2 Fractions and Decimals

"Dear Sir: You say that MOST humans use only a fraction of their brain power."
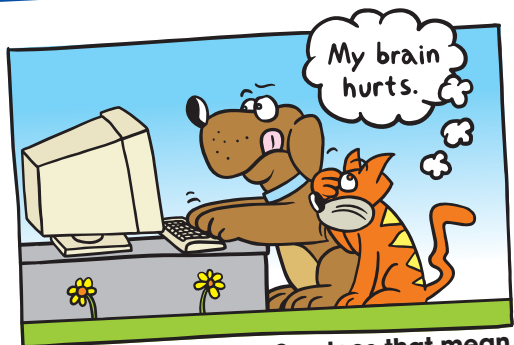
"But, $\frac{3}{2}$ is a fraction. So, does that mean that SOME humans use one and a half of their brain power?"

"My brain hurts."

"One of my homework problems is 'How many halves are in five halves?'"

"Duh?"

"If the answer isn't 5, I'm on the wrong planet."

What You Learned Before

"On a scale from 1 to 10, how do you like my painting?"

● Estimating Whole Number Products and Quotients (5.NBT.4)

Example 1 Estimate 32×88.

32 is close to 30.

$$32 \times 88 \approx 30 \times 90 = 2700$$

88 is close to 90.

Example 2 Estimate $176 \div 57$.

176 is close to 180.

$$176 \div 57 \approx 180 \div 60 = 3$$

57 is close to 60.

Try It Yourself

Estimate the product or the quotient.

1. 9×23
2. 19×22
3. 49×21
4. 38×61
5. $38 \div 9$
6. $63 \div 22$
7. $118 \div 19$
8. $245 \div 62$

● Multiplying and Dividing Whole Numbers (5.NBT.5, 5.NBT.6)

Example 3 Find 356×21.

$$\begin{array}{r} 11 \\ 356 \\ \times \quad 21 \\ \hline 356 \\ + \ 7120 \\ \hline 7476 \end{array}$$

Example 4 Estimate $765 \div 3$.

$$\begin{array}{r} 255 \\ 3\overline{)765} \\ -\ 6 \\ \hline 16 \\ -\ 15 \\ \hline 15 \\ -\ 15 \\ \hline 0 \end{array}$$

Try It Yourself

Find the product or the quotient.

9. $\begin{array}{r} 425 \\ \times \quad 9 \end{array}$
10. $\begin{array}{r} 721 \\ \times \quad 18 \end{array}$
11. $\begin{array}{r} 599 \\ \times \quad 29 \end{array}$
12. $\begin{array}{r} 503 \\ \times \quad 12 \end{array}$

13. $7\overline{)280}$
14. $4\overline{)428}$
15. $14\overline{)532}$
16. $23\overline{)8303}$

Essential Question What does it mean to multiply fractions?

1 **ACTIVITY: Multiplying Fractions**

Work with a partner. A bottle of water is $\frac{1}{2}$ full. You drink $\frac{2}{3}$ of the water. How much of the bottle of water do you drink?

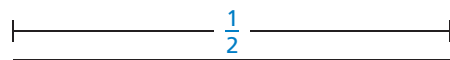**THINK ABOUT THE QUESTION:** To help you think about this question, rewrite the question.

Words: What is $\frac{2}{3}$ of $\frac{1}{2}$?   **Numbers:** $\frac{2}{3} \times \frac{1}{2} = ?$
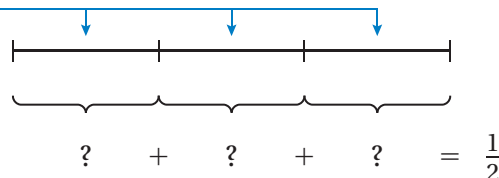
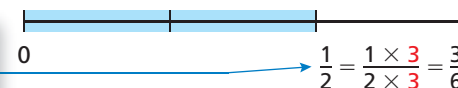Here is one way to get the answer.

- **Draw** a length of $\frac{1}{2}$.

> Because you want to find $\frac{2}{3}$ of the length, divide it into 3 equal sections.

$$? \quad + \quad ? \quad + \quad ? \quad = \quad \frac{1}{2}$$

Now, you need to think of a way to divide $\frac{1}{2}$ into 3 equal parts.

- **Rewrite** $\frac{1}{2}$ as a fraction whose numerator is divisible by 3.

> Because the length is divided into 3 equal sections, multiply the numerator and denominator by 3.

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

In this form, you see that $\frac{3}{6}$ can be divided into 3 equal parts of $\frac{1}{6}$.

- Each part is $\frac{1}{6}$ of the bottle of water, and you drank two of them. Written as multiplication, you have

$$\frac{2}{3} \times \frac{1}{2} = \frac{2}{\boxed{}} = \frac{\boxed{}}{\boxed{}}.$$
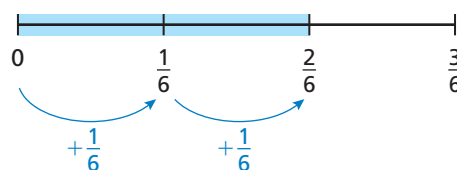
So, you drank $\frac{\boxed{}}{\boxed{}}$ of the bottle of water.

COMMON CORE

Dividing Fractions
In this lesson, you will
- use models to multiply fractions.
- multiply fractions by fractions.
Preparing for Standard 6.NS.1

ACTIVITY: **Multiplying Fractions**
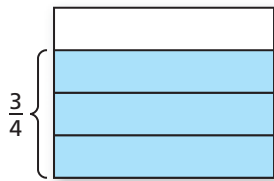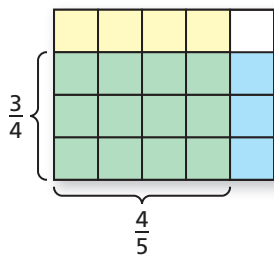
$\dfrac{3}{4}$ {

Work with a partner. A park has a playground that is $\dfrac{3}{4}$ of its width and $\dfrac{4}{5}$ of its length. What fraction of the park is covered by the playground?
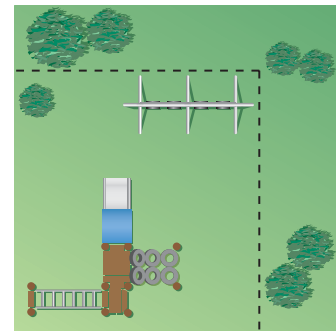
Fold a piece of paper horizontally into fourths and shade three of the fourths to represent $\dfrac{3}{4}$.

$\dfrac{3}{4}$ {

Fold the paper vertically into fifths and shade $\dfrac{4}{5}$ of the paper another color.

$\dfrac{4}{5}$

Count the total number of squares. This number is the denominator. The numerator is the number of squares shaded with both colors.

$\dfrac{3}{4} \times \dfrac{4}{5} = \dfrac{}{} = \dfrac{}{}$. So, $\dfrac{}{}$ of the park is covered by the playground.

Inductive Reasoning

Work with a partner. Complete the table by using a model or folding paper.

Exercise	Verbal Expression	Answer
① **3.** $\dfrac{2}{3} \times \dfrac{1}{2}$	$\dfrac{2}{3}$ of $\dfrac{1}{2}$	$\dfrac{}{}$
② **4.** $\dfrac{3}{4} \times \dfrac{4}{5}$	$\dfrac{3}{4}$ of $\dfrac{4}{5}$	$\dfrac{}{}$
5. $\dfrac{2}{3} \times \dfrac{5}{6}$		
6. $\dfrac{1}{6} \times \dfrac{1}{4}$		
7. $\dfrac{2}{5} \times \dfrac{1}{2}$		
8. $\dfrac{5}{8} \times \dfrac{4}{5}$		

Math Practice **1**

Consider Similar Problems

What are the similarities in constructing the models for each problem? What are the differences?

What Is Your Answer?

9. **IN YOUR OWN WORDS** What does it mean to multiply fractions?

10. **STRUCTURE** Write a general rule for multiplying fractions.

Practice Use what you learned about multiplying fractions to complete Exercises 4–11 on page 59.

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Key Idea

Multiplying Fractions

Words Multiply the numerators and multiply the denominators.

Numbers $\dfrac{3}{7} \times \dfrac{1}{2} = \dfrac{3 \times 1}{7 \times 2} = \dfrac{3}{14}$

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

EXAMPLE 1 Multiplying Fractions

Find $\dfrac{1}{5} \times \dfrac{1}{3}$.

$\dfrac{1}{5} \times \dfrac{1}{3} = \dfrac{1 \times 1}{5 \times 3}$ ← Multiply the numerators.
← Multiply the denominators.

$= \dfrac{1}{15}$ Simplify.

EXAMPLE 2 Multiplying Fractions with Common Factors

Find $\dfrac{8}{9} \times \dfrac{3}{4}$.

Estimate $1 \times \dfrac{3}{4} = \dfrac{3}{4}$

Study Tip

When the numerator of one fraction is the same as the denominator of another fraction, you can use mental math to multiply. For example, $\dfrac{4}{5} \times \dfrac{5}{9} = \dfrac{4}{9}$ because you can divide out the common factor 5.

$\dfrac{8}{9} \times \dfrac{3}{4} = \dfrac{8 \times 3}{9 \times 4}$ ← Multiply the numerators.
← Multiply the denominators.

$= \dfrac{\overset{2}{\cancel{8}} \times \overset{1}{\cancel{3}}}{\underset{3}{\cancel{9}} \times \underset{1}{\cancel{4}}}$ Divide out common factors.

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

∴ The product is $\dfrac{2}{3}$.   **Reasonable?** $\dfrac{2}{3} \approx \dfrac{3}{4}$ ✓

On Your Own

Now You're Ready
Exercises 4–19

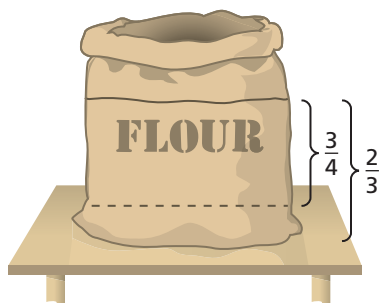**Multiply. Write the answer in simplest form.**

1. $\dfrac{1}{2} \times \dfrac{5}{6}$ **2.** $\dfrac{7}{8} \times \dfrac{1}{4}$ **3.** $\dfrac{3}{7} \times \dfrac{2}{3}$ **4.** $\dfrac{4}{9} \times \dfrac{3}{10}$
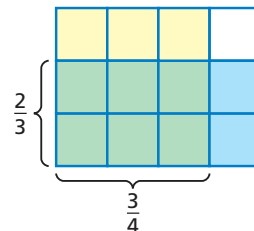
EXAMPLE 3 **Real-Life Application**

You have $\frac{2}{3}$ of a bag of flour. You use $\frac{3}{4}$ of the flour to make empanada dough. How much of the entire bag do you use to make the dough?

Method 1: Use a model. Six of the 12 squares have both types of shading.

So, you use $\frac{6}{12} = \frac{1}{2}$ of the entire bag.

Method 2: To find $\frac{3}{4}$ of $\frac{2}{3}$, multiply.

$$\frac{3}{4} \times \frac{2}{3} = \frac{\cancel{3} \times \cancel{2}^{1}}{\cancel{4} \times \cancel{3}_{1}}$$ Multiply the numerators and the denominators. Divide out common factors.

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

So, you use $\frac{1}{2}$ of the entire bag.

On Your Own

5. **WHAT IF?** In Example 3, you use $\frac{1}{4}$ of the flour to make the dough. How much of the entire bag do you use to make the dough?

Key Idea

Multiplying Mixed Numbers

Write each mixed number as an improper fraction. Then multiply as you would with fractions.

EXAMPLE 4 **Multiplying a Fraction and a Mixed Number**

Find $\frac{1}{2} \times 2\frac{3}{4}$. **Estimate** $\frac{1}{2} \times 3 = 1\frac{1}{2}$

$$\frac{1}{2} \times 2\frac{3}{4} = \frac{1}{2} \times \frac{11}{4}$$ Write $2\frac{3}{4}$ as the improper fraction $\frac{11}{4}$.

$$= \frac{1 \times 11}{2 \times 4}$$ Multiply the numerators and the denominators.

$$= \frac{11}{8}, \text{ or } 1\frac{3}{8}$$ Simplify.

The product is $1\frac{3}{8}$. **Reasonable?** $1\frac{3}{8} \approx 1\frac{1}{2}$ ✔

EXAMPLE **5**

Multiplying Mixed Numbers

Find $1\dfrac{4}{5} \times 3\dfrac{2}{3}$.　　　　　　　**Estimate** $2 \times 4 = 8$

$$1\dfrac{4}{5} \times 3\dfrac{2}{3} = \dfrac{9}{5} \times \dfrac{11}{3}$$　　Write $1\dfrac{4}{5}$ and $3\dfrac{2}{3}$ as improper fractions.

$$= \dfrac{\overset{3}{\cancel{9}} \times 11}{5 \times \underset{1}{\cancel{3}}}$$　　Multiply fractions. Divide out the common factor 3.

$$= \dfrac{33}{5}, \text{ or } 6\dfrac{3}{5}$$　　Simplify.

∴ The product is $6\dfrac{3}{5}$.　　　　**Reasonable?** $6\dfrac{3}{5} \approx 8$ ✓

On Your Own
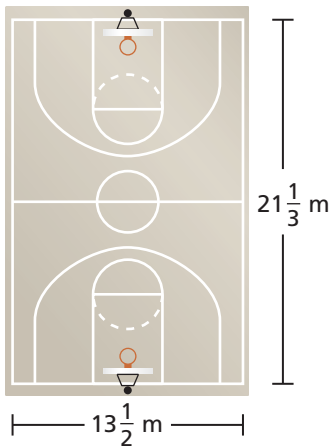
Now You're Ready
Exercises 26–41

Multiply. Write the answer in simplest form.

6. $\dfrac{1}{3} \times 1\dfrac{1}{6}$　　　**7.** $3\dfrac{1}{2} \times \dfrac{4}{9}$　　　**8.** $1\dfrac{7}{8} \times 2\dfrac{2}{5}$　　　**9.** $5\dfrac{5}{7} \times 2\dfrac{1}{10}$

EXAMPLE **6**

Real-Life Application

$21\dfrac{1}{3}$ m

$13\dfrac{1}{2}$ m

A city is resurfacing a basketball court. Find the area of the court.

Estimate $21 \times 14 = 294$

$$A = \ell w$$　　Write the formula for the area of a rectangle.

$$= 21\dfrac{1}{3} \times 13\dfrac{1}{2}$$　　Substitute $21\dfrac{1}{3}$ for ℓ and $13\dfrac{1}{2}$ for w.

$$= \dfrac{64}{3} \times \dfrac{27}{2}$$　　Write $21\dfrac{1}{3}$ and $13\dfrac{1}{2}$ as improper fractions.

$$= \dfrac{\overset{32}{\cancel{64}} \times \overset{9}{\cancel{27}}}{\underset{1}{\cancel{3}} \times \underset{1}{\cancel{2}}}$$　　Multiply fractions. Divide out common factors.

$$= 288$$　　Simplify.

∴ So, the area of the court is 288 square meters.

Reasonable? $288 \approx 294$ ✓

On Your Own

10. Find the area of a rectangular air hockey table that is $8\dfrac{1}{4}$ feet by $4\dfrac{3}{8}$ feet.
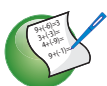
Vocabulary and Concept Check

1. **WRITING** Explain how to multiply two fractions.

2. **REASONING** Name the missing denominator.
$$\frac{3}{7} \times \frac{1}{\boxed{}} = \frac{3}{28}$$

3. **OPEN-ENDED** Write two mixed numbers between 3 and 4 that have a product between 9 and 12.

Practice and Problem Solving

Multiply. Write the answer in simplest form.

① ②

4. $\frac{1}{7} \times \frac{2}{3}$

5. $\frac{5}{8} \times \frac{1}{2}$

6. $\frac{1}{4} \times \frac{2}{5}$

7. $\frac{3}{7} \times \frac{1}{4}$

8. $\frac{2}{3} \times \frac{4}{7}$

9. $\frac{5}{7} \times \frac{7}{8}$

10. $\frac{3}{8} \times \frac{1}{9}$

11. $\frac{5}{6} \times \frac{2}{5}$

12. $\frac{5}{12} \times 10$

13. $6 \times \frac{7}{8}$

14. $\frac{3}{4} \times \frac{8}{15}$

15. $\frac{4}{9} \times \frac{4}{5}$

16. $\frac{3}{7} \times \frac{3}{7}$

17. $\frac{5}{6} \times \frac{2}{9}$

18. $\frac{13}{18} \times \frac{6}{7}$

19. $\frac{7}{9} \times \frac{21}{10}$

20. **ERROR ANALYSIS** Describe and correct the error in finding the product.

✗ $\frac{2}{5} \times \frac{3}{10} = \frac{4}{10} \times \frac{3}{10} = \frac{4 \times 3}{10} = \frac{12}{10} = 1\frac{1}{5}$

21. **AQUARIUM** In an aquarium, $\frac{2}{5}$ of the fish are surgeonfish. Of these, $\frac{3}{4}$ are yellow tangs. What fraction of all fish in the aquarium are yellow tangs?

22. **JUMP ROPE** You exercise for $\frac{3}{4}$ of an hour. You jump rope for $\frac{1}{3}$ of that time. What fraction of the hour do you spend jumping rope?

Without finding the product, copy and complete the statement using <, >, or =. Explain your reasoning.

23. $\frac{4}{7} \boxed{} \left(\frac{9}{10} \times \frac{4}{7} \right)$

24. $\left(\frac{5}{8} \times \frac{22}{15} \right) \boxed{} \frac{5}{8}$

25. $\frac{5}{6} \boxed{} \left(\frac{5}{6} \times \frac{7}{7} \right)$

Multiply. Write the answer in simplest form.

④ ⑤ **26.** $1\frac{1}{3} \times \frac{2}{3}$

27. $6\frac{2}{3} \times \frac{3}{10}$

28. $2\frac{1}{2} \times \frac{4}{5}$

29. $\frac{3}{5} \times 3\frac{1}{3}$

30. $7\frac{1}{2} \times \frac{2}{3}$

31. $\frac{5}{9} \times 3\frac{3}{5}$

32. $\frac{3}{4} \times 1\frac{1}{3}$

33. $3\frac{3}{4} \times \frac{2}{5}$

34. $4\frac{3}{8} \times \frac{4}{5}$

35. $\frac{3}{7} \times 2\frac{5}{6}$

36. $1\frac{3}{10} \times 18$

37. $15 \times 2\frac{4}{9}$

38. $1\frac{1}{6} \times 6\frac{3}{4}$

39. $2\frac{5}{12} \times 2\frac{2}{3}$

40. $5\frac{5}{7} \times 3\frac{1}{8}$

41. $2\frac{4}{5} \times 4\frac{1}{16}$

ERROR ANALYSIS Describe and correct the error in finding the product.

42.

❌ $4 \times 3\frac{7}{10} = 12\frac{7}{10}$

43.

❌ $2\frac{1}{2} \times 7\frac{4}{5} = (2 \times 7) + \left(\frac{1}{2} \times \frac{4}{5}\right)$

$= 14 + \frac{2}{5} = 14\frac{2}{5}$

44. VITAMIN C A vitamin C tablet contains $\frac{1}{40}$ of a gram of vitamin C. You take $1\frac{1}{2}$ tablets every day. How many grams of vitamin C do you take every day?

45. SCHOOL BANNER You make a banner for a football rally.

   a. What is the area of the banner?

   b. You add a $\frac{1}{4}$-foot border on each side. What is the new area of the banner?

GO PANTHERS! $1\frac{1}{2}$ ft

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

46. NUMBER SENSE Without calculating, is $1\frac{1}{6} \cdot \frac{4}{5}$ less than or greater than $1\frac{1}{6}$? Is the product less than or greater than $\frac{4}{5}$? Explain your reasoning.

Multiply. Write the answer in simplest form.

47. $\frac{1}{2} \times \frac{3}{5} \times \frac{4}{9}$

48. $\frac{4}{7} \times 4\frac{3}{8} \times \frac{5}{6}$

49. $1\frac{1}{15} \times 5\frac{2}{5} \times 4\frac{7}{12}$

50. $\left(\frac{3}{5}\right)^3$

51. $\left(\frac{4}{5}\right)^2 \times \left(\frac{3}{4}\right)^2$

52. $\left(\frac{5}{6}\right)^2 \times \left(1\frac{1}{10}\right)^2$

53. PICTURES Three pictures hang side by side on a wall. What is the total area of the wall that the pictures cover?

$14\frac{2}{3}$ in.

$\vdash 10\frac{1}{2}$ in. $\dashv$ $\vdash 10\frac{1}{2}$ in. $\dashv$ $\vdash 10\frac{1}{2}$ in. $\dashv$

54. OPEN-ENDED Find a fraction that, when multiplied by $\frac{1}{2}$, is less than $\frac{1}{4}$.

55. DISTANCES You are in a bike race. When you get to the first checkpoint, you are $\frac{2}{5}$ of the distance to the second checkpoint. When you get to the second checkpoint, you are $\frac{1}{4}$ of the distance to the finish. What is the distance from the start to the first checkpoint?
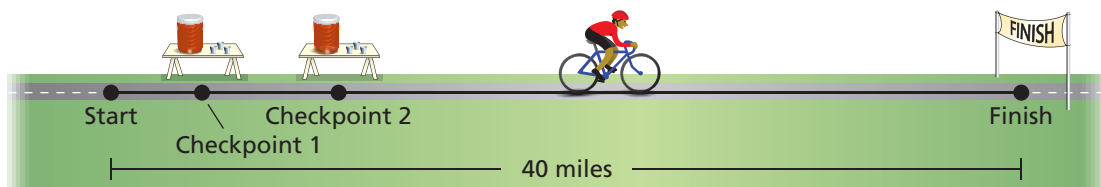
56. NUMBER SENSE Is the product of two positive mixed numbers ever less than 1? Explain.

57. MODELING You plan to add a fountain to your garden.

    a. Draw a diagram of the fountain in the garden. Label the dimensions.
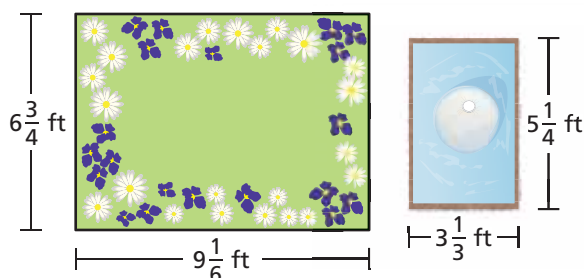
    b. Describe two methods for finding the area of the garden that surrounds the fountain.

    c. Find the area. Which method did you use, and why?

58. COOKING The cooking time for a ham is $\frac{2}{5}$ of an hour for each pound.

    a. How long should you cook a ham that weighs $12\frac{3}{4}$ pounds?

    b. Dinner time is 4:45 P.M. What time should you start cooking the ham?

59. PETS You ask 150 people about their pets. The results show that $\frac{9}{25}$ of the people own a dog. Of the people who own a dog, $\frac{1}{6}$ of them also own a cat.

    a. What fraction of the people own a dog and a cat?

    b. Reasoning How many people own a dog but not a cat? Explain.

Fair Game Review What you learned in previous grades & lessons

Find the prime factorization of the number. *(Section 1.4)*

60. 24   **61.** 45   **62.** 53   **63.** 60

64. MULTIPLE CHOICE A science experiment calls for $\frac{3}{4}$ cup of baking powder. You have $\frac{1}{3}$ cup of baking powder. How much more baking powder do you need? *(Section 1.6)*

    Ⓐ $\frac{1}{4}$ cup   **Ⓑ** $\frac{5}{12}$ cup   **Ⓒ** $\frac{4}{7}$ cup   **Ⓓ** $1\frac{1}{12}$ cups

2.2 Dividing Fractions

Essential Question How can you divide by a fraction?

1 ACTIVITY: Dividing by a Fraction

Work with a partner. Write the division problem and solve it using a model.

a. How many two-thirds are in three?

The division problem is $\boxed{} \div \dfrac{\boxed{}}{\boxed{}}$.

1   1   1

Remaining piece

$\dfrac{2}{3}$ $\dfrac{2}{3}$ $\dfrac{2}{3}$ $\dfrac{2}{3}$
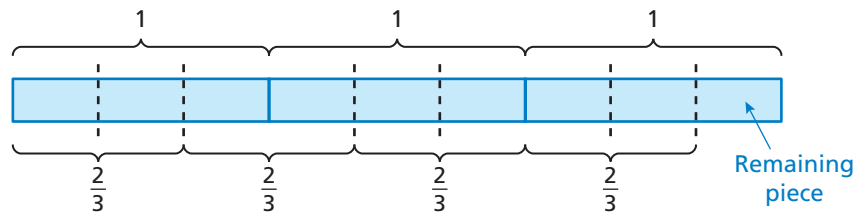
How many groups of $\dfrac{2}{3}$ are in 3? $\boxed{}$

The remaining piece represents $\dfrac{\boxed{}}{\boxed{}}$ of $\dfrac{2}{3}$.

So, there are $\boxed{}\dfrac{\boxed{}}{\boxed{}}$ groups of $\dfrac{2}{3}$ in 3.

So, $\boxed{} \div \dfrac{\boxed{}}{\boxed{}} = \boxed{}\dfrac{\boxed{}}{\boxed{}}$.

b. How many halves are in five halves?

1   1 $\dfrac{1}{2}$
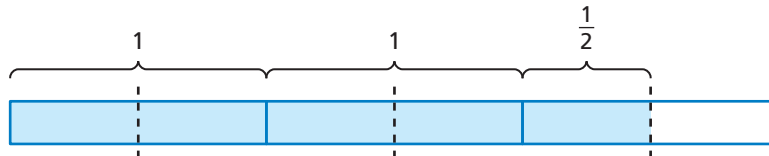
c. How many four-fifths are in eight?

d. How many one-thirds are in seven halves?

e. How many three-fourths are in five halves?

ACTIVITY: Using Tables to Recognize a Pattern

Work with a partner.

a. Complete each table.

Division Table

$8 \div 16$	$\dfrac{1}{2}$
$8 \div 8$	1
$8 \div 4$	2
$8 \div 2$	4
$8 \div 1$	8
$8 \div \dfrac{1}{2}$	
$8 \div \dfrac{1}{4}$	
$8 \div \dfrac{1}{8}$	

Multiplication Table

$8 \times \dfrac{1}{16}$	$\dfrac{1}{2}$
$8 \times \dfrac{1}{8}$	1
$8 \times \dfrac{1}{4}$	2
$8 \times \dfrac{1}{2}$	4
8×1	8
8×2	
8×4	
8×8	

Math Practice 4

Analyze Relationships

How is multiplying numbers similar to dividing numbers?

b. Describe the relationship between the red numbers in the division table and the red numbers in the multiplication table.

c. Describe the relationship between the blue numbers in the division table and the blue numbers in the multiplication table.

d. **STRUCTURE** Make a conjecture about how you can use multiplication to divide by a fraction.

e. Test your conjecture using the problems in Activity 1.

What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you divide by a fraction? Give an example.

4. How many halves are in a fourth? Explain how you found your answer.

Practice   Use what you learned about dividing fractions to complete Exercises 11–18 on page 67.

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Key Vocabulary
reciprocals, *p. 64*

Two numbers whose product is 1 are **reciprocals**. To write the reciprocal of a number, write the number as a fraction. Then invert the fraction. So, the reciprocal of a fraction $\frac{a}{b}$ is $\frac{b}{a}$, where a and $b \neq 0$.

The Meaning of a Word ● Invert

When you **invert** a glass,   you turn it over.

Study Tip

The product of a nonzero number and its reciprocal is 1.
$$\frac{a}{b} \cdot \frac{b}{a} = 1$$
This is called the *Multiplicative Inverse Property*. You will learn more about this property in Chapter 7.

EXAMPLE 1 — Writing Reciprocals

Study Tip

When any number is multiplied by 0, the product is 0. So, the number 0 does not have a reciprocal.

	Original Number	*Fraction*	*Reciprocal*	*Check*
a.	$\frac{3}{5}$	$\frac{3}{5}$	$\frac{5}{3}$	$\frac{3}{5} \times \frac{5}{3} = 1$
b.	$\frac{9}{5}$	$\frac{9}{5}$	$\frac{5}{9}$	$\frac{9}{5} \times \frac{5}{9} = 1$
c.	2	$\frac{2}{1}$	$\frac{1}{2}$	$\frac{2}{1} \times \frac{1}{2} = 1$

On Your Own

Now You're Ready
Exercises 7–10

Write the reciprocal of the number.

1. $\frac{3}{4}$ **2.** 5 **3.** $\frac{7}{2}$ **4.** $\frac{4}{9}$

🔑 Key Idea

Dividing Fractions

Words   To divide a number by a fraction, multiply the number by the reciprocal of the fraction.

Numbers $\dfrac{1}{5} \div \dfrac{3}{4} = \dfrac{1}{5} \times \dfrac{4}{3} = \dfrac{1 \times 4}{5 \times 3}$

Algebra $\dfrac{a}{b} \div \dfrac{c}{d} = \dfrac{a}{b} \cdot \dfrac{d}{c} = \dfrac{a \cdot d}{b \cdot c}$, where b, c, and $d \neq 0$

🔊 Multi-Language Glossary at BigIdeasMath.com

EXAMPLE **2** **Dividing a Fraction by a Fraction**

Find $\dfrac{1}{6} \div \dfrac{2}{3}$.

$$\dfrac{1}{6} \div \dfrac{2}{3} = \dfrac{1}{6} \times \dfrac{3}{2} \qquad \text{Multiply by the reciprocal of } \dfrac{2}{3}, \text{ which is } \dfrac{3}{2}.$$

$$= \dfrac{1 \times \overset{1}{\cancel{3}}}{\underset{2}{\cancel{6}} \times 2} \qquad \text{Multiply fractions. Divide out the common factor 3.}$$

$$= \dfrac{1}{4} \qquad \text{Simplify.}$$

EXAMPLE **3** **Dividing a Whole Number by a Fraction**
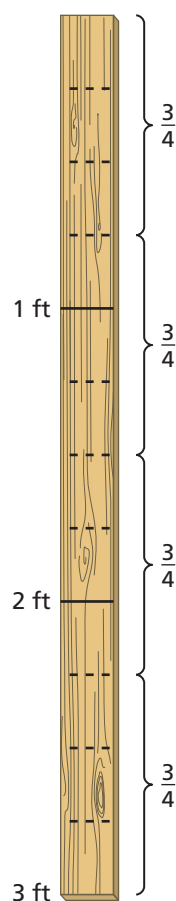
A piece of wood is 3 feet long. How many $\dfrac{3}{4}$-foot pieces can you cut from the piece of wood?

Method 1: Draw a diagram. Mark each foot on the diagram. Then divide each foot into $\dfrac{1}{4}$-foot sections.

Count the number of $\dfrac{3}{4}$-foot pieces of wood. There are four.

∴ So, you can cut four $\dfrac{3}{4}$-foot pieces from the piece of wood.

Method 2: Divide 3 by $\dfrac{3}{4}$ to find the number of $\dfrac{3}{4}$-foot pieces.

$$3 \div \dfrac{3}{4} = 3 \times \dfrac{4}{3} \qquad \text{Multiply by the reciprocal of } \dfrac{3}{4}, \text{ which is } \dfrac{4}{3}.$$

$$= \dfrac{\overset{1}{\cancel{3}} \times 4}{\underset{1}{\cancel{3}}} \qquad \text{Multiply. Divide out the common factor 3.}$$

$$= 4 \qquad \text{Simplify.}$$

∴ So, you can cut four $\dfrac{3}{4}$-foot pieces from the piece of wood.

On Your Own

Divide. Write the answer in simplest form.

5. $\dfrac{2}{7} \div \dfrac{1}{3}$ **6.** $\dfrac{1}{2} \div \dfrac{1}{8}$ **7.** $\dfrac{3}{8} \div \dfrac{1}{4}$ **8.** $\dfrac{2}{5} \div \dfrac{3}{10}$

9. How many $\dfrac{1}{2}$-foot pieces can you cut from a 7-foot piece of wood?

EXAMPLE **4** **Dividing a Fraction by a Whole Number**

Find $\dfrac{4}{5} \div 2$.

$$\dfrac{4}{5} \div 2 = \dfrac{4}{5} \div \dfrac{2}{1}$$ Write 2 as an improper fraction.

$$= \dfrac{4}{5} \times \dfrac{1}{2}$$ Multiply by the reciprocal of $\dfrac{2}{1}$, which is $\dfrac{1}{2}$.

$$= \dfrac{\overset{2}{\cancel{4}} \times 1}{5 \times \underset{1}{\cancel{2}}}$$ Multiply fractions. Divide out the common factor 2.

$$= \dfrac{2}{5}$$ Simplify.

On Your Own

Divide. Write the answer in simplest form.

10. $\dfrac{1}{2} \div 3$

11. $\dfrac{2}{3} \div 10$

12. $\dfrac{5}{8} \div 4$

13. $\dfrac{6}{7} \div 4$

EXAMPLE **5** **Using Order of Operations**

Evaluate $\dfrac{3}{8} + \dfrac{5}{6} \div 5$.

$$\dfrac{3}{8} + \dfrac{5}{6} \div 5 = \dfrac{3}{8} + \dfrac{5}{6} \times \dfrac{1}{5}$$ Multiply by the reciprocal of 5, which is $\dfrac{1}{5}$.

$$= \dfrac{3}{8} + \dfrac{\overset{1}{\cancel{5}} \times 1}{6 \times \underset{1}{\cancel{5}}}$$ Multiply $\dfrac{5}{6}$ and $\dfrac{1}{5}$. Divide out the common factor 5.

$$= \dfrac{3}{8} + \dfrac{1}{6}$$ Simplify.

$$= \dfrac{18}{48} + \dfrac{8}{48}$$ Rewrite fractions using a common denominator.

$$= \dfrac{26}{48}, \text{ or } \dfrac{13}{24}$$ Simplify.

> **Study Tip**
>
> You can use the LCD, 24, to add the fractions in Example 5.
>
> $\dfrac{3}{8} + \dfrac{1}{6} = \dfrac{9}{24} + \dfrac{4}{24} = \dfrac{13}{24}$

On Your Own

Evaluate the expression. Write the answer in simplest form.

14. $\dfrac{4}{5} + \dfrac{2}{5} \div 4$

15. $\dfrac{3}{8} \div \dfrac{3}{4} - \dfrac{1}{6}$

16. $\dfrac{8}{9} \div 2 \div 8$

✓ Vocabulary and Concept Check

1. **OPEN-ENDED** Write a fraction and its reciprocal.

2. **WHICH ONE DOESN'T BELONG?** Which of the following does *not* belong with the other three? Explain your reasoning.

$$\frac{1}{3} \qquad \frac{1}{6} \qquad \frac{2}{9} \qquad \frac{1}{8}$$

MATCHING Match the expression with its value.

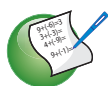3. $\dfrac{2}{5} \div \dfrac{8}{15}$ 4. $\dfrac{8}{15} \div \dfrac{2}{5}$ 5. $\dfrac{2}{15} \div \dfrac{8}{5}$ 6. $\dfrac{8}{5} \div \dfrac{2}{15}$

A. $\dfrac{1}{12}$ **B.** $\dfrac{3}{4}$ **C.** 12   **D.** $1\dfrac{1}{3}$

✎ Practice and Problem Solving

Write the reciprocal of the number.

① 7. 8   8. $\dfrac{6}{7}$ 9. $\dfrac{2}{5}$ 10. $\dfrac{8}{11}$

Divide. Write the answer in simplest form.

② ③ ④ 11. $\dfrac{1}{8} \div \dfrac{1}{4}$ 12. $\dfrac{5}{6} \div \dfrac{2}{7}$ 13. $12 \div \dfrac{3}{4}$ 14. $8 \div \dfrac{2}{5}$

15. $\dfrac{3}{7} \div 6$ 16. $\dfrac{12}{25} \div 4$ 17. $\dfrac{2}{9} \div \dfrac{2}{3}$ 18. $\dfrac{8}{15} \div \dfrac{4}{5}$

19. $\dfrac{1}{3} \div \dfrac{1}{9}$ 20. $\dfrac{7}{10} \div \dfrac{3}{8}$ 21. $\dfrac{14}{27} \div 7$ 22. $\dfrac{5}{8} \div 15$

23. $\dfrac{27}{32} \div \dfrac{7}{8}$ 24. $\dfrac{4}{15} \div \dfrac{10}{13}$ 25. $9 \div \dfrac{4}{9}$ 26. $10 \div \dfrac{5}{12}$

ERROR ANALYSIS Describe and correct the error in finding the quotient.

27. ✗
$$\frac{4}{7} \div \frac{13}{28} = \frac{4}{7} \times \frac{13}{28}$$
$$= \frac{\overset{1}{\cancel{4}} \times 13}{7 \times \cancel{28}_{\,7}}$$
$$= \frac{13}{49}$$

28. ✗
$$\frac{2}{5} \div \frac{8}{9} = \frac{5}{2} \times \frac{8}{9}$$
$$= \frac{5 \times \overset{4}{\cancel{8}}}{\underset{1}{\cancel{2}} \times 9}$$
$$= \frac{20}{9}$$

29. **REASONING** How can you use estimation to show that the quotient in Exercise 28 is incorrect?

30. APPLE PIE You have $\frac{3}{5}$ of an apple pie. You divide the remaining pie into 5 equal slices. What fraction of the original pie is each slice?

31. ANIMALS How many times longer is the baby alligator than the baby gecko?

$\frac{2}{15}$ ft

$\frac{3}{4}$ ft
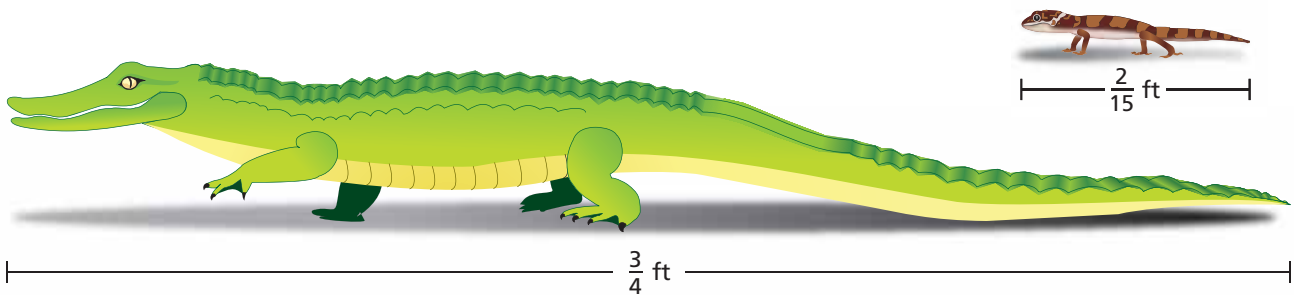
Determine whether the numbers are reciprocals. If not, write the reciprocal of each number.

32. $9, \frac{1}{9}$

33. $\frac{4}{5}, \frac{10}{8}$

34. $\frac{5}{6}, \frac{15}{18}$

35. $\frac{6}{5}, \frac{5}{6}$

Copy and complete the statement.

36. $\frac{5}{12} \times \boxed{} = 1$

37. $3 \times \boxed{} = 1$

38. $7 \div \boxed{} = 56$

Without finding the quotient, copy and complete the statement using <, >, or =. Explain your reasoning.

39. $5 \div \frac{7}{9} \boxed{} 5$

40. $\frac{3}{7} \div 1 \boxed{} \frac{3}{7}$

41. $8 \div \frac{3}{4} \boxed{} 8$

42. $\frac{5}{6} \div \frac{7}{8} \boxed{} \frac{5}{6}$

Evaluate the expression. Write the answer in simplest form.

⑤ 43. $\frac{1}{6} \div 6 \div 6$

44. $\frac{7}{12} \div 14 \div 6$

45. $\frac{3}{5} \div \frac{4}{7} \div \frac{9}{10}$

46. $4 \div \frac{8}{9} - \frac{1}{2}$

47. $\frac{3}{4} + \frac{5}{6} \div \frac{2}{3}$

48. $\frac{7}{8} - \frac{3}{8} \div 9$

49. $\frac{9}{16} \div \frac{3}{4} \cdot \frac{2}{13}$

50. $\frac{3}{14} \cdot \frac{2}{5} \div \frac{6}{7}$

51. $\frac{10}{27} \cdot \left(\frac{3}{8} \div \frac{5}{24} \right)$

52. REASONING Use a model to evaluate the quotient $\frac{1}{2} \div \frac{1}{6}$. Explain.

53. VIDEO CHATTING You use $\frac{1}{8}$ of your battery for every $\frac{2}{5}$ of an hour that you video chat. You use $\frac{3}{4}$ of your battery video chatting. How long did you video chat?

54. NUMBER SENSE When is the reciprocal of a fraction a whole number? Explain.

55. BUDGETS The table shows the portions of a family budget that are spent on several expenses.

a. How many times more is the expense for housing than for automobiles?

b. How many times more is the expense for food than for recreation?

c. The expense for automobile fuel is $\frac{1}{60}$ of the total expenses. What fraction of the automobile expense is spent on fuel?

Expense	Portion of Budget
Housing	$\frac{1}{4}$
Food	$\frac{1}{12}$
Automobiles	$\frac{1}{15}$
Recreation	$\frac{1}{40}$

56. PROBLEM SOLVING You have 6 pints of glaze. It takes $\frac{7}{8}$ of a pint to glaze a bowl and $\frac{9}{16}$ of a pint to glaze a plate.

a. How many bowls could you glaze? How many plates could you glaze?

b. You want to glaze 5 bowls, and then use the rest for plates. How many plates can you glaze? How much glaze will be left over?

c. How many of each object could you glaze so that there is no glaze left over? Explain how you found your answer.

57. **Reasoning** A water tank is $\frac{1}{8}$ full. The tank is $\frac{3}{4}$ full when 42 gallons of water are added to the tank.

a. How much water can the tank hold?

b. How much water was originally in the tank?

c. How much water is in the tank when it is $\frac{1}{2}$ full?

Fair Game Review What you learned in previous grades & lessons

Find the GCF of the numbers. *(Section 1.5)*

58. 8, 16   **59.** 24, 66   **60.** 48, 80   **61.** 15, 45, 100

62. MULTIPLE CHOICE How many inches are in $5\frac{1}{2}$ yards? *(Skills Review Handbook)*

(A) $15\frac{1}{2}$ (B) $16\frac{1}{2}$ (C) 66   (D) 198

Essential Question How can you model division by a mixed number?

1 ACTIVITY: Writing a Story

Work with a partner. Think of a story that uses division by a mixed number.

$$\boxed{} \div \frac{\boxed{}}{\boxed{}}$$

Whole number, fraction, or mixed number

Mixed number

a. Write your story. Then draw pictures for your story.

b. Solve the division problem and use the answer in your story. Include a diagram of the division problem.

There are many possible stories. Here is one that uses $6 \div 1\frac{1}{2}$.

Joe goes on a camping trip with his aunt, his uncle, and three cousins. They leave at 5:00 P.M. and drive 2 hours to the campground.
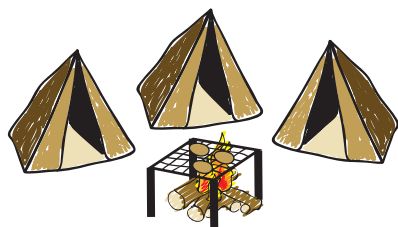
Joe helps his uncle put up three tents. His aunt cooks hamburgers on a grill that is over a fire.

In the morning, Joe tells his aunt that he is making pancakes. He decides to triple the recipe so there will be plenty of pancakes for everyone. A single recipe uses 2 cups of water, so he needs a total of 6 cups.

Pancake Mix
Recipe:
2 cups water
2 cups pancake mix
1/4 cup oil
1 egg
1/4 teaspoon salt
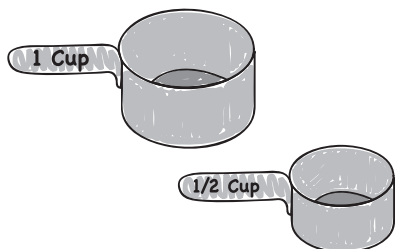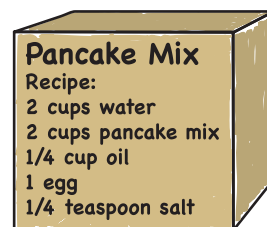
1 Cup

1/2 Cup

Joe's aunt has a 1-cup measuring cup and a ½-cup measuring cup. The water faucet is about 50 yards from the campsite. Joe tells his cousins that he can get 6 cups of water in only 4 trips.

When his cousins ask him how he knows that, he uses a stick to draw a diagram in the dirt. Joe says, "This diagram shows that there are four 1½s in 6." In other words, $6 \div 1\frac{1}{2} = 4$.

COMMON CORE
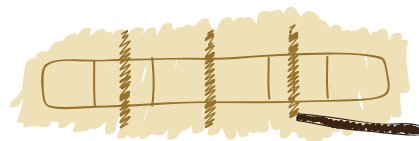
Dividing Fractions
In this lesson, you will
• use models to divide mixed numbers.
• divide mixed numbers.
• solve real-life problems.
Learning Standard
6.NS.1

2 ACTIVITY: Dividing Mixed Numbers

Work with a partner. Write the division problem and solve it using a model.

Math Practice 2

Make Sense of Quantities

What values do the parts of the model represent?

a. How many three-fourths are in four and one-half?

$1 \qquad 1 \qquad 1 \qquad 1 \qquad \frac{1}{2}$
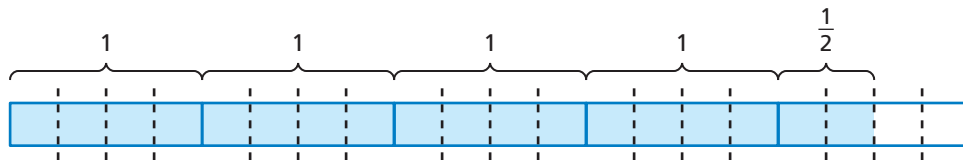
b. How many five-sixths are in three and one-third?

$1 \qquad 1 \qquad 1 \qquad \frac{1}{3}$
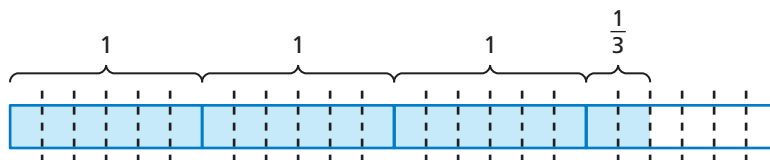
c. How many three-eighths are in three and three-fourths?

$1 \qquad 1 \qquad 1 \qquad \frac{3}{4}$
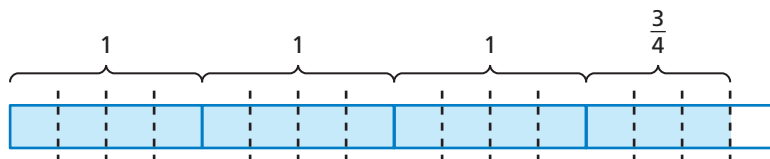
d. How many one and one-halves are in six?

e. How many one and one-fifths are in five?

f. How many one and one-fourths are in four and one-half?

g. How many two and one-thirds are in five and five-sixths?

What Is Your Answer?

3. IN YOUR OWN WORDS How can you model division by a mixed number?

4. Can you think of another method you can use to obtain your answers in Activity 2?

Practice Use what you learned about dividing mixed numbers to complete Exercises 5–12 on page 74.

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🔑 Key Idea

Dividing Mixed Numbers

Write each mixed number as an improper fraction. Then divide as you would with proper fractions.

EXAMPLE 1 Dividing a Mixed Number by a Fraction

Find $2\dfrac{1}{4} \div \dfrac{3}{8}$.

$$2\frac{1}{4} \div \frac{3}{8} = \frac{9}{4} \div \frac{3}{8}$$ Write $2\dfrac{1}{4}$ as the improper fraction $\dfrac{9}{4}$.

$$= \frac{9}{4} \times \frac{8}{3}$$ Multiply by the reciprocal of $\dfrac{3}{8}$, which is $\dfrac{8}{3}$.

$$= \frac{\overset{3}{\cancel{9}} \times \overset{2}{\cancel{8}}}{\underset{1}{\cancel{4}} \times \underset{1}{\cancel{3}}}$$ Multiply fractions. Divide out common factors.

$$= 6$$ Simplify.

Check
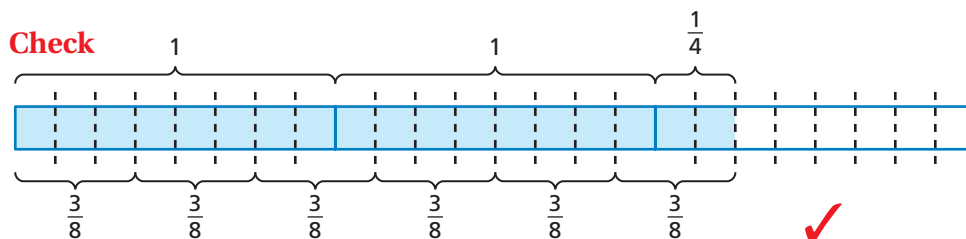
EXAMPLE 2 Dividing Mixed Numbers

Find $3\dfrac{5}{6} \div 1\dfrac{2}{3}$.

Estimate $4 \div 2 = 2$

$$3\frac{5}{6} \div 1\frac{2}{3} = \frac{23}{6} \div \frac{5}{3}$$ Write each mixed number as an improper fraction.

$$= \frac{23}{6} \times \frac{3}{5}$$ Multiply by the reciprocal of $\dfrac{5}{3}$, which is $\dfrac{3}{5}$.

$$= \frac{23 \times \overset{1}{\cancel{3}}}{\underset{2}{\cancel{6}} \times 5}$$ Multiply fractions. Divide out common factors.

$$= \frac{23}{10}, \text{ or } 2\frac{3}{10}$$ Simplify.

∴ So, the quotient is $2\dfrac{3}{10}$.   **Reasonable?** $2\dfrac{3}{10} \approx 2$ $\checkmark$

🔴 On Your Own

Now You're Ready
Exercises 5–20

Divide. Write the answer in simplest form.

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

EXAMPLE ③ Using Order of Operations

Evaluate $5\frac{1}{4} \div 1\frac{1}{8} - \frac{2}{3}$.

$$5\frac{1}{4} \div 1\frac{1}{8} - \frac{2}{3} = \frac{21}{4} \div \frac{9}{8} - \frac{2}{3}$$ 　Write each mixed number as an improper fraction.

$$= \frac{21}{4} \times \frac{8}{9} - \frac{2}{3}$$ 　Multiply by the reciprocal of $\frac{9}{8}$, which is $\frac{8}{9}$.

$$= \frac{\overset{7}{\cancel{21}} \times \overset{2}{\cancel{8}}}{\underset{1}{\cancel{4}} \times \underset{3}{\cancel{9}}} - \frac{2}{3}$$ 　Multiply $\frac{21}{4}$ and $\frac{8}{9}$. Divide out common factors.

$$= \frac{14}{3} - \frac{2}{3}$$ 　Simplify.

$$= \frac{12}{3}, \text{ or } 4$$ 　Subtract.

EXAMPLE ④ Real-Life Application

One serving of tortilla soup is $1\frac{2}{3}$ **cups. A restaurant cook makes 50 cups of soup. Is there enough to serve 35 people? Explain.**

Divide 50 by $1\frac{2}{3}$ to find the number of available servings.

$$50 \div 1\frac{2}{3} = \frac{50}{1} \div \frac{5}{3}$$ 　Rewrite each number as an improper fraction.

$$= \frac{50}{1} \cdot \frac{3}{5}$$ 　Multiply by the reciprocal of $\frac{5}{3}$, which is $\frac{3}{5}$.

$$= \frac{\overset{10}{\cancel{50}} \cdot 3}{1 \cdot \underset{1}{\cancel{5}}}$$ 　Multiply fractions. Divide out common factors.

$$= 30$$ 　Simplify.

⋮ No. Because 30 is less than 35, there is not enough soup to serve 35 people.

On Your Own

Evaluate the expression. Write the answer in simplest form.

5. $1\frac{1}{2} \div \frac{1}{6} - \frac{7}{8}$

6. $3\frac{1}{3} \div \frac{5}{6} + \frac{8}{9}$

7. $\frac{2}{5} + 2\frac{4}{5} \div 1\frac{3}{4}$

8. $\frac{2}{3} - 1\frac{4}{7} \div 4\frac{5}{7}$

9. In Example 4, can 30 cups of tortilla soup serve 15 people? Explain.

✓ Vocabulary and Concept Check

1. **VOCABULARY** What is the reciprocal of $7\frac{1}{3}$?

2. **NUMBER SENSE** Is $5\frac{1}{4} \div 3\frac{1}{2}$ the same as $3\frac{1}{2} \div 5\frac{1}{4}$? Explain.

3. **NUMBER SENSE** Is the reciprocal of an improper fraction *sometimes*, *always*, or *never* a proper fraction? Explain.

4. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

> What is $5\frac{1}{2}$ divided by $\frac{1}{8}$?

> Find the quotient of $5\frac{1}{2}$ and $\frac{1}{8}$.

> What is $5\frac{1}{2}$ times 8?

> Find the product of $5\frac{1}{2}$ and $\frac{1}{8}$.
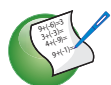
Practice and Problem Solving

Divide. Write the answer in simplest form.

1 2 5. $2\frac{1}{4} \div \frac{3}{4}$

6. $3\frac{4}{5} \div \frac{2}{5}$

7. $8\frac{1}{8} \div \frac{5}{6}$

8. $7\frac{5}{9} \div \frac{4}{7}$

9. $7\frac{1}{2} \div 1\frac{9}{10}$

10. $3\frac{3}{4} \div 2\frac{1}{12}$

11. $7\frac{1}{5} \div 8$

12. $8\frac{4}{7} \div 15$

13. $8\frac{1}{3} \div \frac{2}{3}$

14. $9\frac{1}{6} \div \frac{5}{6}$

15. $13 \div 10\frac{5}{6}$

16. $12 \div 5\frac{9}{11}$

17. $\frac{7}{8} \div 3\frac{1}{16}$

18. $\frac{4}{9} \div 1\frac{7}{15}$

19. $4\frac{5}{16} \div 3\frac{3}{8}$

20. $6\frac{2}{9} \div 5\frac{5}{6}$

21. **ERROR ANALYSIS** Describe and correct the error in finding the quotient.

> ✗ $3\frac{1}{2} \div 1\frac{2}{3} = 3\frac{1}{2} \times 1\frac{3}{2} = \frac{7}{2} \times \frac{5}{2} = \frac{35}{4} = 8\frac{3}{4}$

22. **DOG FOOD** A bag contains 42 cups of dog food. Your dog eats $2\frac{1}{3}$ cups of dog food each day. How many days does the bag of dog food last?

23. **HAMBURGERS** How many $\frac{1}{4}$-pound hamburgers can you make from $3\frac{1}{2}$ pounds of ground beef?

24. **BOOKS** How many $1\frac{3}{5}$-inch-thick books can fit on a $14\frac{1}{2}$-inch-long bookshelf?

25. LOGIC Alexei uses the model shown to state that $2\frac{1}{2} \div 1\frac{1}{6} = 2\frac{1}{6}$. Is Alexei correct? Justify your answer using the model.
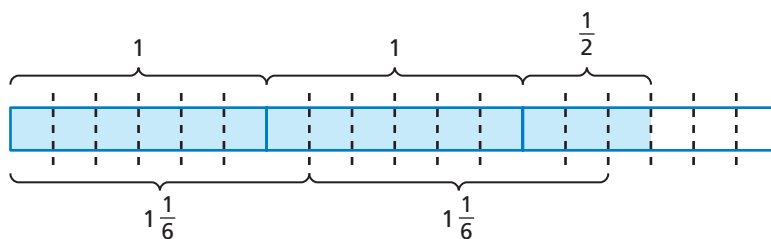
Evaluate the expression. Write the answer in simplest form.

③ 26. $3 \div 1\frac{1}{5} + \frac{1}{2}$

27. $4\frac{2}{3} - 1\frac{1}{3} \div 2$

28. $\frac{2}{5} + 2\frac{1}{6} \div \frac{5}{6}$

29. $5\frac{5}{6} \div 3\frac{3}{4} - \frac{2}{9}$

30. $6\frac{1}{2} - \frac{7}{8} \div 5\frac{11}{16}$

31. $9\frac{1}{6} \div 5 + 3\frac{1}{3}$

32. $3\frac{3}{5} + 4\frac{4}{15} \div \frac{4}{9}$

33. $\frac{3}{5} \times \frac{7}{12} \div 2\frac{7}{10}$

34. $4\frac{3}{8} \div \frac{3}{4} \times \frac{4}{7}$

35. $1\frac{9}{11} \times 4\frac{7}{12} \div \frac{2}{3}$

36. $3\frac{4}{15} \div \left(8 \times 6\frac{3}{10}\right)$

37. $2\frac{5}{14} \div \left(2\frac{5}{8} \times 1\frac{3}{7}\right)$

38. TRAIL MIX You have 12 cups of granola and $8\frac{1}{2}$ cups of peanuts to make trail mix. What is the greatest number of full batches of trail mix you can make? Explain how you found your answer.

Trail Mix
$2\frac{3}{4}$ cups granola
$1\frac{1}{3}$ cups peanuts

39. RAMPS You make skateboard ramps by cutting pieces from a board that is $12\frac{1}{2}$ feet long.

  a. Estimate how many ramps you can cut from the board. Is your estimate reasonable? Explain.

  b. How many ramps can you cut from the board? How much wood is left over?

$1\frac{7}{8}$ ft

$1\frac{7}{8}$ ft

40. Reasoning At a track meet, the longest shot-put throw by a boy is 25 feet 8 inches. The longest shot-put throw by a girl is 19 feet 3 inches. How many times greater is the longest shot-put throw by the boy than by the girl?

Fair Game Review What you learned in previous grades & lessons

Write the number as a decimal. *(Skills Review Handbook)*

41. forty-three hundredths

42. thirteen thousandths

43. three and eight tenths

44. seven and nine thousandths

45. MULTIPLE CHOICE The winner in a vote for class president received $\frac{3}{4}$ of the 240 votes. How many votes did the winner receive? *(Skills Review Handbook)*

Ⓐ 60　　　　Ⓑ 150　　　　Ⓒ 180　　　　Ⓓ 320

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Graphic Organizer
BigIdeasMath.com

You can use a **notetaking organizer** to write notes, vocabulary, and questions about a topic. Here is an example of a notetaking organizer for dividing fractions.

Write important vocabulary or formulas in this space.

Write your notes about the topic in this space.

Dividing fractions

To divide a number by a fraction, multiply the number by the reciprocal of the fraction.

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$$

$$= \frac{a \cdot d}{b \cdot c}$$

(where b, c, and $d \neq 0$)

Example:

$$\frac{1}{5} \div \frac{3}{4} = \frac{1}{5} \times \frac{4}{3} = \frac{1 \times 4}{5 \times 3} = \frac{4}{15}$$

Write your questions about the topic in this space.

How do you divide a mixed number by a fraction?

On Your Own

Make notetaking organizers to help you study these topics.

1. multiplying fractions
2. multiplying mixed numbers
3. dividing mixed numbers

After you complete this chapter, make notetaking organizers for the following topics.

4. adding and subtracting decimals
5. multiplying decimals by whole numbers
6. multiplying decimals by decimals
7. dividing decimals by whole numbers
8. dividing decimals by decimals

Yeah, but now the knives, forks, and spoons are a mess.

"The **notetaking organizer** in my math class gave me an idea of how to organize my doggy biscuits."

Multiply. Write the answer in simplest form. *(Section 2.1)*

1. $\dfrac{3}{7} \times \dfrac{1}{4}$

2. $\dfrac{9}{10} \times \dfrac{2}{3}$

3. $1\dfrac{1}{6} \times \dfrac{2}{5}$

4. $3\dfrac{1}{2} \times 5\dfrac{7}{10}$

Divide. Write the answer in simplest form. *(Section 2.2 and Section 2.3)*

5. $\dfrac{1}{9} \div \dfrac{1}{3}$

6. $7 \div \dfrac{5}{8}$

7. $4\dfrac{7}{8} \div \dfrac{1}{8}$

8. $7\dfrac{2}{3} \div 1\dfrac{1}{9}$

Evaluate the expression. Write the answer in simplest form. *(Section 2.2 and Section 2.3)*

9. $6 \div \dfrac{2}{3} + \dfrac{1}{2}$

10. $\dfrac{7}{12} \div \dfrac{1}{4} \times \dfrac{9}{14}$

11. $3\dfrac{1}{3} \times 3\dfrac{3}{4} \div \dfrac{5}{6}$

12. $6\dfrac{2}{9} \div \left(4 \times 1\dfrac{1}{6}\right)$

13. MALL In a mall, $\dfrac{1}{15}$ of the stores sell shoes. There are 180 stores in the mall. How many of the stores sell shoes? *(Section 2.1)*

14. CONCERT FLOOR The floor of a concert venue is $100\dfrac{3}{4}$ feet by $75\dfrac{1}{2}$ feet. What is the area of the floor? *(Section 2.1)*

stage

floor $100\dfrac{3}{4}$ ft

$75\dfrac{1}{2}$ ft
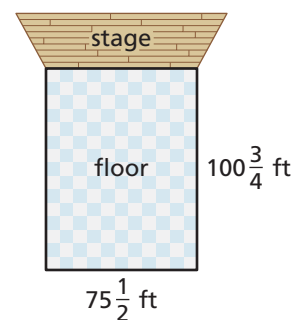
15. BAND Band members make $\dfrac{2}{3}$ of their profit from selling concert tickets. They make $\dfrac{1}{5}$ of their profit from selling band merchandise at the concerts. How many times more profit do they make from ticket sales than from merchandise sales? *(Section 2.2)*

16. SKATEBOARDS You are cutting as many $32\dfrac{1}{4}$-inch sections as you can out of the board to make skateboards. How many skateboards can you make? *(Section 2.3)*

129 in.

$32\dfrac{1}{4}$ in.
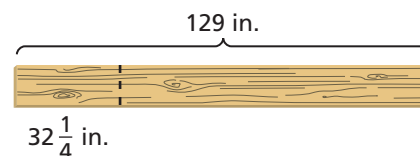
2.4 Adding and Subtracting Decimals

Essential Question How can you add and subtract decimals?

Base ten blocks can be used to model numbers.
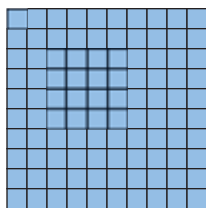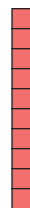
1 one   1 tenth   1 hundredth

1 ACTIVITY: Modeling a Sum

Work with a partner. Use base ten blocks to find the sum.

a. $1.23 + 0.87$

Which base ten blocks do you need to model the numbers in the sum? How many of each do you need?

$+$

1.23 $+$ 0.87

How many of each base ten block do you have when you combine the blocks?

⬜ ones   ⬜ tenths   ⬜ hundredths

How many of each base ten block do you have when you trade the blocks?

⬜ ones   ⬜ tenths   ⬜ hundredths

So, $1.23 + 0.87 = $ ⬜ .

b. $1.25 + 1.35$ **c.** $2.14 + 0.92$ **d.** $0.73 + 0.86$

2 ACTIVITY: Modeling a Difference

Work with a partner. Use base ten blocks to find the difference.

a. $2.43 - 0.73$

Which number is shown by the model? ⬜

Circle the portion of the model that represents 0.73.
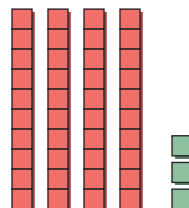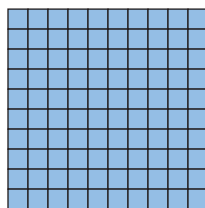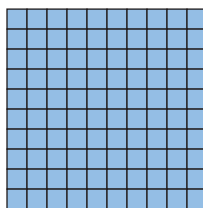
So, $2.43 - 0.73 = $ ⬜ .

b. $1.86 - 1.26$ **c.** $3.72 - 0.5$ **d.** $1.58 - 0.09$

3 ACTIVITY: Making a Conjecture

Work with a partner.

a. Find each sum or difference.

$123 + 87$	$125 + 135$	$214 + 92$	$73 + 86$
$243 - 73$	$186 - 126$	$372 - 50$	$158 - 9$

b. How are the numerical expressions in part (a) related to the numerical expressions in Activities 1 and 2? How are the sums and differences related?

c. **STRUCTURE** There is a relationship between adding and subtracting decimals and adding and subtracting whole numbers. What conjecture can you make about this relationship?

4 ACTIVITY: Using a Place Value Chart

Work with a partner. Use the place value chart to find the sum or difference.

Math Practice 3

Analyze Conjectures

How can the conjecture you wrote in Activity 3 help you to solve these problems?

Place Value Chart

millions | hundred thousands | ten thousands | thousands | hundreds | tens | ones | and | tenths | hundredths | thousandths | ten-thousandths | hundred-thousandths | millionths

a. $16.05 + 2.94$ **b.** $7.421 + 92.55$

c. $38.72 - 8.61$ **d.** $64.968 - 51.167$

What Is Your Answer?

5. **MODELING** Describe two real-life examples of when you would need to add and subtract decimals.

6. **IN YOUR OWN WORDS** How can you add and subtract decimals?

Practice Use what you learned about adding and subtracting decimals to complete Exercises 3–4 on page 82.

2.4 Lesson

🔑 Key Idea

Adding and Subtracting Decimals

To add or subtract decimals, write the numbers vertically and line up the decimal points. Then bring down the decimal point and add or subtract as you would with whole numbers.

EXAMPLE 1 — Adding Decimals

a. Add $8.13 + 2.76$.   **Estimate** $8.13 + 2.76 \approx 8 + 3 = 11$

Line up the decimal points.

$$
\begin{array}{r}
8.13 \\
+\ 2.76 \\
\hline
10.89
\end{array}
$$

Add as you would with whole numbers.

Reasonable? $10.89 \approx 11$ ✓

Study Tip

Be sure to add or subtract only digits that have the same place value.

b. Add $1.459 + 23.7$.

$$
\begin{array}{r}
\overset{1}{1}.459 \\
+\ 23.700 \\
\hline
25.159
\end{array}
$$

Insert zeros so that both numbers have the same number of decimal places.

EXAMPLE 2 — Subtracting Decimals

a. Subtract $5.508 - 3.174$.   **Estimate** $5.508 - 3.174 \approx 6 - 3 = 3$

Line up the decimal points.

$$
\begin{array}{r}
5.\overset{4\ 10}{\cancel{5}\cancel{0}}8 \\
-\ 3.1\,7\,4 \\
\hline
2.3\,3\,4
\end{array}
$$

Subtract as you would with whole numbers.

Reasonable? $2.334 \approx 3$ ✓

b. Subtract $21.9 - 1.605$.

$$
\begin{array}{r}
21.\overset{9}{\overset{8\ 10\ 10}{\cancel{9}\cancel{0}\cancel{0}}} \\
-\ 1.6\,0\,5 \\
\hline
20.2\,9\,5
\end{array}
$$

Insert zeros so that both numbers have the same number of decimal places.

🔴 On Your Own

Now You're Ready
Exercises 5–16

Add or subtract.

1. $4.206 + 10.85$ **2.** $15.5 + 8.229$ **3.** $78.41 + 90.99$

4. $6.34 - 5.33$ **5.** $27.9 - 0.905$ **6.** $18.626 - 13.88$

EXAMPLE **3** **Real-Life Application**

Your meal at the school cafeteria costs $3.45. Your friend's meal costs $3.90. You pay for both meals with a $10 bill. How much change do you receive?

Use a verbal model to solve the problem.

$$\underset{\text{change}}{\text{amount of}} = \underset{\text{given}}{\text{amount}} - \left(\underset{\text{your meal}}{\text{cost of}} + \underset{\text{friend's meal}}{\text{cost of}} \right)$$

$\qquad = 10.00 - (3.45 + 3.90)$ Substitute values.

$\qquad = 10.00 - 7.35$ Add inside parentheses.

$\qquad = 2.65$ Subtract.

So, you receive $2.65.

EXAMPLE 4 **Real-Life Application**

The Lincoln Memorial Reflecting Pool is approximately rectangular. Its width is 50.9 meters, and its length is 618.44 meters. You walk the perimeter of the pool. About how many meters do you walk?

Draw a diagram and label the dimensions.

50.9 m

Find the sum of the side lengths.

```
    1 1 2
  618.44
   50.90
  618.44
+  50.90
 1338.68
```

618.44 m   618.44 m

So, you walk about 1339 meters.

Not drawn to scale

50.9 m
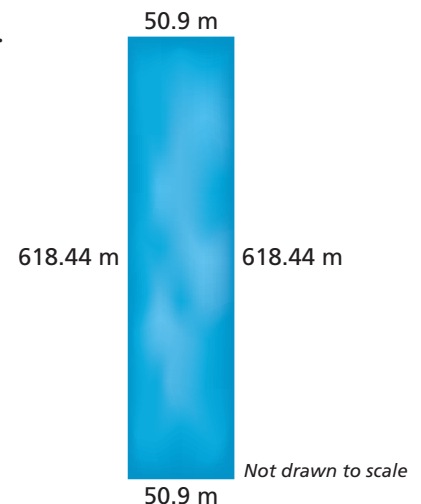
On Your Own

Now You're Ready
Exercises 21–26

7. WHAT IF? In Example 3, your meal costs $4.10 and your friend's meal costs $3.65. You pay for both meals with a $20 bill. How much change do you receive?

8. Find the perimeter of the triangle.

66.04 cm

60.96 cm

25.4 cm
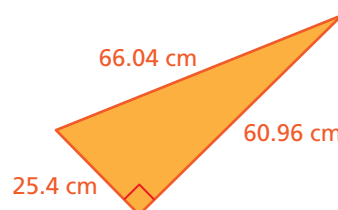
✓ Vocabulary and Concept Check

1. **CHOOSE TOOLS** Why is it helpful to estimate the answer before adding or subtracting decimals?

2. **WRITING** When adding or subtracting decimals, how can you be sure to add or subtract only digits that have the same place value?

Practice and Problem Solving

Write and evaluate the numerical expression modeled by the base ten blocks.

3.

4.

Add.
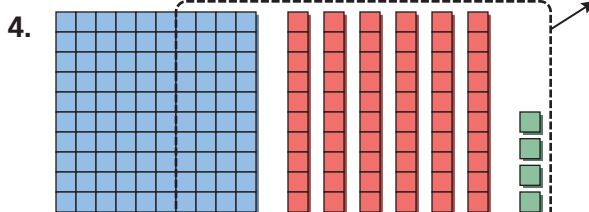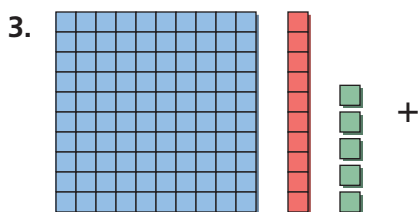
5. $7.82 + 3.209$

6. $3.7 + 2.774$

7. $12.829 + 10.07$

8. $20.35 + 13.748$

9. $17.440 + 12.497$

10. $15.255 + 19.058$

Subtract.

11. $4.58 - 3.12$

12. $8.629 - 5.309$

13. $6.98 - 2.614$

14. $15.131 - 11.57$

15. $13.5 - 10.856$

16. $25.82 - 22.936$

ERROR ANALYSIS Describe and correct the error in the solution.

17.
✗
$$
\begin{array}{r}
6.058 \\
+\ 3.95 \\
\hline
6.453
\end{array}
$$

18.
✗
$$
\begin{array}{r}
9.5 \\
-\ 7.18 \\
\hline
2.48
\end{array}
$$

Breakfast Specials

☙ Breakfast Menu ☙
7:30 A.M. to 11:00 A.M.

2 Eggs (any style)	2^{95}	Bacon & Eggs	3^{95}
Steak & Eggs	6^{25}	Cheese Omelet	3^{55}
Ham & Eggs	3^{95}	Ham Omelet	4^{35}
Sausage & Eggs	3^{95}	Ham & Cheese	
Salami & Eggs	3^{95}	Omelet	4^{95}

19. **BREAKFAST** You order the sausage and eggs breakfast, and your friend orders the ham omelet. How much is the bill before taxes and tip?

20. **HAM & CHEESE** How much more does the ham and cheese omelet cost than the cheese omelet?

Evaluate the expression.

③ **21.** $6.105 + 10.4 + 3.075$

22. $22.6 - 12.286 - 3.542$

23. $15.35 + 7.604 - 12.954$

24. $16.5 - 13.45 + 7.293$

25. $25.92 - 18.478 + 8.164$

26. $23.45 + 17.75 - 19.618$

27. STRUCTURE When is the sum of two decimals equal to a whole number? When is the difference of two decimals equal to a whole number?

28. OPEN-ENDED Write three decimals that have a sum of 27.905.

10.6 m   11.845 m

12.55 m
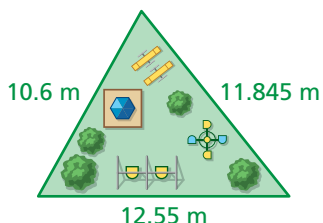
29. DAY CARE A day-care center is building a new outdoor play area. The diagram shows the dimensions in meters. How much fencing is needed to enclose the play area?

30. HOMEWORK You work 1.15 hours on English homework and 1.75 hours on math homework. Your science homework takes 1.05 hours less than your math homework. How many hours do you work on homework?

ASTRONOMY An astronomical unit (AU) is the average distance of Earth from the Sun. In Exercises 31–34, use the table that shows the average distance of each planet in our solar system from the Sun.

31. How much farther is Jupiter from the Sun than Mercury?

32. How much farther is Neptune from the Sun than Mars?

33. Estimate the greatest distance between Earth and Uranus.

34. Estimate the greatest distance between Venus and Saturn.

35. **Critical Thinking** The length of a rectangle is twice the width. The perimeter of the rectangle can be expressed as 3 • 13.7. What is the width?

Planet	Average Distance from the Sun (AU)
Mercury	0.387
Venus	0.723
Earth	1.000
Mars	1.524
Jupiter	5.203
Saturn	9.537
Uranus	19.189
Neptune	30.07

Fair Game Review What you learned in previous grades & lessons

Multiply. Write the answer in simplest form. *(Section 2.1)*

36. $\dfrac{7}{10} \times \dfrac{5}{7}$

37. $\dfrac{5}{6} \times \dfrac{3}{10}$

38. $\dfrac{3}{4} \times \dfrac{2}{9}$

39. $\dfrac{2}{5} \times \dfrac{1}{8}$

40. MULTIPLE CHOICE What is the LCM of 6, 12, and 18? *(Section 1.6)*

Ⓐ 6   **Ⓑ** 18   **Ⓒ** 36   **Ⓓ** 72

Essential Question How can you multiply decimals?

1 **ACTIVITY: Multiplying Decimals Using a Rectangle**

Work with a partner. Use a rectangle to find the product.

a. 2.7 • 1.3

Arrange base ten blocks to form a rectangle of length 2.7 units and width 1.3 units.

2.7

1.3
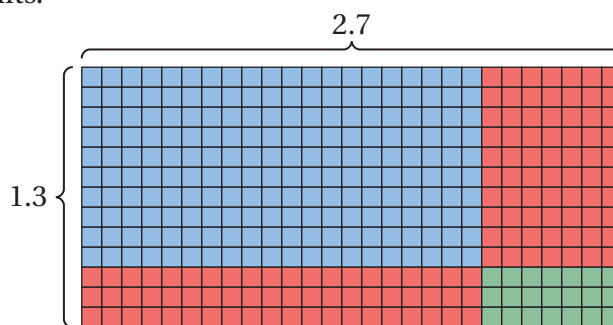
The area of the rectangle represents the product.

Find the total area represented by each grouping of base ten blocks.

Area = [   ] units²   Area = [   ] units²

Area = [   ] units²   Area = [   ] units²
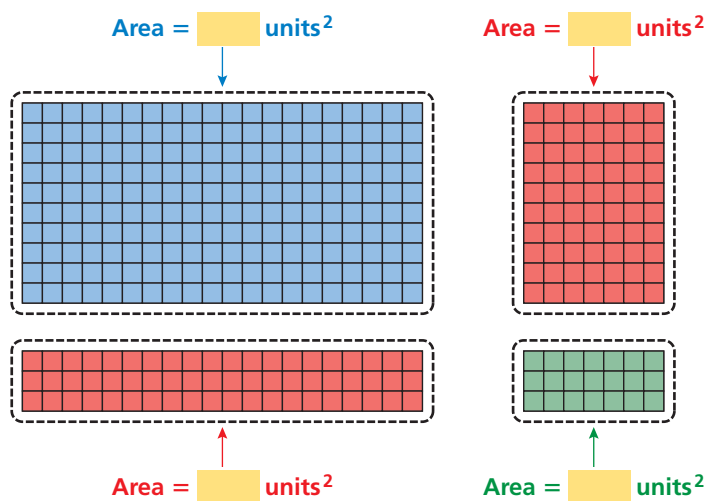
The area of the rectangle is:

[   ]
[   ]
[   ]
+ [   ]
─────
[   ] units²

So, 2.7 • 1.3 = [   ].

b. 1.8 • 1.1   **c.** 4.6 • 1.2   **d.** 3.2 • 2.4

COMMON CORE

Multiplying Decimals

In this lesson, you will
• use models to multiply decimals.
• multiply decimals.
Learning Standard
6.NS.3

2 ACTIVITY: Multiplying Decimals Using an Area Model

Work with a partner. Use an area model to find the product. Explain your reasoning.

a. $0.8 \cdot 0.5$

0.5

0.8

Math Practice 7

View as Components

How can you use an area model to find the product?
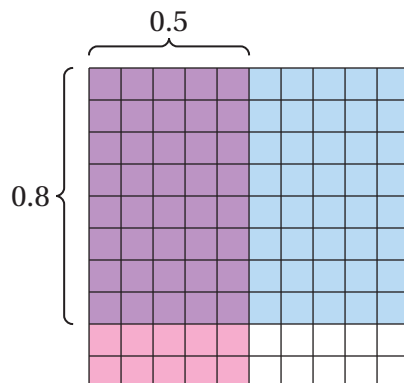
Because ▮ hundredths are shaded with both colors, the product is

$\dfrac{\rule{1cm}{0.4pt}}{100} = $ ▮ .

So, $0.8 \cdot 0.5 = $ ▮ .

b. $0.3 \cdot 0.5$ **c.** $0.7 \cdot 0.6$ **d.** $0.2 \cdot 0.9$

3 ACTIVITY: Making a Conjecture

Work with a partner.

a. Find each product.

$27 \cdot 13$	$18 \cdot 11$	$46 \cdot 12$	$32 \cdot 24$
$8 \cdot 5$	$3 \cdot 5$	$7 \cdot 6$	$2 \cdot 9$

b. How are the numerical expressions in part (a) related to the numerical expressions in Activities 1 and 2? How are the products related?

c. **STRUCTURE** What conjecture can you make about the relationship between multiplying decimals and multiplying whole numbers?

What Is Your Answer?

4. IN YOUR OWN WORDS How can you multiply decimals?

Practice

Use what you learned about multiplying decimals to complete Exercises 9–12 on page 89.

2.5 Lesson

🔑 Key Idea

Multiplying Decimals by Whole Numbers

Words Multiply as you would with whole numbers. Then count the number of decimal places in the decimal factor. The product has the same number of decimal places.

Numbers

$$13.\underline{91}$$
$$\times \quad 7 \qquad \rightarrow \text{2 decimal places}$$
$$97.\underline{37}$$

$$6.\underline{218}$$
$$\times \quad 4 \qquad \rightarrow \text{3 decimal places}$$
$$24.\underline{872}$$

EXAMPLE 1 — Multiplying Decimals and Whole Numbers

a. Find 6 × 3.91.

Estimate $6 \times 4 = 24$

$$\overset{5}{3.91} \leftarrow \boxed{\text{2 decimal places}}$$
$$\times \quad 6$$
$$23.46 \leftarrow \boxed{\text{Count 2 decimal places from right to left.}}$$

∴ So, $6 \times 3.91 = 23.46$.

Reasonable? $23.46 \approx 24$ ✓

b. Find 3 × 0.016.

Estimate $3 \times 0 = 0$

$$\overset{1}{0.016} \leftarrow \boxed{\text{3 decimal places}}$$
$$\times \quad 3$$
$$0.048 \leftarrow \boxed{\text{To have 3 decimal places, insert zeros to the left of 48.}}$$

∴ So, $3 \times 0.016 = 0.048$.

Reasonable? $0.048 \approx 0$ ✓

EXAMPLE 2 — Use Mental Math

How high is a stack of 100 dimes?

1.35 millimeters

Method 1: Multiply 1.35 by 100.

$$1.35$$
$$\times 1\,00$$
$$0\,00$$
$$00\,0 \qquad \boxed{\text{2 decimal places}}$$
$$\underline{135\quad}$$
$$135.00$$

Method 2: You are multiplying by a power of 10. Use mental math.

There are two zeros in 100. So, move the decimal point in 1.35 two places to the right.

$$1.35 \times 100 = 135. = 135$$

∴ So, a stack of 100 dimes is 135 millimeters high.

🔴 On Your Own

Now You're Ready
Exercises 13–24

Multiply. Use estimation to check your answer.

1. 12.3×8 **2.** 5×14.51 **3.** 0.88×9 **4.** 0.003×10

5. A quarter is 1.75 millimeters thick. How high is a stack of 1000 quarters? Solve using both methods.

The rule for multiplying two decimals is similar to the rule for multiplying a decimal by a whole number.

Key Idea

Multiplying Decimals by Decimals

Words Multiply as you would with whole numbers. Then add the number of decimal places in the factors. The sum is the number of decimal places in the product.

Numbers

$$
\begin{array}{rl}
4.716 & \leftarrow \quad 3 \text{ decimal places} \\
\times \quad 0.2 & \leftarrow \quad +\ 1 \text{ decimal place} \\
\hline
0.9432 & \leftarrow \quad 4 \text{ decimal places}
\end{array}
$$

EXAMPLE 3 Multiplying Decimals

a. Multiply 4.8 × 7.2.   **Estimate** $5 \times 7 = 35$

$$
\begin{array}{rl}
4.8 & \leftarrow \quad 1 \text{ decimal place} \\
\times\ 7.2 & \leftarrow \quad +\ 1 \text{ decimal place} \\
\hline
96 & \\
336 & \\
\hline
34.56 & \leftarrow \quad 2 \text{ decimal places}
\end{array}
$$

So, $4.8 \times 7.2 = 34.56$.   **Reasonable?** $34.56 \approx 35$ ✓

b. Multiply 3.1 × 0.05.   **Estimate** $3 \times 0 = 0$

$$
\begin{array}{rl}
3.1 & \leftarrow \quad 1 \text{ decimal place} \\
\times\ 0.05 & \leftarrow \quad +\ 2 \text{ decimal places} \\
\hline
0.155 & \leftarrow \quad 3 \text{ decimal places}
\end{array}
$$

So, $3.1 \times 0.05 = 0.155$.   **Reasonable?** $0.155 \approx 0$ ✓

On Your Own

Now You're Ready
Exercises 30–45

Multiply. Use estimation to check your answer.

6. 8.1×5.6 **7.** 2.7×9.04

8. 6.32×0.09 **9.** 1.785×0.2

EXAMPLE 4 **Evaluating an Expression**

What is the value of 2.44(4.5 − 3.175)?

(A) 3.233   (B) 3.599   (C) 7.805   (D) 32.33

Step 1: Subtract first because the minus sign is in parentheses.

$$
\begin{array}{r}
{\scriptstyle 9} \\
{\scriptstyle 4\ \cancel{10}10} \\
4.\cancel{5}\,\cancel{0}\,\cancel{0} \\
-\ 3.1\,7\,5 \\
\hline
1.3\,2\,5
\end{array}
$$

So, 2.44(4.5 − 3.175) = 2.44(1.325).

Step 2: Multiply the result from Step 1 by 2.44.

$$
\begin{array}{r}
1.3\,2\,5 \\
\times\ \ 2.4\,4 \\
\hline
5\,3\,0\,0 \\
5\,3\,0\,0 \\
2\,6\,5\,0 \\
\hline
3.2\,3\,3\,0\,0
\end{array}
$$

⁙ The correct answer is (A).

🔴 **On Your Own**

Evaluate the expression.

10. 12.67 + 8.2 • 1.9

11. 6.4(1.8 • 7.5)

EXAMPLE 5 **Real-Life Application**

You buy 2.75 pounds of tomatoes. You hand the cashier a $10 bill. How much change will you receive?

Tomatoes
$1.89/pound

Grapes
$1.99/pound

Bananas
$0.49/pound
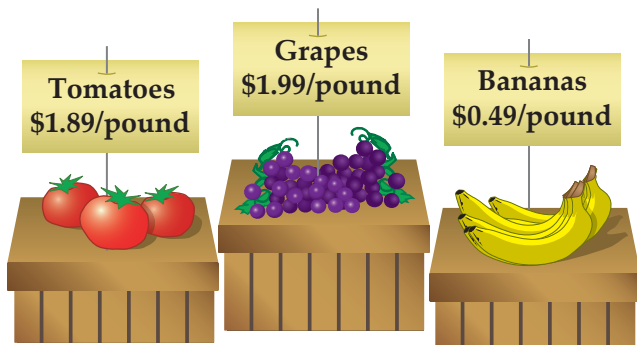
Step 1: Find the cost of the tomatoes. Multiply 1.89 by 2.75.

$$
\begin{array}{r}
1.8\,9 \\
\times\ 2.7\,5 \\
\hline
9\,4\,5 \\
1\,3\,2\,3 \\
3\,7\,8 \\
\hline
5.1\,9\,7\,5
\end{array}
$$

⟵ 2 decimal places
⟵ + 2 decimal places

⟵ 4 decimal places

The cost of 2.75 pounds of tomatoes is $5.20.

Step 2: Subtract the cost of the tomatoes from the amount of money you hand the cashier.

10.00 − 5.20 = $4.80

⁙ So, you will receive $4.80 in change.

🔴 **On Your Own**

12. **WHAT IF?** You buy 2.25 pounds of grapes. You hand the cashier a $5 bill. How much change will you receive?

✓ Vocabulary and Concept Check

1. **NUMBER SENSE** If you know $12 \times 24 = 288$, how can you find 1.2×2.4?

2. **NUMBER SENSE** Is the product 1.23×8 greater than or less than 8? Explain.

Copy the problem and place the decimal point in the product.

3.
$$
\begin{array}{r}
1.7\,8 \\
\times\ \ 4.9 \\
\hline
8\,7\,2\,2
\end{array}
$$

4.
$$
\begin{array}{r}
9.2\,4 \\
\times\ \ 0.6\,8 \\
\hline
6\,2\,8\,3\,2
\end{array}
$$

5.
$$
\begin{array}{r}
3.7\,5 \\
\times\ \ 5.2\,2 \\
\hline
1\,9\,5\,7\,5\,0
\end{array}
$$

How many decimal places are in the product?

6. 6.17×8.2

7. 1.684×10.2

8. 0.053×2.78
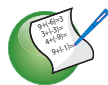
Practice and Problem Solving

Use base ten blocks or an area model to find the product.

9.
$$
\begin{array}{r}
2.1 \\
\times\ 1.5 \\
\hline
\end{array}
$$

10.
$$
\begin{array}{r}
0.6 \\
\times\ 0.4 \\
\hline
\end{array}
$$

11.
$$
\begin{array}{r}
0.7 \\
\times\ 0.3 \\
\hline
\end{array}
$$

12.
$$
\begin{array}{r}
2.7 \\
\times\ 2.3 \\
\hline
\end{array}
$$

Multiply. Use estimation to check your answer.

① ② 13.
$$
\begin{array}{r}
4.8 \\
\times\ \ 7 \\
\hline
\end{array}
$$

14.
$$
\begin{array}{r}
6.3 \\
\times\ \ 5 \\
\hline
\end{array}
$$

15.
$$
\begin{array}{r}
7.19 \\
\times\ \ 16 \\
\hline
\end{array}
$$

16.
$$
\begin{array}{r}
0.87 \\
\times\ \ 21 \\
\hline
\end{array}
$$

17.
$$
\begin{array}{r}
1.95 \\
\times\ \ 11 \\
\hline
\end{array}
$$

18.
$$
\begin{array}{r}
5.89 \\
\times\ \ 5 \\
\hline
\end{array}
$$

19.
$$
\begin{array}{r}
3.472 \\
\times\ \ \ 4 \\
\hline
\end{array}
$$

20.
$$
\begin{array}{r}
8.188 \\
\times\ \ \ 12 \\
\hline
\end{array}
$$

21. 100×0.024

22. 19×0.004

23. 0.0038×9

24. 10×0.0093

ERROR ANALYSIS Describe and correct the error in the solution.

25.
✗
$$
\begin{array}{r}
0.0045 \\
\times\ \ \ \ \ \ 9 \\
\hline
4.05
\end{array}
$$

26.
✗
$$
\begin{array}{r}
0.32 \\
\times\ \ \ \ 5 \\
\hline
0.160
\end{array}
$$

27. **MOON** The weight of an object on the Moon is about 0.167 of its weight on Earth. How much does a 180-pound astronaut weigh on the Moon?

28. **BAMBOO** A bamboo plant grows about 1.25 feet each day. Find the growth in one week.

29. **NAILS** A fingernail grows about 0.1 millimeter each day. How much does a fingernail grow in 30 days? 90 days?

Multiply.

③ **30.**
$$\begin{array}{r} 0.7 \\ \times\ 0.2 \\ \hline \end{array}$$
31.
$$\begin{array}{r} 0.08 \\ \times\ 0.3 \\ \hline \end{array}$$
32.
$$\begin{array}{r} 0.007 \\ \times\ 0.03 \\ \hline \end{array}$$
33.
$$\begin{array}{r} 0.0008 \\ \times\ 0.09 \\ \hline \end{array}$$

34.
$$\begin{array}{r} 0.004 \\ \times\ 0.9 \\ \hline \end{array}$$
35.
$$\begin{array}{r} 0.06 \\ \times\ 0.5 \\ \hline \end{array}$$
36.
$$\begin{array}{r} 0.0008 \\ \times\ 0.004 \\ \hline \end{array}$$
37.
$$\begin{array}{r} 0.0002 \\ \times\ 0.06 \\ \hline \end{array}$$

38. 12.4×0.2 **39.** 18.6×5.9 **40.** 7.91×0.72 **41.** 1.16×3.35

42. 6.478×18.21 **43.** 1.9×7.216 **44.** 0.0021×18.2 **45.** 6.109×8.4

46. ERROR ANALYSIS Describe and correct the error in the solution.

$$\times\ \begin{array}{r} 4.9 \\ 3.8 \\ \hline 186.2 \end{array}$$

47. TAKEOUT A Chinese restaurant offers buffet takeout for $4.99 per pound. How much does your takeout meal cost?

48. CROPLAND Alabama has about 2.51 million acres of cropland. Florida has about 1.15 times as much cropland as Alabama. How much cropland does Florida have?

49. GOLD On a tour of an old gold mine, you find a nugget containing 0.82 ounce of gold. Gold is worth $1566.80 per ounce. How much is your nugget worth?

50. BUILDING HEIGHTS One meter is approximately 3.28 feet. Find the height of each building in feet by multiplying its height in meters by 3.28.

Continent	Tallest Building	Height (meters)
Africa	Carlton Centre Office Tower	223
Asia	Burj Khalifa	828
Australia	Q1 Tower	323
Europe	The Shard	310
North America	Willis Tower	442
South America	Gran Torre	300

51. REASONING Show how to evaluate $7.12 \times 8.22 \times 100$ without multiplying the two decimals.

ORDER OF OPERATIONS Evaluate the expression.

④ **52.** $2.4 \times 16 + 7$ **53.** $6.85 \times 2 \times 10$ **54.** $1.047 \times 5 - 0.88$

55. $4.32(3.7 + 1.65)$ **56.** $23.98 - 1.7^2 \cdot 7.6$ **57.** $12 \cdot 5.16 + 10.064$

58. $0.9(8.2 \cdot 20.35)$ **59.** $7.5^2(6.084 - 5.44)$ **60.** $6.8 \cdot 2.18 \cdot 3.95$

61. REASONING Without multiplying, how many decimal places does 3.4^2 have? 3.4^3? 3.4^4? Explain your reasoning.

REPEATED REASONING **Describe the pattern. Find the next three numbers.**

62. 1, 0.6, 0.36, 0.216, . . .

63. 15, 1.5, 0.15, 0.015, . . .

64. 0.04, 0.02, 0.01, 0.005, . . .

65. 5, 7.5, 11.25, 16.875, . . .

66. **FOOD** You buy 2.6 pounds of apples and 1.475 pounds of peaches. You hand the cashier a $20 bill. How much change will you receive?

Apples
$1.23/pound

Peaches
$1.88/pound

67. **MILEAGE** A car can travel 22.36 miles on one gallon of gasoline.

   a. How far can the car travel on 8.5 gallons of gasoline?

   b. A hybrid car can travel 33.1 miles on one gallon of gasoline. How much farther can the hybrid car travel on 8.5 gallons of gasoline?

68. **OPEN-ENDED** You and four friends have dinner at a restaurant.

   a. Draw a restaurant menu that has main items, desserts, and beverages, with their prices.

   b. Write a guest check that shows what each of you ate. Find the subtotal.

   c. Multiply by 0.07 to find the tax. Then find the total.

   d. Round the total to the nearest whole number. Multiply by 0.20 to estimate a tip. Including the tip, how much did you spend?

GUEST CHECK

Check No.	Table No.	Order No.	Server Name
		240796	

Subtotal

Tax

Total

69. **Geometry** A rectangular painting has an area of 9.52 square feet.

   a. Draw three different ways in which this can happen.

   b. The cost of a frame depends on the perimeter of the painting. Which of your drawings from part (a) is the least expensive to frame? Explain your reasoning.

   c. The thin, black framing costs $1 per foot. The fancy framing costs $5 per foot. Will the fancy framing cost five times as much as the black framing? Explain why or why not.

   d. Suppose the cost of a frame depends on the outside perimeter of the frame. Does this change your answer to part (c)? Explain why or why not.

Fair Game Review What you learned in previous grades & lessons

Divide. *(Skills Review Handbook)*

70. 78 ÷ 3

71. 65 ÷ 13

72. 57 ÷ 19

73. 84 ÷ 12

74. **MULTIPLE CHOICE** How many edges does the rectangular prism at the right have? *(Skills Review Handbook)*

   (A) 4

   (B) 6

   (C) 8
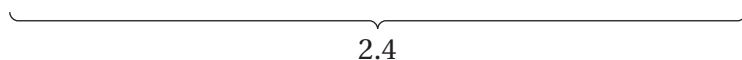
   (D) 12

Essential Question How can you use base ten blocks to model decimal division?

1 ACTIVITY: Dividing Decimals

Work with a partner. Use base ten blocks to model the division. Then find the quotient.

a. $2.4 \div 0.6$

Begin by modeling 2.4.

$$\underbrace{\hspace{6cm}}_{2.4}$$

How many of each base ten block did you use?

 ones

 tenths

 hundredths

Next, think of the division problem $2.4 \div 0.6$ as the question,

"How can you divide 2.4 into groups of 0.6?"

Rearrange the model for 2.4 into groups of 0.6. There are groups of 0.6.
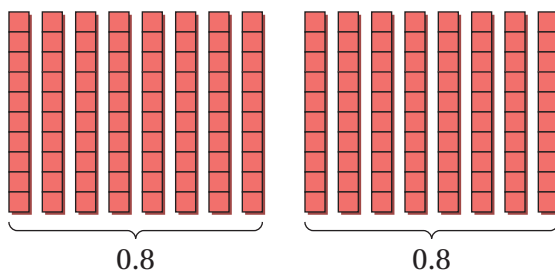
So, $2.4 \div 0.6 = $.

b. $1.8 \div 2$ **c.** $3.9 \div 3$ **d.** $2.8 \div 0.7$ **e.** $3.2 \div 0.4$

f. Write and solve the division problem represented by the model.

$$\underbrace{\hspace{4cm}}_{0.8} \quad \underbrace{\hspace{4cm}}_{0.8}$$

COMMON CORE

Dividing Decimals
In this lesson, you will
• use models to divide decimals.
• divide decimals.
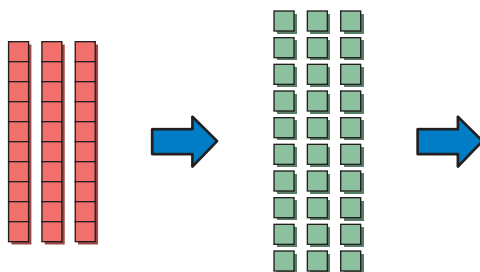Learning Standard
6.NS.3

ACTIVITY: Dividing Decimals

Work with a partner. Use base ten blocks to model the division. Then find the quotient.

a. $0.3 \div 0.06$

Model 0.3.　　　Replace tenths 　　　How many 0.06s are in 0.3?
　　　　　　　with hundredths.　　　　Divide hundredths
　　　　　　　　　　　　　　　　　into groups of 0.06.

There are ▭ groups of 0.06. So, $0.3 \div 0.06 = $ ▭.

b. $0.2 \div 0.04$ 　　　　　　　　**c.** $0.6 \div 0.01$

d. $0.16 \div 0.08$ 　　　　　　　**e.** $0.28 \div 0.07$

What Is Your Answer?

3. IN YOUR OWN WORDS How can you use base ten blocks to model decimal division? Use examples from Activity 1 and Activity 2 as part of your answer.

4. WRITING Newton's poem is about dividing fractions. Write a poem about dividing decimals.

"When you must divide a fraction, do this very simple action: Flip what you're dividing BY, and then it's easy—multiply!"

5. Think of your own cartoon about dividing decimals. Draw your cartoon.

Practice

Use what you learned about dividing decimals to complete Exercises 8–11 on page 97.

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Idea

Dividing Decimals by Whole Numbers

Words Place the decimal point in the quotient above the decimal point in the dividend. Then divide as you would with whole numbers. Continue until there is no remainder.

Numbers

$$4\overline{)7.32} \quad 1.83$$

Place the decimal point in the quotient above the decimal point in the dividend.

EXAMPLE 1 Dividing Decimals by Whole Numbers

a. Find 7.6 ÷ 4. **Estimate 8 ÷ 4 = 2**

$$
\begin{array}{r}
1.9 \\
4\overline{)7.6} \\
-4 \\
\hline
3\,6 \\
-3\,6 \\
\hline
0
\end{array}
$$

Place the decimal point in the quotient above the decimal point in the dividend.

So, 7.6 ÷ 4 = 1.9. **Reasonable? 1.9 ≈ 2** ✓

b. Find 4.38 ÷ 12.

$$
\begin{array}{r}
0.365 \\
12\overline{)4.380} \\
-3\,6 \\
\hline
78 \\
-72 \\
\hline
60 \\
-60 \\
\hline
0
\end{array}
$$

Place the decimal point in the quotient above the decimal point in the dividend.

Insert a zero and continue to divide.

So, 4.38 ÷ 12 = 0.365. **Check 0.365 × 12 = 4.38** ✓

On Your Own

Now You're Ready
Exercises 12–23

Divide. Use estimation to check your answer.

1. 36.4 ÷ 2   **2.** 22.2 ÷ 6   **3.** 59.64 ÷ 7
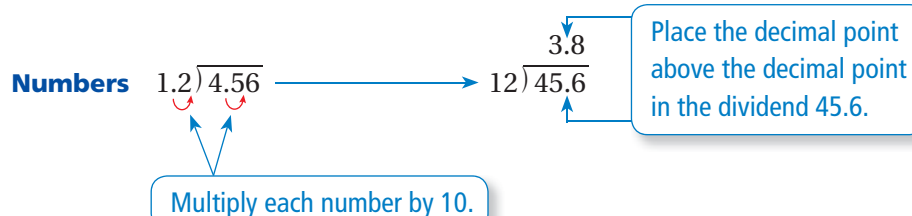
4. 43.26 ÷ 14   **5.** 6.2 ÷ 4   **6.** 3.12 ÷ 16

🔑 Key Idea

Dividing Decimals by Decimals

Words Multiply the divisor *and* the dividend by a power of 10 to make the divisor a whole number. Then place the decimal point in the quotient and divide as you would with whole numbers. Continue until there is no remainder.

Numbers $1.2\overline{)4.56}$ ⟶ $12\overline{)45.6}$ with quotient 3.8

Multiply each number by 10.

> Place the decimal point above the decimal point in the dividend 45.6.

EXAMPLE 2 Dividing Decimals

a. Find 18.2 ÷ 1.4.

$1.4\overline{)18.2}$ ⟶ $14\overline{)182.}$

$$\begin{array}{r} 13. \\ 14\overline{)182.} \\ -14 \\ \hline 42 \\ -42 \\ \hline 0 \end{array}$$

Multiply each number by 10.

> Place the decimal point above the decimal point in the dividend 182.

∴ So, 18.2 ÷ 1.4 = 13.   **Check 13 × 1.4 = 18.2** ✓

b. Find 0.273 ÷ 0.39.

$0.39\overline{)0.273}$ ⟶ $39\overline{)27.3}$

$$\begin{array}{r} 0.7 \\ 39\overline{)27.3} \\ -27.3 \\ \hline 0 \end{array}$$

Multiply each number by 100.

∴ So, 0.273 ÷ 0.39 = 0.7.   **Check 0.7 × 0.39 = 0.273** ✓

🔴 On Your Own

Now You're Ready
Exercises 36–39

Divide. Check your answer.

7. $1.2\overline{)9.6}$ **8.** $3.4\overline{)57.8}$

9. $21.643 \div 2.3$ **10.** $0.459 \div 0.51$

EXAMPLE 3 **Inserting Zeros in the Dividend and the Quotient**

Divide 2.45 ÷ 0.007.

Study Tip

Remember to check your answer by multiplying the quotient by the divisor.

$$0.007\overline{)2.450}$$

Multiply each number by 1000. Insert a zero in the dividend.

$$
\begin{array}{r}
35\mathbf{0} \\
7\overline{)2450} \\
-21 \\
\hline
35 \\
-35 \\
\hline
0\mathbf{0}
\end{array}
$$

Because 0 ÷ 7 = 0, insert a zero in the quotient.

So, 2.45 ÷ 0.007 = 350.

On Your Own

Now You're Ready
Exercises 40–43

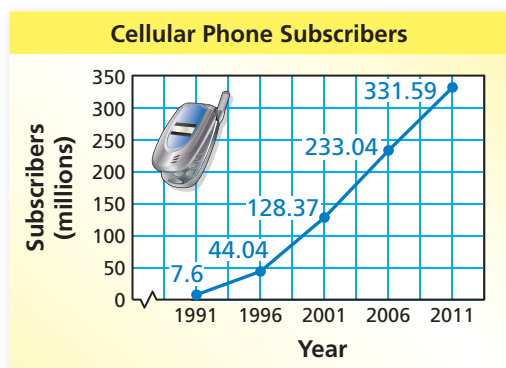**Divide. Check your answer.**

11. 3.8 ÷ 0.16

12. 15.6 ÷ 0.78

13. 7.2 ÷ 0.048

14. 0.18 ÷ 0.003

EXAMPLE 4 **Real-Life Application**

How many times more cellular phone subscribers were there in 2011 than in 1991? Round to the nearest whole number.

Cellular Phone Subscribers

From the graph, there were 331.59 million subscribers in 2011 and 7.6 million in 1991. So, divide 331.59 by 7.6.

Estimate 320 ÷ 8 = 40

$$7.6\overline{)331.59}$$

$$
\begin{array}{r}
43.6 \\
76\overline{)3315.9} \\
-304 \\
\hline
275 \\
-228 \\
\hline
47\ 9 \\
-45\ 6 \\
\hline
2\ 3
\end{array}
$$

Rounds to 44.

So, there were about 44 times more subscribers in 2011 than in 1991.

Reasonable? 44 ≈ 40 ✓

On Your Own

15. How many times more subscribers were there in 2006 than in 1996? Round to the nearest whole number.

✓ Vocabulary and Concept Check

1. **NUMBER SENSE** Fix the one that is not correct.

$$4\overline{)24.4} = 6.1 \qquad 4\overline{)244} = 61 \qquad 4\overline{)2.44} = 6.1$$

Copy the problem and place the decimal point in the correct location.

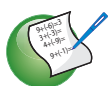2. $18.6 \div 4 = 465$

3. $6.38 \div 11 = 58$

4. $88.27 \div 7 = 1261$

Rewrite the problem so that the divisor is a whole number.

5. $4.7\overline{)13.6}$

6. $0.21\overline{)17.66}$

7. $2.16\overline{)18.5}$

✎ Practice and Problem Solving

Use base ten blocks to find the quotient.

8. $3.6 \div 0.3$

9. $2.6 \div 0.2$

10. $0.72 \div 0.06$

11. $0.36 \div 0.04$

Divide. Use estimation to check your answer.

① 12. $6\overline{)25.2}$

13. $5\overline{)33.5}$

14. $7\overline{)3.5}$

15. $8\overline{)10.4}$

16. $38.7 \div 9$

17. $37.6 \div 4$

18. $43.4 \div 7$

19. $25.6 \div 8$

20. $44.64 \div 8$

21. $0.294 \div 3$

22. $3.6 \div 24$

23. $64.26 \div 18$

ERROR ANALYSIS Describe and correct the error in finding the quotient.

24.

✗
$$
\begin{array}{r}
3.922 \\
9\overline{)28.008} \\
27 \\
\hline
1\,00 \\
81 \\
\hline
198 \\
198 \\
\hline
0
\end{array}
$$

25.

✗
$$
\begin{array}{r}
0.86 \\
6\overline{)0.516} \\
48 \\
\hline
36 \\
36 \\
\hline
0
\end{array}
$$

26. **TEXT MESSAGING** You send 40 text messages in one month. The total cost is $4.80. How much does each text message cost?

27. **SUNBLOCK** Of the two bottles of sunblock shown, which is the better buy? Explain.

4-ounce bottle $8.49

5-ounce bottle $10.29

ORDER OF OPERATIONS Evaluate the expression.

28. $7.68 + 3.18 \div 12$

29. $10.56 \div 3 - 1.9$

30. $19.6 \div 7 \times 9$

31. $5.5 \times 16.56 \div 9$

32. $35.25 \div 5 \div 3$

33. $13.41 \times (5.4 \div 9)$

Fruit Punch
Sale Price

4-pack	$2.95
12-pack	$8.65
24-pack	$17.50

34. FRUIT PUNCH Which pack of fruit punch is the best buy? Explain.

35. SALE You buy 3 pairs of jeans for $35.95 each and get a fourth pair for free. What is your cost per pair of jeans?

Divide. Check your answer.

36. $2.1\overline{)25.2}$

37. $3.8\overline{)34.2}$

38. $36.47 \div 0.7$

39. $0.984 \div 12.3$

40. $4.23 \div 0.012$

41. $0.52 \div 0.0013$

42. $95.04 \div 0.0132$

43. $32.2 \div 0.07$

Divide. Round to the nearest hundredth if necessary.

44. $80.88 \div 8.425$

45. $0.8 \div 0.6$

46. $38.9 \div 6.44$

47. $11.6 \div 0.95$

48. ERROR ANALYSIS Describe and correct the error in rewriting the problem.

✗ $0.32\overline{)146.4} \longrightarrow 32\overline{)1.464}$

49. TICKETS Tickets to the school musical cost $6.25. The amount received from ticket sales is $706.25. How many tickets were sold?

50. HEIGHT A person's running stride is about 1.14 times the person's height. Your friend's stride is 5.472 feet. How tall is your friend?

51. MP3 PLAYER You have 3.4 gigabytes available on your MP3 player. Each song is about 0.004 gigabyte. How many more songs can you download onto your MP3 player?

52. SWIMMING The table shows the top three times in a swimming event at the Summer Olympics. The event consists of a team of four women swimming 100 meters each.

Women's 4 × 100 Freestyle Relay		
Medal	**Country**	**Time (seconds)**
Gold	Australia	215.94
Silver	United States	216.39
Bronze	Netherlands	217.59

a. Suppose the times of all four swimmers on each team were the same. For each team, how much time does it take a swimmer to swim 100 meters?

b. Suppose each U.S. swimmer completed 100 meters a quarter second faster. Would the U.S. team have won the gold medal? Explain your reasoning.

Without finding the quotient, copy and complete the statement using <, >, or =.

53. $6.66 \div 0.74$ [ ] $66.6 \div 7.4$

54. $32.2 \div 0.7$ [ ] $3.22 \div 7$

55. $160.72 \div 16.4$ [ ] $160.72 \div 1.64$

56. $75.6 \div 63$ [ ] $7.56 \div 0.63$

57. BEES To approximate the number of bees in a hive, multiply the number of bees that leave the hive in one minute by 3 and divide by 0.014. You count 25 bees leaving a hive in one minute. How many bees are in the hive?

58. PROBLEM SOLVING You are saving money to buy a new bicycle that costs $155.75. You have $30 and plan to save $5 each week. Your aunt decides to give you an additional $10 each week.

    a. How many weeks will you have to save until you have enough money to buy the bicycle?

    b. How many more weeks would you have to save to buy a new bicycle that costs $203.89? Explain how you found your answer.

Applesauce

|	
3.9-ounce bowl	$0.52
24-ounce jar	$2.63

59. PRECISION A store sells applesauce in two sizes.

    a. How many *bowls* of applesauce fit in a *jar*? Round your answer to the nearest hundredth.

    b. Explain two ways to find the better buy.

    c. What is the better buy?

60. Geometry The large rectangle's dimensions are three times the dimensions of the small rectangle.

    a. How many times greater is the perimeter of the large rectangle compared to the perimeter of the small rectangle?

    b. How many times greater is the area of the large rectangle compared to the area of the small rectangle?

    c. Are the answers to parts (a) and (b) the same? *Explain* why or why not.

    d. What happens in parts (a) and (b) if the dimensions of the large rectangle are two times the dimensions of the small rectangle?

23.1 ft
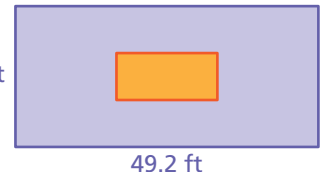
49.2 ft

Fair Game Review What you learned in previous grades & lessons

Add or subtract. Write your answer in simplest form. *(Section 1.6)*

61. $\dfrac{1}{2} + \dfrac{2}{3}$

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

63. $\dfrac{3}{10} - \dfrac{1}{4}$

64. $\dfrac{11}{12} - \dfrac{7}{8}$

65. MULTIPLE CHOICE Melissa earns $7.40 an hour working at a grocery store. She works 14.25 hours this week. How much does she earn? *(Section 2.5)*

    (A) $83.13   **(B)** $105.45   **(C)** $156.75   **(D)** $1054.50

Check It Out
Progress Check
BigIdeasMath.com

Add or subtract. *(Section 2.4)*

1. $6.329 + 14.38$

2. $43.56 + 41.82$

3. $85.8 - 2.354$

4. $26.782 - 14.96$

Multiply. Use estimation to check your answer. *(Section 2.5)*

5. $\begin{array}{r} 7.6 \\ \times\ \ 5 \\ \hline \end{array}$

6. $\begin{array}{r} 0.62 \\ \times\ \ 17 \\ \hline \end{array}$

7. $\begin{array}{r} 0.54 \\ \times\ 0.9 \\ \hline \end{array}$

8. $\begin{array}{r} 4.16 \\ \times\ 0.7 \\ \hline \end{array}$

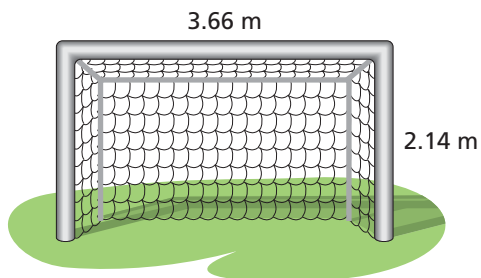**Divide. Use estimation to check your answer.** *(Section 2.6)*

9. $5\overline{)8.4}$

10. $6\overline{)6.48}$

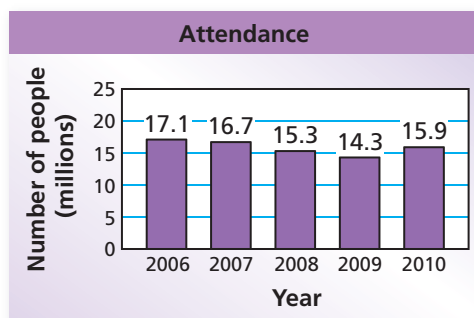11. $5.6 \div 0.7$

12. $1.8 \div 0.03$

13. **FIELD HOCKEY** A field hockey field is rectangular. Its width is 54.88 meters, and its length is 91.46 meters. Find the perimeter of the field. *(Section 2.4)*

3.66 m

2.14 m

14. **GEOMETRY** Find the area of the mouth of the field hockey goal. *(Section 2.5)*

15. **BROADWAY** The bar graph shows the yearly attendance at traveling Broadway shows. *(Section 2.6)*

   a. Suppose the attendance was the same each month in 2008. How many people attended each month?

   b. How many times more people attended shows in 2006 than in 2009? Round your answer to the nearest tenth.

Attendance

Number of people (millions)

17.1   16.7   15.3   14.3   15.9

2006   2007   2008   2009   2010

Year

Review Key Vocabulary

reciprocals, *p. 64*

Review Examples and Exercises

2.1 **Multiplying Fractions**   *(pp. 54–61)*

a. Find $\dfrac{1}{4} \times \dfrac{3}{5}$.

$\dfrac{1}{4} \times \dfrac{3}{5} = \dfrac{1 \times 3}{4 \times 5} = \dfrac{3}{20}$ Multiply the numerators and the denominators.

b. Find $\dfrac{3}{5} \times 1\dfrac{1}{8}$.

$\dfrac{3}{5} \times 1\dfrac{1}{8} = \dfrac{3}{5} \times \dfrac{9}{8}$ Write $1\dfrac{1}{8}$ as the improper fraction $\dfrac{9}{8}$.

$\quad = \dfrac{3 \times 9}{5 \times 8} = \dfrac{27}{40}$ Multiply the numerators and the denominators.

Exercises

Multiply. Write the answer in simplest form.

1. $\dfrac{1}{8} \times \dfrac{5}{7}$ **2.** $\dfrac{3}{5} \times \dfrac{1}{2}$ **3.** $\dfrac{2}{9} \times \dfrac{3}{4}$ **4.** $\dfrac{3}{10} \times \dfrac{4}{5}$

5. $2\dfrac{2}{3} \times \dfrac{4}{5}$ **6.** $\dfrac{2}{7} \times 4\dfrac{4}{9}$ **7.** $1\dfrac{5}{6} \times 2\dfrac{3}{8}$ **8.** $2\dfrac{3}{10} \times 5\dfrac{1}{3}$

2.2 **Dividing Fractions**   *(pp. 62–69)*

Find $\dfrac{3}{7} \div \dfrac{5}{8}$.

$\dfrac{3}{7} \div \dfrac{5}{8} = \dfrac{3}{7} \times \dfrac{8}{5}$ Multiply by the reciprocal of $\dfrac{5}{8}$, which is $\dfrac{8}{5}$.

$\quad = \dfrac{3 \times 8}{7 \times 5} = \dfrac{24}{35}$ Multiply fractions and simplify.

Exercises

Divide. Write the answer in simplest form.

9. $\dfrac{1}{9} \div \dfrac{2}{5}$ **10.** $\dfrac{3}{4} \div \dfrac{5}{6}$ **11.** $5 \div \dfrac{1}{3}$ **12.** $\dfrac{8}{9} \div \dfrac{3}{10}$

Dividing Mixed Numbers *(pp. 70–75)*

Find $3\dfrac{3}{4} \div 1\dfrac{1}{2}$.

$3\dfrac{3}{4} \div 1\dfrac{1}{2} = \dfrac{15}{4} \div \dfrac{3}{2}$ Write each mixed number as an improper fraction.

$= \dfrac{15}{4} \times \dfrac{2}{3}$ Multiply by the reciprocal of $\dfrac{3}{2}$, which is $\dfrac{2}{3}$.

$= \dfrac{\overset{5}{\cancel{15}} \times \overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}} \times \underset{1}{\cancel{3}}}$ Multiply fractions. Divide out common factors.

$= \dfrac{5}{2}$, or $2\dfrac{1}{2}$ Simplify.

Exercises

Divide. Write the answer in simplest form.

13. $1\dfrac{2}{5} \div \dfrac{4}{7}$ **14.** $2\dfrac{3}{8} \div \dfrac{3}{5}$ **15.** $4\dfrac{1}{8} \div 2\dfrac{1}{4}$ **16.** $5\dfrac{5}{8} \div 1\dfrac{2}{9}$

17. PANCAKES A box contains 10 cups of pancake mix. You use $\dfrac{2}{3}$ cup each time you make pancakes. How many times can you make pancakes?

Adding and Subtracting Decimals *(pp. 78–83)*

a. Add 7.36 + 2.22.

> Line up the decimal points.

$\begin{array}{r} 7.36 \\ +\ 2.22 \\ \hline 9.58 \end{array}$ Add as you would with whole numbers.

b. Subtract 5.467 − 2.736.

> Line up the decimal points.

$\begin{array}{r} {}^{4}\cancel{5}.{}^{14}467 \\ -\ 2.736 \\ \hline 2.731 \end{array}$ Subtract as you would with whole numbers.

Exercises

Add or subtract.

18. $3.78 + 8.94$ **19.** $19.89 + 4.372$

20. $7.638 - 2.365$ **21.** $14.21 - 4.103$

2.5 Multiplying Decimals *(pp. 84–91)*

Find 7.5 × 5.3.

$$
\begin{array}{r}
7.5 \quad \longleftarrow \quad \text{1 decimal place} \\
\underline{\times\ 5.3} \quad \longleftarrow \quad \underline{+\ \text{1 decimal place}} \\
2\,2\,5 \\
\underline{+\ 3\,7\,5\ } \\
3\,9.7\,5 \quad \longleftarrow \quad \text{2 decimal places}
\end{array}
$$

So, $7.5 \times 5.3 = 39.75$.

Exercises

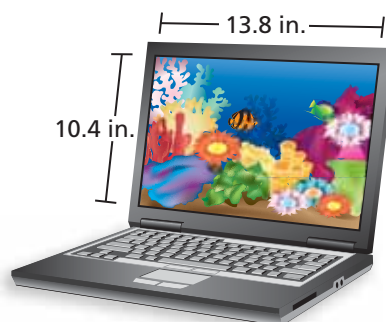**Multiply. Use estimation to check your answer.**

22. 5.3×8

23. 6.1×7

24. 4.68×3

25. 9.475×8.03

26. 0.27×4.42

27. 0.051×0.244

28. AREA Find the area of the computer screen.

13.8 in.

10.4 in.

2.6 Dividing Decimals *(pp. 92–99)*

Find 22.8 ÷ 1.2.

Place the decimal point above the decimal point in the dividend 228.

Multiply 1.2 by 10.

$1.2\overline{)22.8}$

Multiply 22.8 by 10.

$$
\begin{array}{r}
19. \\
12\overline{)228.} \\
\underline{-\ 12} \\
108 \\
\underline{-\ 108} \\
0
\end{array}
$$

So, $22.8 \div 1.2 = 19$.

Exercises

Divide. Use estimation to check your answer.

29. $6.8 \div 4$

30. $13.2 \div 6 + 4$

31. $49.7 \div 7$

32. $0.12\overline{)3.6}$

33. $2.5\overline{)0.125}$

34. $3.9\overline{)22.23}$

Multiply. Write the answer in simplest form.

1. $\dfrac{9}{16} \times \dfrac{2}{3}$

2. $\dfrac{1}{10} \times \dfrac{5}{6}$

3. $1\dfrac{3}{7} \times 6\dfrac{7}{10}$

Divide. Write the answer in simplest form.

4. $\dfrac{1}{6} \div \dfrac{1}{3}$

5. $10 \div \dfrac{2}{5}$

6. $8\dfrac{3}{4} \div 2\dfrac{7}{8}$

Add or subtract.

7. $4.92 + 3.79$

8. $5.138 + 2.624$

9. $5.316 - 1.942$

Multiply. Use estimation to check your answer.

10. 6.7×8

11. 0.4×0.7

12. 4.87×7.23

Divide. Use estimation to check your answer.

13. $5.6 \div 7$

14. $2.6 \div 0.02$

15. $4\overline{)9.32}$

16. $0.25\overline{)5.46}$

17. **DVD SALE** Which deal is the better buy?

2 for $24.99

5 for $58.99

18. **BLOG** You spend $2\dfrac{1}{2}$ hours online. You spend $\dfrac{1}{5}$ of that time writing a blog. How long do you spend writing your blog?

19. **GRAPES** A grocery store sells grapes for $1.99 per pound. You buy 2.34 pounds of the grapes. How much do you pay?

20. **PHOTOGRAPHY** A motocross rider is in the air for 2.5 seconds. Your camera can take a picture every 0.125 second. Your friend's camera can take a picture every 0.15 second.

   a. How many times faster is your camera than your friend's camera?

   b. How many more pictures can you take while the rider is in the air?

1. At a party, 10 people equally shared $2\frac{1}{2}$ gallons of ice cream. How much ice cream did each person eat? *(6.NS.1)*

   A. $\frac{1}{5}$ gal
   C. $\frac{2}{5}$ gal

   B. $\frac{1}{4}$ gal
   D. $\frac{3}{4}$ gal

2. What is the value of the expression below? *(6.NS.3)*

   $$4.643 + 11.02 \div 2.32$$

3. Which number is equivalent to the expression below? *(6.EE.1)*

   $$2 \cdot 4^2 + 3(6 \div 2)$$

   F. 25
   H. 73

   G. 41
   I. 105

4. Your friend divided two decimal numbers. Her work is shown in the box below. What should your friend change in order to divide the two decimal numbers correctly? *(6.NS.3)*

   $$0.07\overline{)14.56} \rightarrow 7\overline{)14.56}^{\,2.08}$$

   A. Rewrite the problem as $0.07\overline{)0.1456}$.
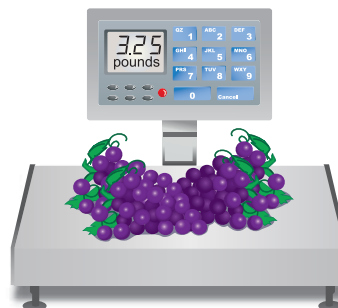   C. Rewrite the problem as $7\overline{)0.1456}$.

   B. Rewrite the problem as $0.07\overline{)1456}$.
   D. Rewrite the problem as $7\overline{)1456}$.

5. You bought some grapes at a farm stand. You paid $2.48 per pound.

   What was the total amount that you paid for the grapes? *(6.NS.3)*

   3.25 pounds

Test-Taking Strategy
Estimate the Answer

$5\frac{1}{2}$ treats are divided evenly between you and Fluffy. How many do you get?

Ⓐ $1\frac{1}{2}$ Ⓑ $2\frac{3}{4}$ Ⓒ $5\frac{1}{2}$ Ⓓ 11

Fluffy: 1/2
Me: Five

"Using **estimation** you can see that the answer is about 3. So, you should choose B."

6. The steps your friend took to divide two mixed numbers are shown below.

$$4\frac{2}{3} \div 2\frac{1}{4} = \frac{14}{3} \times \frac{9}{4}$$
$$= \frac{21}{2}$$
$$= 10\frac{1}{2}$$

What should your friend change in order to divide the two mixed numbers correctly? *(6.NS.1)*

F. Find a common denominator of 3 and 4.

G. Multiply by the reciprocal of $\frac{14}{3}$.

H. Multiply by the reciprocal of $\frac{9}{4}$.

I. Rename $4\frac{2}{3}$ as $3\frac{5}{3}$.

7. Which pair of numbers does *not* have a least common multiple less than 100? *(6.NS.4)*

A. 10, 15   **C.** 16, 18

B. 12, 16   **D.** 18, 24

8. You are making identical snack bags. You have 18 fruit-chew snacks and 24 granola snacks. What is the greatest number of snack bags that you can make with no snacks left over? *(6.NS.4)*

F. 1   **H.** 3

G. 2   **I.** 6

9. Which expression is *not* equivalent to $\frac{2}{3}$? *(6.NS.1)*

A. $\frac{1}{4} + \frac{1}{3} \div \frac{4}{5}$ **C.** $\frac{5}{6} - \frac{1}{8} \div \frac{1}{2}$

B. $\frac{13}{30} + \frac{1}{5} \div \frac{6}{7}$ **D.** $\frac{13}{18} - \frac{1}{26} \div \frac{9}{13}$

10. Which number is equivalent to $5.139 - 2.64$? *(6.NS.3)*

    F. 2.499   **H.** 3.519

    G. 2.599   **I.** 3.599

11. Which expression is equivalent to $\dfrac{4}{9} \div \dfrac{5}{7}$? *(6.NS.1)*

    A. $\dfrac{20}{63}$ **C.** $\dfrac{45}{28}$

    B. $\dfrac{28}{45}$ **D.** $\dfrac{63}{20}$

12. Which of the following expressions is equivalent to a perfect square? *(6.EE.1)*

    F. $3 + 2^2 \times 7$ **H.** $(80 + 4) \div 4$

    G. $34 + 18 \div 3^2$ **I.** $3^2 + 6 \times 5 \div 3$

13. You are filling baskets using 18 green eggs, 36 red eggs, and 54 blue eggs. What is the greatest number of baskets that you can fill so that the baskets are identical and there are no eggs left over? *(6.NS.4)*
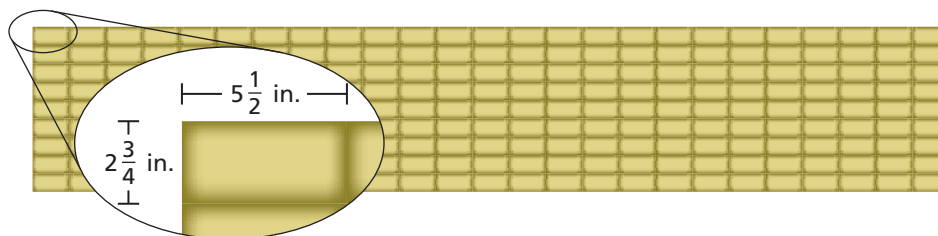
    A. 3   **C.** 9

    B. 6   **D.** 18

14. A walkway was built using identical concrete blocks. *(6.NS.1)*

Think Solve Explain

$5\frac{1}{2}$ in.

$2\frac{3}{4}$ in.

    Part A   How much longer, in inches, is the length of the walkway than the width of the walkway? Show your work and explain your reasoning.

    Part B   How many times longer is the length of the walkway than the width of the walkway? Show your work and explain your reasoning.