

2.1 Exercises


Vocabulary and Concept Check

- WRITING** Explain how to multiply two fractions.
- REASONING** Name the missing denominator.

$$\frac{3}{7} \times \frac{1}{\square} = \frac{3}{28}$$

- 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. $\frac{7}{9} \times \frac{21}{10}$ |

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

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



- 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?



- 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.

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

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

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

Multiply. Write the answer in simplest form.

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.

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

43.

X $2\frac{1}{2} \times 7\frac{4}{5} = (2 \times 7) + (1\frac{1}{2} \times \frac{4}{5})$
 $= 14 + \frac{2}{5} = 14\frac{2}{5}$

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?



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. $(\frac{3}{5})^3$ 51. $(\frac{4}{5})^2 \times (\frac{3}{4})^2$ 52. $(\frac{5}{6})^2 \times (1\frac{1}{10})^2$

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

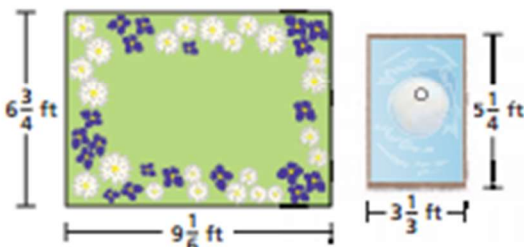


54. **OPEN-ENDED** Find a fraction that, when multiplied by $\frac{1}{2}$, is less than $\frac{1}{4}$.

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.
- Draw a diagram of the fountain in the garden. Label the dimensions.
 - Describe two methods for finding the area of the garden that surrounds the fountain.
 - 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.
- How long should you cook a ham that weighs $12\frac{3}{4}$ pounds?
 - 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.
- What fraction of the people own a dog and a cat?
 - 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)

(A) $\frac{1}{4}$ cup

(B) $\frac{5}{12}$ cup

(C) $\frac{4}{7}$ cup

(D) $1\frac{1}{12}$ cups

2.2 Lesson

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

Write the reciprocal of the number.

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

2. 5

3. $\frac{7}{2}$

4. $\frac{4}{9}$

Now You're Ready
Exercises 7–10

Key Idea

Dividing Fractions

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

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

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

EXAMPLE 2 Dividing a Fraction by a FractionFind $\frac{1}{6} \div \frac{2}{3}$.

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

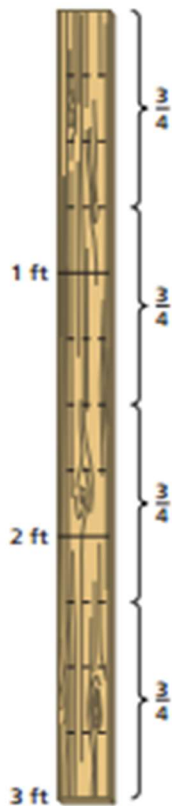
Multiply by the reciprocal of $\frac{2}{3}$, which is $\frac{3}{2}$.

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

Multiply fractions. Divide out the common factor 3.

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

Simplify.

EXAMPLE 3 Dividing a Whole Number by a FractionA piece of wood is 3 feet long. How many $\frac{3}{4}$ -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 $\frac{3}{4}$ -foot sections.Count the number of $\frac{3}{4}$ -foot pieces of wood. There are four.∴ So, you can cut four $\frac{3}{4}$ -foot pieces from the piece of wood.**Method 2:** Divide 3 by $\frac{3}{4}$ to find the number of $\frac{3}{4}$ -foot pieces.

$$3 \div \frac{3}{4} = 3 \times \frac{4}{3}$$

Multiply by the reciprocal of $\frac{3}{4}$, which is $\frac{4}{3}$.

$$= \frac{\cancel{3}^1 \times 4}{\cancel{3}_1}$$

Multiply. Divide out the common factor 3.

$$= 4$$

Simplify.

∴ So, you can cut four $\frac{3}{4}$ -foot pieces from the piece of wood.**On Your Own**

Divide. Write the answer in simplest form.

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

6. $\frac{1}{2} \div \frac{1}{8}$

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

8. $\frac{2}{5} \div \frac{3}{10}$

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

2.2 Exercises

Vocabulary and Concept Check

- OPEN-ENDED** Write a fraction and its reciprocal.
- WHICH ONE DOESN'T BELONG?** Which of the following does *not* belong with the other three? Explain your reasoning.

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

MATCHING Match the expression with its value.

- | | | | |
|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| 3. $\frac{2}{5} \div \frac{8}{15}$ | 4. $\frac{8}{15} \div \frac{2}{5}$ | 5. $\frac{2}{15} \div \frac{8}{5}$ | 6. $\frac{8}{5} \div \frac{2}{15}$ |
| A. $\frac{1}{12}$ | B. $\frac{3}{4}$ | C. 12 | D. $1\frac{1}{3}$ |

Practice and Problem Solving


Write the reciprocal of the number.


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

Divide. Write the answer in simplest form.

11. $\frac{1}{8} \div \frac{1}{4}$ 12. $\frac{5}{6} \div \frac{2}{7}$ 13. $12 \div \frac{3}{4}$ 14. $8 \div \frac{2}{5}$
15. $\frac{3}{7} \div 6$ 16. $\frac{12}{25} \div 4$ 17. $\frac{2}{9} \div \frac{2}{3}$ 18. $\frac{8}{15} \div \frac{4}{5}$
19. $\frac{1}{3} \div \frac{1}{9}$ 20. $\frac{7}{10} \div \frac{3}{8}$ 21. $\frac{14}{27} \div 7$ 22. $\frac{5}{8} \div 15$
23. $\frac{27}{32} \div \frac{7}{8}$ 24. $\frac{4}{15} \div \frac{10}{13}$ 25. $9 \div \frac{4}{9}$ 26. $10 \div \frac{5}{12}$

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

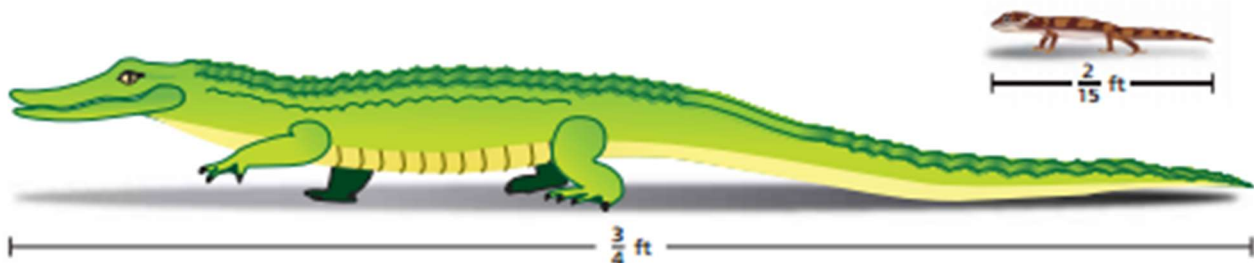
27.  $\frac{4}{7} \div \frac{13}{28} = \frac{4}{7} \times \frac{13}{28}$
 $= \frac{1 \cancel{\times} 13}{7 \times \cancel{28}_7}$
 $= \frac{13}{49}$

28.  $\frac{2}{5} \div \frac{8}{9} = \frac{5}{2} \times \frac{8}{9}$
 $= \frac{5 \times \cancel{8}_4}{2 \times 9}$
 $= \frac{20}{9}$

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?



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. $\frac{5}{12} \times \square = 1$

37. $3 \times \square = 1$

38. $7 \div \square = 56$

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

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

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

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

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

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.

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

- How many times more is the expense for housing than for automobiles?
- How many times more is the expense for food than for recreation?
- The expense for automobile fuel is $\frac{1}{60}$ of the total expenses. What fraction of the automobile expense is spent on fuel?

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.



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

- How much water can the tank hold?
- How much water was originally in the tank?
- 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

 **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 $2\frac{1}{4} \div \frac{3}{8}$

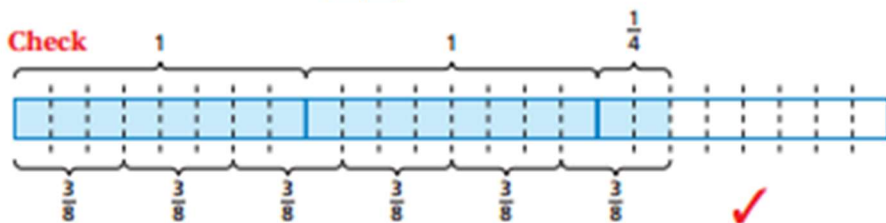
$$\begin{aligned} 2\frac{1}{4} \div \frac{3}{8} &= \frac{9}{4} \div \frac{3}{8} \\ &= \frac{9}{4} \times \frac{8}{3} \\ &= \frac{\cancel{3}^1 \times \cancel{8}^2}{\cancel{4}^2 \times \cancel{3}_1} \\ &= 6 \end{aligned}$$

Write $2\frac{1}{4}$ as the improper fraction $\frac{9}{4}$.

Multiply by the reciprocal of $\frac{3}{8}$, which is $\frac{8}{3}$.

Multiply fractions. Divide out common factors.

Simplify.

**EXAMPLE 2** Dividing Mixed Numbers

Find $3\frac{5}{6} \div 1\frac{2}{3}$

$$\begin{aligned} 3\frac{5}{6} \div 1\frac{2}{3} &= \frac{23}{6} \div \frac{5}{3} \\ &= \frac{23}{6} \times \frac{3}{5} \\ &= \frac{23 \times \cancel{3}^1}{\cancel{6}^2 \times 5} \\ &= \frac{23}{10}, \text{ or } 2\frac{3}{10} \end{aligned}$$

Estimate $4 \div 2 = 2$

Write each mixed number as an improper fraction.

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

Multiply fractions. Divide out common factors.

Simplify.

So, the quotient is $2\frac{3}{10}$.

Reasonable? $2\frac{3}{10} \approx 2$ ✓

 **On Your Own**

Divide. Write the answer in simplest form.

1. $1\frac{3}{7} \div \frac{2}{3}$

2. $2\frac{1}{6} \div \frac{3}{4}$

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

4. $6\frac{4}{5} \div 2\frac{1}{8}$

Now You're Ready
 Exercises 5–20

2.3 Exercises

Vocabulary and Concept Check

- VOCABULARY** What is the reciprocal of $7\frac{1}{3}$?
- 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.
- NUMBER SENSE** Is the reciprocal of an improper fraction *sometimes*, *always*, or *never* a proper fraction? Explain.
- 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?

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

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

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

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

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

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

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

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

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

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

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

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

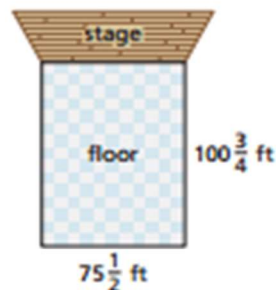
10. $\frac{7}{12} \div \frac{1}{4} \times \frac{9}{14}$

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

12. $6\frac{2}{9} \div (4 \times 1\frac{1}{6})$

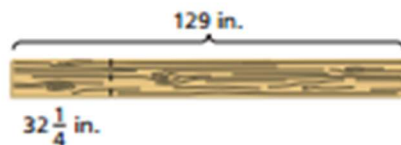
13. **MALL** In a mall, $\frac{1}{15}$ of the stores sell shoes. There are 180 stores in the mall. How many of the stores sell shoes? (Section 2.1)

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



15. **BAND** Band members make $\frac{2}{3}$ of their profit from selling concert tickets. They make $\frac{1}{5}$ 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 $32\frac{1}{4}$ -inch sections as you can out of the board to make skateboards. How many skateboards can you make? (Section 2.3)



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 $1.459 + 23.7$.

$$\begin{array}{r} 1.459 \\ + 23.700 \\ \hline 25.159 \end{array}$$

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.

$$\begin{array}{r} 5.508 \\ - 3.174 \\ \hline 2.334 \end{array}$$

Subtract as you would with whole numbers.

Reasonable? $2.334 \approx 3$ ✓

b. Subtract $21.9 - 1.605$.

$$\begin{array}{r} 21.900 \\ - 1.605 \\ \hline 20.295 \end{array}$$

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. $18.626 - 13.88$

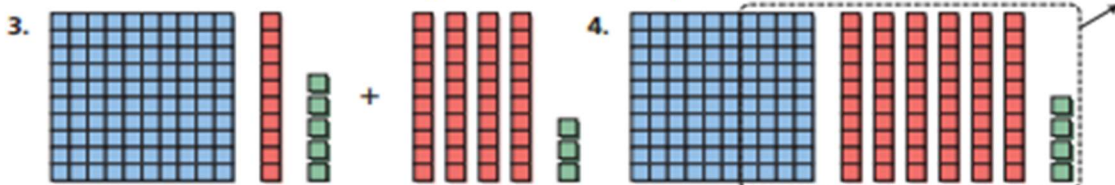
2.4 Exercises

Vocabulary and Concept Check

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



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

- BREAKFAST** You order the sausage and eggs breakfast, and your friend orders the ham omelet. How much is the bill before taxes and tip?
- HAM & CHEESE** How much more does the ham and cheese omelet cost than the cheese omelet?

Evaluate the expression.

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.



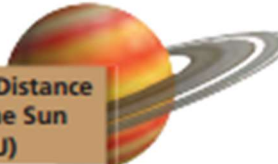
29. **DAY CARE** A day-care center is building a new outdoor play area. The diagram shows the dimensions in meters. How much fencing is needed to enclose the play area?

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 $3 \cdot 13.7$. 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. $\frac{7}{10} \times \frac{5}{7}$ 37. $\frac{5}{6} \times \frac{3}{10}$ 38. $\frac{3}{4} \times \frac{2}{9}$ 39. $\frac{2}{5} \times \frac{1}{8}$
40. **MULTIPLE CHOICE** What is the LCM of 6, 12, and 18? (Section 1.6)
- (A) 6 (B) 18 (C) 36 (D) 72

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

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

EXAMPLE 3 Multiplying Decimals

a. Multiply 4.8×7.2 .

Estimate $5 \times 7 = 35$

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

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

b. Multiply 3.1×0.05 .

Estimate $3 \times 0 = 0$

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

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

On Your Own


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

 Now You're Ready
Exercises 30–45

2.5 Exercises

Vocabulary and Concept Check

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

$$\begin{array}{r} 3. \quad 1.78 \\ \times 4.9 \\ \hline 8722 \end{array}$$

$$\begin{array}{r} 4. \quad 9.24 \\ \times 0.68 \\ \hline 62832 \end{array}$$

$$\begin{array}{r} 5. \quad 3.75 \\ \times 5.22 \\ \hline 195750 \end{array}$$

How many decimal places are in the product?

$$6. \quad 6.17 \times 8.2$$

$$7. \quad 1.684 \times 10.2$$

$$8. \quad 0.053 \times 2.78$$

Practice and Problem Solving

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

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

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

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

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

Multiply. Use estimation to check your answer.

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

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

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

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

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

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

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

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

$$21. \quad 100 \times 0.024$$

$$22. \quad 19 \times 0.004$$

$$23. \quad 0.0038 \times 9$$

$$24. \quad 10 \times 0.0093$$



ERROR ANALYSIS Describe and correct the error in the solution.

25. $\begin{array}{r} \text{X} \quad 0.0045 \\ \times 9 \\ \hline 4.05 \end{array}$

26. $\begin{array}{r} \text{X} \quad 0.32 \\ \times 5 \\ \hline 0.160 \end{array}$

- 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?
- BAMBOO** A bamboo plant grows about 1.25 feet each day. Find the growth in one week.
- NAILS** A fingernail grows about 0.1 millimeter each day. How much does a fingernail grow in 30 days? 90 days?

Multiply.

30. 0.7
 $\times 0.2$
31. 0.08
 $\times 0.3$
32. 0.007
 $\times 0.03$
33. 0.0008
 $\times 0.09$
34. 0.004
 $\times 0.9$
35. 0.06
 $\times 0.5$
36. 0.0008
 $\times 0.004$
37. 0.0002
 $\times 0.06$
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.

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

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.

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.

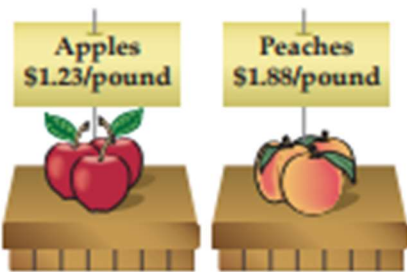
62. 1, 0.6, 0.36, 0.216, ...

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?



67. **MILEAGE** A car can travel 22.36 miles on one gallon of gasoline.
- How far can the car travel on 8.5 gallons of gasoline?
 - 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.

- Draw a restaurant menu that has main items, desserts, and beverages, with their prices.
- Write a guest check that shows what each of you ate. Find the subtotal.
- Multiply by 0.07 to find the tax. Then find the total.
- Round the total to the nearest whole number. Multiply by 0.20 to estimate a tip. Including the tip, how much did you spend?



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

- Draw three different ways in which this can happen.
- 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.
- 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.
- 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. $78 \div 3$

71. $65 \div 13$

72. $57 \div 19$

73. $84 \div 12$

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



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

$$\begin{array}{r} 1.83 \\ 4 \overline{)7.32} \end{array}$$

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

EXAMPLE 1 Dividing Decimals by Whole Numbersa. Find $7.6 \div 4$.**Estimate** $8 \div 4 = 2$

$$\begin{array}{r} 1.9 \\ 4 \overline{)7.6} \\ -4 \\ \hline 36 \\ -36 \\ \hline 0 \end{array}$$

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

So, $7.6 \div 4 = 1.9$.

Reasonable? $1.9 \approx 2$ ✓

b. Find $4.38 \div 12$.

$$\begin{array}{r} 0.365 \\ 12 \overline{)4.380} \\ -36 \\ \hline 78 \\ -72 \\ \hline 60 \\ -60 \\ \hline 0 \end{array}$$

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

Insert a zero and continue to divide.

So, $4.38 \div 12 = 0.365$.

Check $0.365 \times 12 = 4.38$ ✓

On Your Own

Now You're Ready
Exercises 12–23

Divide. Use estimation to check your answer.

1. $36.4 \div 2$

2. $22.2 \div 6$

3. $59.64 \div 7$

4. $43.26 \div 14$

5. $6.2 \div 4$

6. $3.12 \div 16$

2.6 Exercises

Vocabulary and Concept Check

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

$$\begin{array}{r} 6.1 \\ 4 \overline{)24.4} \end{array}$$

$$\begin{array}{r} 61 \\ 4 \overline{)244} \end{array}$$

$$\begin{array}{r} 6.1 \\ 4 \overline{)2.44} \end{array}$$

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.

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.

$$\begin{array}{r} \text{X} \quad 3.922 \\ 9 \overline{)28.008} \\ \underline{27} \\ 100 \\ \underline{81} \\ 198 \\ \underline{198} \\ 0 \end{array}$$

25.

$$\begin{array}{r} \text{X} \quad 0.86 \\ 6 \overline{)0.516} \\ \underline{48} \\ 36 \\ \underline{36} \\ 0 \end{array}$$

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



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.

2 36. $2.1 \overline{)25.2}$

37. $3.8 \overline{)34.2}$

38. $36.47 \div 0.7$

39. $0.984 \div 12.3$

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.



$$0.32 \overline{)146.4} \rightarrow 32 \overline{)1.464}$$

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.

- How many weeks will you have to save until you have enough money to buy the bicycle?
- How many more weeks would you have to save to buy a new bicycle that costs \$203.89? Explain how you found your answer.

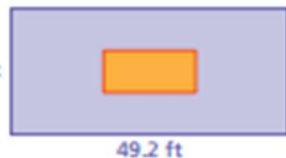
Applesauce	
3.9-ounce bowl	\$0.52
24-ounce jar	\$2.63

59. **PRECISION** A store sells applesauce in two sizes.

- How many *bowls* of applesauce fit in a *jar*? Round your answer to the nearest hundredth.
- Explain two ways to find the better buy.
- What is the better buy?

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

23.1 ft



49.2 ft

- How many times greater is the perimeter of the large rectangle compared to the perimeter of the small rectangle?
- How many times greater is the area of the large rectangle compared to the area of the small rectangle?
- Are the answers to parts (a) and (b) the same? *Explain* why or why not.
- What happens in parts (a) and (b) if the dimensions of the large rectangle are two times the dimensions of the small rectangle?



Fair Game Review

What you learned in previous grades & lessons

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

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

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

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

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

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

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)

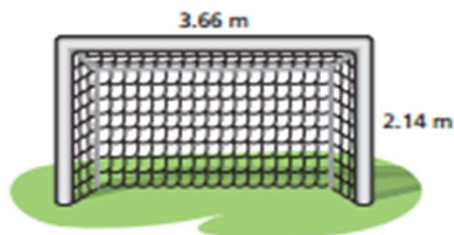
9. $5 \overline{)8.4}$

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)



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)

- Suppose the attendance was the same each month in 2008. How many people attended each month?
- How many times more people attended shows in 2006 than in 2009? Round your answer to the nearest tenth.

