per bag, including tax. Find how many bags you can buy. Estimate to check that your answer is reasonable. Show your work.

Kilauea Volcano, Hawaii

GOAL
Collect and analyze data.

MATERIALS
• number cubes

Collecting and Analyzing Data

You can collect data and find a number that represents the data. The *median* is the middle value when the values are written in order. The *mode* is the value that occurs most often.

Explore 1   **Collect data by rolling two number cubes to explore how often each sum occurs.**

1 Roll a pair of number cubes eleven times and record the results.

$3 + 2 = 5$ $4 + 4 = 8$ $6 + 6 = 12$ $1 + 2 = 3$ $1 + 6 = 7$ $2 + 1 = 3$

$5 + 3 = 8$ $4 + 1 = 5$ $1 + 5 = 6$ $2 + 6 = 8$ $2 + 2 = 4$

2 Add the sums together. Divide by the number of rolls to find the mean.

$$\frac{5 + 8 + 12 + 3 + 7 + 3 + 8 + 5 + 6 + 8 + 4}{11} = \frac{69}{11} \approx 6.3$$

3 Order the sums. Find the median and the mode.

$$3, 3, 4, 5, 5, 6, 7, 8, 8, 8, 12$$

middle number   most frequent number

4 Which sum do you think occurs most often? Compare your results with other groups.

Your turn now   **Find the mean, median, and mode of the data set.**

1. 4.2, 6.1, 3.8, 4.1, 10.2, 9.6, 6.1, 7.3, 2.1, 2.4, 9.8

2. 105, 121, 42, 78, 77, 63, 108, 32, 33, 121, 64

3. $2\frac{1}{2}, 7\frac{3}{4}, 9\frac{1}{4}, 7\frac{1}{2}, 4\frac{3}{8}, 7\frac{3}{4}, 3\frac{7}{8}$

Explore 2 Collect data about the number of letters in the last name of each student in your class.

1 Find the shortest and longest names so you can make a frequency table.

Cho = 3
Fitzpatrick = 11

Number of Letters

3	4	5	6	7	8	9	10	11
II	III	₸₸₸₸	₸₸₸₸	₸₸₸₸ I	II	I		I

2 Count the number of letters in each name. Make a tally mark for each name.

3 Find the most frequent name length. This is the mode.

The mode is 7.

4 Find the mean number of letters in the last names.

5 Can you use the mean to describe the average length of a last name in your class? Can you use the mode? Explain.

Number of Letters

3	4	5	6	7	8	9	10	11
II	III	₸₸₸₸	₸₸₸₸	₸₸₸₸ I	II	I		I

$$3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8$$
$$\times 2 \quad \times 3 \quad \times 5 \quad \times 5 \quad \times 6 \quad \times 2$$
$$6 + 12 + 25 + 30 + 42 + 16 + 9 + 0 + 11 = 151$$

You can multiply to count the number of letters for each column. Then add the column totals.

Divide by the number of students. The mean is $151 \div 25 \approx 6$.

Your turn now

4. A new student whose last name has 16 letters joins your class. If you add "16" to your data, how does this affect the mean and the mode? Explain.

Stop and Think

5. **Writing** You are designing a form to collect data. Students will write their last names in a row of small boxes, one letter per box. How many boxes do you think the form should provide? Explain.

Mean, Median, and Mode

BEFORE	Now	WHY?
You used tables and graphs to analyze data sets.	You'll describe data sets using mean, median, mode, and range.	So you can describe World Series attendance, as in Ex. 14.

In the Real World

Word Watch

mean, p. 257
median, p. 257
mode, p. 257
range, p. 258

Biology A marine biologist records the locations of deep sea jellies in relation to the ocean surface. Jellies are found at -2278 feet, -1875 feet, -3210 feet, -2755 feet, -2407 feet, and -2901 feet. What is the average location of a deep sea jelly?

Three types of averages can be used to describe a data set.

Averages

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

The **median** of a data set is the middle value when the values are written in numerical order. If a data set has an even number of values, the median is the mean of the two middle values.

The **mode** of a data set is the value that occurs most often. A data set can have no mode, one mode, or more than one mode.

EXAMPLE 1 Finding a Mean

To find the mean of the 6 locations of the deep sea jellies in the problem above, divide the sum of the locations by 6.

$$\text{Mean} = \frac{-2278 + (-1875) + (-3210) + (-2755) + (-2407) + (-2901)}{6}$$

$$= \frac{-15,426}{6}$$

$$= -2571$$

ANSWER The mean location in relation to the ocean surface is -2571 ft.
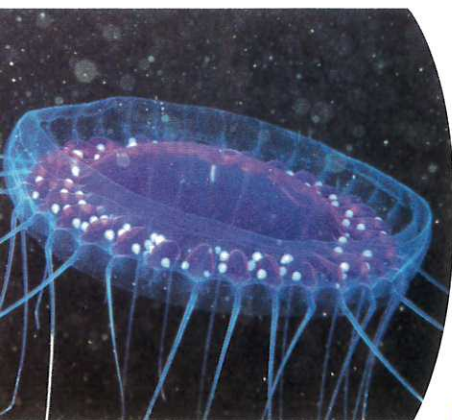
Deep sea jelly

Your turn now Find the mean of the data.

1. $-3°C, 44°C, -11°C, 9°C, -21°C$ **2.** $12\frac{1}{2}$ in., $14\frac{3}{4}$ in., $20\frac{1}{2}$ in., $16\frac{3}{4}$ in.

Range The **range** of a data set is the difference of the greatest value and the least value.

EXAMPLE 2 **Finding Median, Mode, and Range**

Movies **Find the median, mode(s), and range of the movie prices below.**

$7.20, $13.25, $14.94, $16.56, $18.74, $19.99, $19.99, $29.49

Median: The data set has an even number of prices, so the median is the mean of the two middle values, $16.56 and $18.74.

$$\text{Median} = \frac{\$16.56 + \$18.74}{2} = \frac{\$35.30}{2} = \$17.65$$

Mode: The price that occurs most often is $19.99. This is the mode.

Range: Find the difference of the greatest and the least values.

$$\text{Range} = \$29.49 - \$7.20 = \$22.29$$

Watch Out!

If the data are not ordered, you need to order the data so you can find the median.

Your turn now **Find the median, mode(s), and range of the data.**

3. 14, 13, 20, 24, 15, 10, 22, 17, 18   **4.** 9, 7, 4, 9, 4, 10, 5, 14, 9, 4

EXAMPLE 3 **Choosing a Representative Average**

Ice Cream Groups A and B try a new ice cream flavor and rate it on a scale of 1 to 10 as shown. Which average best represents each group?

Group A Ratings

1, 2, 3, 3, 5, 5, 5, 7, 8, 10

Group B Ratings

1, 1, 1, 2, 3, 4, 4, 9, 10, 10

Solution

Group A

$$\text{Mean} = \frac{49}{10} = 4.9$$

$$\text{Median} = \frac{5 + 5}{2} = \frac{10}{2} = 5$$

Mode: 5

ANSWER The mean, median, and mode are very close. So each average is a fair representation of the ratings as a group.

Group B

$$\text{Mean} = \frac{45}{10} = 4.5$$

$$\text{Median} = \frac{3 + 4}{2} = \frac{7}{2} = 3.5$$

Mode: 1

ANSWER The mean is higher than all but 3 ratings. The mode is equal to the lowest rating. So, mean and mode are not good choices. The median best represents the ratings.

Getting Ready to Practice

Vocabulary In Exercises 1–3, use the data set 6, 12, 4, 15, 10, 6, 2, 9. Complete the statement using *mean, median, mode, or range.*

1. The _?_ is 8.
2. The _?_ is 6.
3. The _?_ is 13.

Find the mean, median, mode(s), and range of the data.

4. 8.98, 3.67, 11.13, 8.98, 11.24
5. −71, −56, −62, −44, −56, −47

6. Find the Error Describe and correct the error in the solution.

$\times$ 3, 6, 5, 2, 8, 9, 5, 8, 1, 5, 10, 8
The mode of the data set is 5.

7. Guided Problem Solving Gwen is training to run in a 5K race. Her practice times (in minutes and seconds) are 22:45, 21:56, 21:03, 20:33, and 20:28. Find her mean time to complete the race.

(**1** Change Gwen's practice times to seconds.

(**2** Find the sum of the practice times. Divide by the number of times.

(**3** Convert your answer to minutes and seconds.

Practice and Problem Solving

Find the mean, median, mode(s), and range of the data.

8. Distances: 16 km, 23 km, 11 km, 6 km, 15 km, 23 km, 17 km, 16 km

9. Weekly hits at a Web site: 115, 157, 289, 185, 164, 225, 185, 208

10. Golf scores: −2, 0, 3, 1, 0, −1, 2, −2, −3, 0, 4, 1

11. Elevations: 127 ft, −8 ft, 436 ft, 508 ft, −23 ft, 47 ft

12. Daily calories: 2000, 1872, 2112, 2255, 2080, 1795, 1977

13. Shoe lengths: $10\frac{3}{4}$ in., $9\frac{1}{2}$ in., $8\frac{7}{8}$ in., $10\frac{1}{2}$ in., $8\frac{3}{8}$ in., $10\frac{1}{2}$ in.

14. Baseball The attendance for the 2001 World Series is shown in the table. Find the mean, median, and mode(s) of the data. Which average do you think best represents the attendance data? Explain.

Game	1	2	3	4	5	6	7
Attendance	49,646	49,646	55,820	55,863	56,018	49,707	49,589

15. Gymnastics A gymnast's performance is rated by six judges. The highest and lowest scores are dropped, and the mean of the remaining four scores is the final score awarded. Find the final score of each gymnast based on the judge's ratings given. Whose final score is the highest?

	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6
Isaac	9.5	9.1	9.3	9.3	9.6	9.4
Carl	9.8	9.7	9.3	9.7	9.6	9.4
Kurt	9.4	9.3	9.3	9.5	9.5	9.6

16. Writing Why does it make sense to find the median of a data set with an even number of values by finding the mean of the middle values?

17. Salary You are researching the average salaries for several different careers. Would you rather know the mean, median, or mode(s) of the salaries for each career? Explain your reasoning.

18. Lakes The average depth of a local lake is reported to be 2 feet. You want to know if you can wade across the lake. What information might be concealed when depth is reported as an average?

19. Algebra Find the mean of $3b$, $5b$, b, $6b$, $-6b$, and $-2b$.

20. Bowling You are bowling three games. In the first two games, you score 125 and 113 points. How many points do you need in the third game to have a mean score of 126 points?

21. Compare and Contrast Jerry and Roberta find the mean of $-2a$, a, $3a$, $6a$, and $9a$ when $a = 2.5$, as shown below. Do both methods work? If so, which method do you prefer? Explain.

Jerry

$-2a = -5 \qquad a = 2.5 \qquad 3a = 7.5$

$6a = 15 \qquad 9a = 22.5$

$$\frac{-5 + 2.5 + 7.5 + 15 + 22.5}{5} = \frac{42.5}{5}$$

$$= 8.5$$

Roberta

$$\frac{-2a + a + 3a + 6a + 9a}{5} = \frac{17a}{5}$$

$$= \frac{17 \cdot 2.5}{5}$$

$$= 8.5$$

22. Number Sense Make two different lists of numbers that have a mean of 8 and a median and mode of 10.

23. Challenge The table shows the numbers of points you scored during your first 14 basketball games of the 15-game season. By halftime of your final game, you have scored 7 points. How many points do you need to score in the second half to have a mean of 10 points per game?

Game	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Points	15	8	7	10	12	4	20	13	7	7	5	3	10	14

Mixed Review

Find the quotient. *(Lesson 2.5)*

24. $\dfrac{-39}{13}$ **25.** $\dfrac{200}{-40}$ **26.** $\dfrac{-44}{-11}$ **27.** $\dfrac{0}{-197}$

Solve the equation. *(Lessons 3.1–3.3)*

28. $x - 15 = -10$ **29.** $-8 + x = -24$ **30.** $-7x = 84$

31. $-\dfrac{1}{6}x = -11$ **32.** $3x - 28 = -37$ **33.** $-\dfrac{x}{4} + 12 = 16$

Test-Taking Practice

34. Extended Response The table shows attendance at school dances for a year.

Make a bar graph of the data. Find the mean and median attendance. The student council wants to find the total amount of money collected from students for admission to the dances. Would they find the bar graph, the mean, or the median most useful? Explain.

Dance	Number of Students
Fall	97
Winter Ball	88
Valentine's Day	133
Spring Fling	210
End of Year	198

What other information is also needed to find how much money was collected?

BRAIN GAME

The Prize is Right!

You are a contestant on a television game show. To win a trip you must find the prices of the five items in a shopping cart.

The game show host gives you four hints about the prices.

- The mean of the prices is $1.68.
- The mode of the prices is $1.50.
- The median of the prices is $1.65.
- One item costs $.10 more than the median.

List the prices of the items in the cart in order from least to greatest.

Notebook Review

Review the vocabulary definitions in your notebook.

Copy the review examples in your notebook. Then complete the exercises.

Check Your Definitions

rational number, p. 242	front-end estimation, p. 248	median, p. 257
terminating decimal, p. 242	leading digit, p. 251	mode, p. 257
repeating decimal, p. 242	mean, p. 257	range, p. 258

Use Your Vocabulary

✓ **1.** Name three averages you can use to represent a data set.

5.5 Can you order rational numbers?

Review

EXAMPLE Order the numbers 3.7, $3\frac{5}{8}$, 3.6, and $3\frac{2}{3}$ from least to greatest.

$3\frac{5}{8} = 3.625$ $3\frac{2}{3} = 3.\overline{6}$ So, the order is 3.6, $3\frac{5}{8}$, $3\frac{2}{3}$, 3.7.

✓ **2.** Order the numbers 6.4, $6\frac{4}{9}$, $6\frac{3}{8}$, and $6\frac{5}{12}$ from least to greatest.

5.6–5.7 Can you perform operations with decimals?

Review

a.
$$\begin{array}{r} 14.02 \\ +\ 9.80 \\ \hline 23.82 \end{array}$$

b.
$$\begin{array}{r} 20.500 \\ -\ 3.764 \\ \hline 16.736 \end{array}$$

c.
$$\begin{array}{r} 14.75 \\ \times\ 1.3 \\ \hline 4425 \\ 1475\ \\ \hline 19.175 \end{array}$$
2 decimal places
+1 decimal place

3 decimal places

d. $4.26)\overline{21.726}$ → $426)\overline{2172.6}$ 5.1

✓ **Find the sum, difference, product, or quotient.**

3. $1.2 + 0.67$ **4.** $33.2 + 9.398$ **5.** $3.16 - 1.845$ **6.** $90.3 - (-7.81)$

7. $6.24 \cdot 0.375$ **8.** $3.348 \cdot 0.9$ **9.** $66.96 \div (-2.7)$ **10.** $18.91 \div 9.455$

5.8 Can you find mean, median, mode, and range?

Review **EXAMPLE** Find the mean, median, mode(s), and range of the data set: 4, 5, 6, 6, 7, 9, 11, and 12.

$$\text{Mean} = \frac{4 + 5 + 6 + 6 + 7 + 9 + 11 + 12}{8} = \frac{60}{8} = 7.5$$

$$\text{Median} = \frac{6 + 7}{2} = \frac{13}{2} = 6.5$$

$$\text{Mode} = 6 \qquad\qquad \text{Range} = 12 - 4 = 8$$

✓ **Find the mean, median, mode(s), and range of the data set.**

11. 25, 20, 30, 22, 24, 23, 24

12. 7.2, 7.3, 7.5, 7.7, 7.9, 7.2, 7.7, 7.1

Stop *and* Think about Lessons 5.5–5.8

13. **Critical Thinking** Write an example of a data set whose mode is greater than its mean.

14. **Writing** Explain why terminating decimals and repeating decimals are rational numbers. Use examples.

Review Quiz 2

Write the fraction as a decimal or the decimal as a fraction.

1. $\frac{1}{25}$ **2.** $\frac{4}{9}$ **3.** 0.58   **4.** $0.\overline{2}$

Find the sum or difference.

5. $-2.301 + 8.4$ **6.** $15.25 + 9.636$ **7.** $14.65 - 3.608$ **8.** $3.2 - (-0.225)$

Find the product or quotient.

9. $-15.3 \cdot 0.48$ **10.** $3.88 \cdot 0.9$ **11.** $0.162 \div 2.7$ **12.** $2.07 \div 0.225$

13. **Racing Camel** A racing camel can travel at a speed of 11.75 miles per hour. How far does it travel in 0.02 hour at this speed?

14. **Tornadoes** The table shows the numbers of tornadoes in the United States from 1995–2001. Find the mean, median, mode(s), and range.

Year	1995	1996	1997	1998	1999	2000	2001
Tornadoes	1234	1173	1148	1424	1342	1071	805

5 Chapter Review

📗 Vocabulary

reciprocal, p. 234
multiplicative inverse,
   p. 234
rational number,
   p. 242

terminating decimal,
   p. 242
repeating decimal,
   p. 242
front-end estimation,
   p. 248

leading digit, p. 251
mean, p. 257
median, p. 257
mode, p. 257
range, p. 258

Vocabulary Review

Copy and complete the statement.

1. The fractions $\frac{3}{5}$ and $\frac{5}{3}$ are **?** because their product is 1.

2. If the remainder of the quotient $\frac{a}{b}$ is 0, then the decimal form of $\frac{a}{b}$ is a **?** decimal.

3. You can use **?** when you do not need to find an exact sum of a set of numbers.

4. A value that occurs most often in a data set is a **?** .

5. For a data set, the sum of the values divided by the number of values is the **?** .

6. The difference of the greatest value and the least value of a data set is the **?** .

Review Questions

Find the sum or difference. *(Lessons 5.1, 5.2)*

7. $\frac{8}{9} + \frac{4}{9}$

8. $-3\frac{5}{8} + \frac{7}{8}$

9. $-\frac{19}{25} - \frac{11}{25}$

10. $\frac{3}{10} - \frac{7}{10} - \frac{9}{10}$

11. $\frac{3}{5} + \frac{1}{4}$

12. $\frac{3}{5} - \frac{2}{3}$

13. $6\frac{2}{7} + \left(-7\frac{1}{8}\right)$

14. $-9\frac{3}{4} - 4\frac{2}{3}$

15. $-\frac{7n}{9} - \frac{5n}{9}$

16. $-\frac{m}{4} + \left(-\frac{m}{4}\right)$

17. $\frac{3}{c} - \frac{7}{2c}$

18. $\frac{5v}{3} + \frac{4v}{5}$

19. **Coins** A quarter's width is about $\frac{15}{16}$ inch. A dime's width is about $\frac{11}{16}$ inch. How much wider is a quarter? *(Lesson 5.1)*

20. **Robots** It took Central High's robot team $107\frac{1}{3}$ hours of labor to build their robot. East High built their robot in $111\frac{5}{6}$ hours. How much longer did East High School take to build their robot? *(Lesson 5.2)*

Find the product or quotient. *(Lessons 5.3, 5.4)*

21. $-\dfrac{5}{8} \cdot \dfrac{2}{5}$

22. $-\dfrac{9}{5} \cdot \left(-\dfrac{11}{15}\right)$

23. $-6\dfrac{3}{7} \cdot 2\dfrac{1}{2}$

24. $4 \cdot \left(-3\dfrac{5}{12}\right)$

25. $\dfrac{9}{21} \div 5$

26. $\dfrac{13}{18} \div \dfrac{5}{6}$

27. $5\dfrac{8}{11} \div \left(-\dfrac{3}{4}\right)$

28. $12\dfrac{1}{2} \div 4\dfrac{1}{6}$

Solve the equation. *(Lesson 5.4)*

29. $\dfrac{5}{6}x = 25$

30. $\dfrac{2}{3}b = \dfrac{8}{9}$

31. $-\dfrac{9}{10}y = 6\dfrac{3}{7}$

32. $\dfrac{4}{9}a + 4\dfrac{1}{3} = 5\dfrac{2}{3}$

Order the numbers from least to greatest. *(Lesson 5.5)*

33. $2\dfrac{3}{10}, \dfrac{11}{5}, 2.32, \dfrac{5}{2}, 2.25, 2$

34. $-0.45, -\dfrac{3}{8}, -\dfrac{5}{12}, -0.4, -0.46$

Find the sum, difference, product, or quotient. *(Lessons 5.6, 5.7)*

35. $5.2 + 20.68$

36. $0.103 + 0.7$

37. $9.6 - 3.555$

38. $-4.23 - 8.093$

39. $16.7 \cdot (-3.2)$

40. $43.4 \cdot 0.13$

41. $3.434 \div 8.08$

42. $-13 \div (-0.52)$

Newborn Animals In Exercises 43 and 44, use the table. It shows approximate weights, in pounds, of several newborn animals. *(Lesson 5.6)*

43. How much more does the hippopotamus weigh than the gentoo penguin?

44. How much more does the polar bear weigh than the giant panda?

Newborn Animal	Birth Weight (lb)
Hippopotamus	93
Grizzly bear	1
Giant panda	0.29
Giraffe	150
Polar bear	2.09
Gentoo penguin	0.21

45. Icebergs When an iceberg broke free from Antarctica in May of 2002, it was about 34.5 miles long and 6.9 miles wide. About how much area did the iceberg cover? *(Lesson 5.7)*

46. Cats A tiger at a zoo has a mass of 144.9 kilograms. This is 40.25 times the mass of a house cat. What is the mass of the house cat? *(Lesson 5.7)*

Find the mean, median, mode(s), and range of the data set. *(Lesson 5.8)*

47. Temperatures (°C): $-7, -1, 0, 8, 4, 2, -7, 2$

48. Jumps (meters): $14.6, 19.2, 11, 16.5, 12, 11, 10.9$

49. Hand widths (in.): $3\dfrac{1}{2}, 2\dfrac{7}{8}, 3\dfrac{1}{8}, 3\dfrac{1}{4}, 2\dfrac{3}{4}$

50. Bike trails (km): $7, 8.3, 17.1, 4.8, 3.9, 7, 4.8, 13.1$

5

Chapter Test

Find the sum or difference.

1. $4\frac{5}{11} - 2\frac{6}{11}$ **2.** $\frac{9}{16} - \left(-\frac{11}{16}\right)$ **3.** $-\frac{5}{6} + \frac{1}{8}$ **4.** $\frac{3}{7} + \left(-\frac{8}{21}\right) + \frac{2}{3}$

5. Roller Coaster Yesterday you had to wait in line for $1\frac{3}{4}$ hours to ride a roller coaster. Today you waited $1\frac{1}{4}$ hours. How much longer did you wait yesterday?

Find the product or quotient.

6. $\frac{2}{9} \cdot (-4)$ **7.** $\frac{5}{2} \cdot \frac{4}{15}$ **8.** $3\frac{1}{2} \div 2$ **9.** $7\frac{3}{4} \div 2\frac{7}{12}$

10. Balloons You are inflating balloons for a party. If you can inflate one balloon in $\frac{5}{6}$ minute, how many balloons can you inflate in $\frac{1}{2}$ hour?

Write the fraction as a decimal or the decimal as a fraction.

11. $\frac{7}{20}$ **12.** $\frac{3}{40}$ **13.** 0.0082 **14.** $0.\overline{4}$

Find the sum, difference, product, or quotient.

15. $6.2 - 5.984$ **16.** $2.608 + 12.93$ **17.** $0.7992 \div 0.333$ **18.** $-34.69 \cdot 12.7$

Bagels In Exercises 19 and 20, use the table. It shows the approximate supermarket sales of three types of bagels (in billions of dollars) in the year 2000 in the United States.

Bagel	Sales (billions)
Frozen	$.145
Refrigerated	$.072
Fresh	$.42

19. How much greater were the sales for frozen bagels than the sales for refrigerated bagels?

20. What is the total amount of supermarket sales of all three types of bagels?

21. Algebra Evaluate $0.2x$ and $\frac{x}{0.2}$ when $x = -4.1$, 0.06, and 1.8.

22. Energy Bill A gas supplier charges 64.5 cents per therm of gas used. How much does it cost for 116 therms of gas?

23. Studying Twelve students spent 2, 5, 3, 7, 10, 9, 8, 7, 6, 7, 6, and 2 hours studying. Find the mean, median, mode(s), and range of the data.

Chapter Standardized Test

Test-Taking Strategy Mark unanswered questions in your test booklet so you can find them quickly when you go back.

Multiple Choice

1. What is the sum of $11\frac{5}{9}$ and $-14\frac{11}{12}$?

   A. $-3\frac{13}{36}$ **B.** $-3\frac{1}{3}$ **C.** $-2\frac{13}{36}$ **D.** $-2\frac{33}{108}$

2. You have hiked $2\frac{1}{10}$ miles of a 5 mile trail. How much farther must you hike?

   F. $1\frac{9}{20}$ miles   **G.** $2\frac{9}{10}$ miles

   H. $3\frac{1}{10}$ miles   **I.** $7\frac{1}{10}$ miles

3. You need $4\frac{1}{3}$ yards of fabric to make a costume for your dance team. How much fabric do you need to make 7 costumes?

   A. $11\frac{1}{3}$ yards   **B.** $18\frac{2}{3}$ yards

   C. $28\frac{1}{3}$ yards   **D.** $30\frac{1}{3}$ yards

4. What is the quotient of $-\frac{3}{4}$ and $\frac{5}{2}$?

   F. $-1\frac{3}{20}$ **G.** $-\frac{7}{20}$ **H.** $-\frac{3}{10}$ **I.** $-\frac{3}{20}$

5. You order pants for $25.60, two shirts for $15.99 each, and socks for $6.35. Estimate your cost.

   A. about $46   **B.** about $48
   C. about $54   **D.** about $64

6. By what number can you divide $\frac{5}{6}$ to get the quotient $\frac{5}{9}$?

   F. $\frac{1}{3}$ **G.** $\frac{2}{3}$ **H.** $\frac{3}{2}$ **I.** 2

7. What is the value of x when $\frac{3}{4}x = \frac{9}{16}$?

   A. $\frac{3}{16}$ **B.** $\frac{3}{4}$ **C.** 3   **D.** 4

8. Solve $1.312 + x = 15.6$.

   F. 2.48   **G.** 11.56
   H. 14.288   **I.** 15.4688

9. You use 0.75 meter of wire to hold together bunches of flowers. How many bunches can you make with 15 meters of wire?

   A. 2   **B.** 20   **C.** 200   **D.** 2000

10. Which fraction is greater than 0.34?

    F. $\frac{5}{16}$ **G.** $\frac{1}{3}$ **H.** $\frac{55}{162}$ **I.** $\frac{8}{23}$

11. What is the median of the data set -2, 0.4, 1, -2.6, 4.5, -3.7, 1, 3?

    A. 0.2   **B.** 0.7   **C.** 1   **D.** 2.275

Short Response

12. Your rectangular garden is 3.4 meters by 2.6 meters. Your friend's square garden has sides of 2.9 meters. Whose garden has a greater area?

Extended Response

13. Your most recent phone calls lasted 1, 2, 5, 46, 2, 8, 5, 3, 7, and 2 minutes. Find the mean, median, and mode(s) of the phone call lengths. Use your understanding of mean, median, and mode to explain which of these averages is most representative of the phone calls.

6

Multi-Step Equations and Inequalities

BEFORE

In previous chapters you've...

- Solved equations that required using one or two steps
- Solved one-step inequalities

Now

In Chapter 6 you'll study...

- Solving multi-step equations
- Solving equations that have variables on both sides
- Using multi-step inequalities to solve real-world problems

WHY?

So you can solve real-world problems about...

- Venus flytraps, p. 271
- fundraising, p. 274
- drumming, p. 278
- bowling, p. 296

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- State Test Practice
- More Examples

Chapter Warm-Up Game

Review skills you need for this chapter in this quick game. Work with a partner.

Key Skill:
Solving one- and two-step equations

TREASURE HUNT

MATERIALS

- 1 number cube
- 1 Treasure Hunt board
- 20 red markers
- 20 yellow markers

PREPARE Each player gets 20 markers of the same color. On your turn, follow the steps on the next page. You can challenge the other player when you believe they have covered an incorrect space.