

2.5 Multiplying Decimals

Learning Target: Multiply decimals and solve problems involving multiplication of decimals.

- Success Criteria:**
- I can multiply decimals by whole numbers.
 - I can multiply decimals by decimals.
 - I can evaluate expressions involving multiplication of decimals.

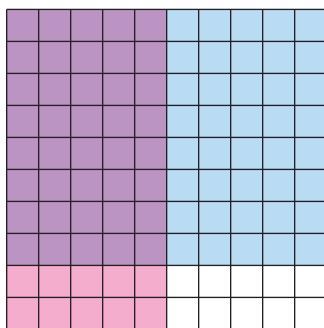
EXPLORATION 1

Multiplying Decimals

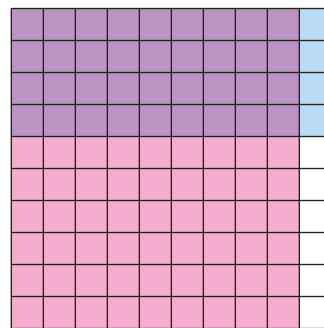
Work with a partner.

- a. Write the multiplication expression represented by each area model. Then find the product. Explain how you found your answer.

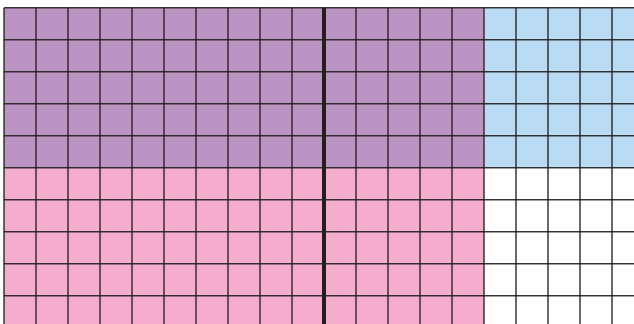
i.



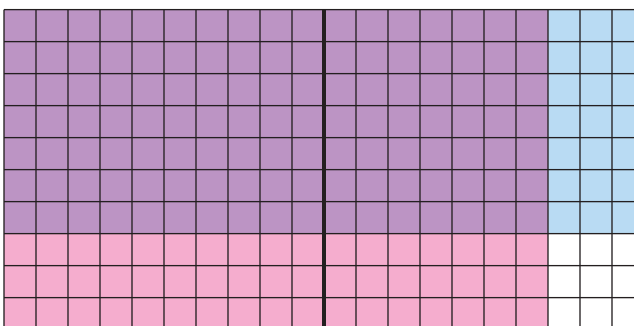
ii.



iii.



iv.



Math Practice

View as Components

How can you use an area model to find the product?

- b. How can you find the products in part (a) without using a model? How do you know where to place the decimal points in the answers?
- c. Find the product of 0.55 and 0.45. Explain how you found your answer.

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

$$\begin{array}{r} 13.91 \\ \times \quad 7 \\ \hline 97.37 \end{array} \quad \leftarrow \begin{array}{l} 2 \text{ decimal places} \\ 2 \text{ decimal places} \end{array}$$
$$\begin{array}{r} 6.218 \\ \times \quad 4 \\ \hline 24.872 \end{array} \quad \leftarrow \begin{array}{l} 3 \text{ decimal places} \\ 3 \text{ decimal places} \end{array}$$

EXAMPLE 1 Multiplying Decimals and Whole Numbers

a. Find 6×3.91 .

Estimate $6 \times 4 = 24$

$$\begin{array}{r} 3.91 \\ \times \quad 6 \\ \hline 23.46 \end{array}$$

\leftarrow 2 decimal places

\leftarrow 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 $3 \times 0 = 0$

$$\begin{array}{r} 0.016 \\ \times \quad 3 \\ \hline 0.048 \end{array}$$

\leftarrow 3 decimal places

\leftarrow To have 3 decimal places, insert zeros to the left of 48.

▶ So, $3 \times 0.016 = 0.048$.

Reasonable? $0.048 \approx 0$ ✓

c. Find $5.1024 \cdot 12$.

Estimate $5 \cdot 12 = 60$

$$\begin{array}{r} 5.1024 \\ \times \quad 12 \\ \hline 102048 \\ 51024 \\ \hline 61.2288 \end{array}$$

\leftarrow 4 decimal places

\leftarrow Count 4 decimal places from right to left.

▶ So, $5.1024 \cdot 12 = 61.2288$.

Reasonable? $61.2288 \approx 60$ ✓

Try It Multiply. Use estimation to check your answer.

1. 12.3×8

2. 5×14.51

3. $20 \cdot 0.008$

4. $2.3275 \cdot 90$

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 2 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 3.1×0.005 .

Estimate $3 \times 0 = 0$

$$\begin{array}{r} 3.1 \leftarrow 1 \text{ decimal place} \\ \times 0.005 \leftarrow + 3 \text{ decimal places} \\ \hline 0.0155 \leftarrow 4 \text{ decimal places} \end{array}$$

▶ So, $3.1 \times 0.005 = 0.0155$.

Reasonable? $0.0155 \approx 0$ ✓

c. Multiply $4.25 \cdot 1.75$.

Estimate $4 \times 2 = 8$

$$\begin{array}{r} 4.25 \leftarrow 2 \text{ decimal places} \\ \times 1.75 \leftarrow + 2 \text{ decimal places} \\ \hline 2125 \\ 2975 \\ 425 \\ \hline 7.4375 \leftarrow 4 \text{ decimal places} \end{array}$$

▶ So, $4.25 \cdot 1.75 = 7.4375$.

Reasonable? $7.4375 \approx 8$ ✓

Try It Multiply. Use estimation to check your answer.

5. 8.1×5.6

6. 2.7×9.04

7. 6.32×0.09

8. 1.785×0.2

EXAMPLE 3**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: Evaluate the expression in parentheses first.

$$\begin{array}{r} \overset{9}{\cancel{10}} \\ 4.5 \cancel{0} \cancel{0} \\ - 3.175 \\ \hline 1.325 \end{array}$$

So, $2.44(4.5 - 3.175) = 2.44(1.325)$.

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

$$\begin{array}{r} 1.325 \leftarrow 3 \text{ decimal places} \\ \times 2.44 \leftarrow + 2 \text{ decimal places} \\ \hline 5300 \\ 5300 \\ 2650 \\ \hline 3.23300 \leftarrow 5 \text{ decimal places} \end{array}$$

▶ The correct answer is **A**.

Try It Evaluate the expression.

9. $12.67 + 8.2 \cdot 1.9$ 10. $6.4(1.8 \cdot 7.5)$



Self-Assessment for Concepts & Skills

Solve each exercise. Then rate your understanding of the success criteria in your journal.

EVALUATING AN EXPRESSION Evaluate the expression.

11. 8×11.215 12. $9.42 \cdot 6.83$ 13. $0.15(4.3 - 2.417)$

14. **(MP) NUMBER SENSE** If you know $12 \times 24 = 288$, how can you find 0.12×0.24 ?
15. **(MP) NUMBER SENSE** Is the product 1.23×8 greater than or less than 8? Explain.
16. **(MP) REASONING** Copy the problem and place the decimal point in the product.

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

EXAMPLE 4

Modeling Real Life



Zinc: \$2.41 per ounce

A science teacher buys 3.25 ounces of zinc for an experiment. The teacher pays with a \$10 bill. How much change does the teacher receive?

Find the cost of 3.25 ounces of zinc at \$2.41 per ounce. Then subtract that amount from \$10.

Step 1: Multiply 2.41 by 3.25 to find the cost of the zinc.

$$\begin{array}{r} 2.41 \quad \leftarrow 2 \text{ decimal places} \\ \times 3.25 \quad \leftarrow + 2 \text{ decimal places} \\ \hline 1205 \\ 482 \\ 723 \\ \hline 7.8325 \quad \leftarrow 4 \text{ decimal places} \end{array}$$

The cost of 3.25 ounces of zinc is \$7.83.

Step 2: Subtract the cost of the zinc from the amount of money the teacher uses to buy the zinc.

$$10.00 - 7.83 = 2.17$$

▶ So, the teacher receives \$2.17 in change.



Self-Assessment for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.



17. You earn \$9.15 per hour painting a fence. It takes 6.75 hours to paint the fence. Did you earn enough money to buy the jersey shown? If so, how much money do you have left? If not, how much money do you need to earn?
18. A sand volleyball court is a rectangle that has a length of 52.5 feet and a width that is half of the length. In case of rain, the court is covered with a tarp. How many square feet of tarp are needed to cover the court?
19. **DIG DEEPER!** You buy 4 cases of bottled water and 5 bottles of fruit punch for a birthday party. Each case of bottled water costs \$2.75, and each bottle of fruit punch costs \$1.35. You hand the cashier a \$20 bill. How much change will you receive?

2.5 Practice



Go to BigIdeasMath.com to get HELP with solving the exercises.

► Review & Refresh

Add or subtract.

1. $12.29 - 6.15$ 2. $4.6 + 11.81$ 3. $9.34 + 17.009$ 4. $18.247 - 16.262$

Divide.

5. $78 \div 3$ 6. $65 \div 13$ 7. $57 \div 19$ 8. $84 \div 12$

9. What is $4\frac{1}{3} \times \frac{4}{5}$?

- A. $2\frac{1}{8}$ B. $3\frac{7}{15}$ C. $4\frac{4}{15}$ D. $5\frac{5}{12}$

Evaluate the expression.

10. $4 + 6^2 \div 2$ 11. $(35 + 9) \div 4 - 3^2$ 12. $8^2 \div [(14 - 12) \times 2^3]$

► Concepts, Skills, & Problem Solving

USING TOOLS Use an area model to find the product. (See Exploration 1, p. 73.)

13. 2.1×1.5 14. 0.6×0.4 15. 0.7×0.3 16. 2.7×2.3

MULTIPLYING DECIMALS AND WHOLE NUMBERS Multiply. Use estimation to check your answer.

17.
$$\begin{array}{r} 4.8 \\ \times 7 \\ \hline \end{array}$$
 18.
$$\begin{array}{r} 6.3 \\ \times 5 \\ \hline \end{array}$$
 19.
$$\begin{array}{r} 7.19 \\ \times 16 \\ \hline \end{array}$$
 20.
$$\begin{array}{r} 0.87 \\ \times 21 \\ \hline \end{array}$$
21.
$$\begin{array}{r} 1.95 \\ \times 11 \\ \hline \end{array}$$
 22.
$$\begin{array}{r} 5.89 \\ \times 5 \\ \hline \end{array}$$
 23.
$$\begin{array}{r} 3.472 \\ \times 4 \\ \hline \end{array}$$
 24.
$$\begin{array}{r} 8.188 \\ \times 12 \\ \hline \end{array}$$

25. 100×0.024 26. 19×0.004 27. 3.27×14 28. $46 \cdot 5.448$
29. 50×12.21 30. $104 \cdot 4.786$ 31. 0.0038×9 32. 10×0.0093

YOU BE THE TEACHER Your friend finds the product. Is your friend correct? Explain your reasoning.

33.
$$\begin{array}{r} 0.0045 \\ \times 9 \\ \hline 0.0405 \end{array}$$

34.
$$\begin{array}{r} 0.32 \\ \times 5 \\ \hline 0.160 \end{array}$$

35. **MODELING REAL LIFE** 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?



MULTIPLYING DECIMALS Multiply.

$$\begin{array}{r} 36. \quad 0.7 \\ \times 0.2 \\ \hline \end{array}$$

$$\begin{array}{r} 37. \quad 0.08 \\ \times 0.3 \\ \hline \end{array}$$

$$\begin{array}{r} 38. \quad 0.007 \\ \times 0.03 \\ \hline \end{array}$$

$$\begin{array}{r} 39. \quad 0.0008 \\ \times 0.09 \\ \hline \end{array}$$

$$\begin{array}{r} 40. \quad 0.004 \\ \times 0.9 \\ \hline \end{array}$$

$$\begin{array}{r} 41. \quad 0.06 \\ \times 0.5 \\ \hline \end{array}$$

$$\begin{array}{r} 42. \quad 0.0008 \\ \times 0.004 \\ \hline \end{array}$$

$$\begin{array}{r} 43. \quad 0.0002 \\ \times 0.06 \\ \hline \end{array}$$

$$44. \quad 12.4 \times 0.2$$

$$45. \quad 18.6 \cdot 5.9$$

$$46. \quad 7.91 \times 0.72$$

$$47. \quad 1.16 \times 3.35$$

$$48. \quad 6.478 \times 18.21$$

$$49. \quad 1.9 \times 7.216$$

$$50. \quad 0.0021 \times 18.2$$

$$51. \quad 6.109 \cdot 8.4$$

52. **YOU BE THE TEACHER** Your friend finds the product of 4.9 and 3.8. Is your friend correct? Explain your reasoning.

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

53. **MP PROBLEM SOLVING** A Chinese restaurant offers buffet takeout for \$4.99 per pound. How much does your takeout meal cost?

54. **MP PROBLEM SOLVING** On a tour of an old gold mine, you find a nugget containing 0.82 ounce of gold. Gold is worth \$1323.80 per ounce. How much is your nugget worth?

55. **MP PRECISION** One meter is approximately 3.28 feet. Find the height of each building in feet.



Continent	Tallest Building	Height (meters)
Africa	Carlton Centre	223
Asia	Burj Khalifa	828
Australia	Q1	323
Europe	Federation Tower	374
North America	One World Trade Center	541
South America	Gran Torre Santiago	300

56. **MP REASONING** Show how to evaluate $(7.12 \times 8.22) \times 100$ without multiplying two decimals.

EVALUATING AN EXPRESSION Evaluate the expression.

$$57. \quad 2.4 \times 16 + 7$$

$$58. \quad 6.85 \times 2 \times 10$$

$$59. \quad 1.047 \times 5 - 0.88$$

$$60. \quad 4.32(3.7 + 1.65)$$

$$61. \quad 23.98 - 1.7^2 \cdot 7.6$$

$$62. \quad 12 \cdot 5.16 + 10.064$$

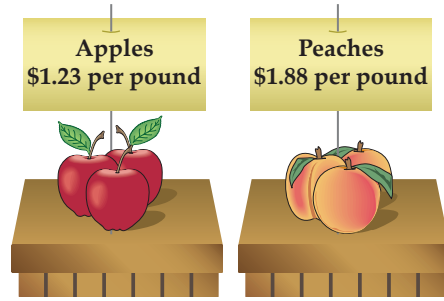
$$63. \quad 0.9(8.2 \cdot 20.35)$$

$$64. \quad 7.5^2(6.084 - 5.44)$$

$$65. \quad 0.629[81 \div (10 \times 2.7)]$$

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

67. **MODELING REAL LIFE** 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?



- MP PATTERNS** Describe the pattern. Find the next three numbers.

68. 1, 0.6, 0.36, 0.216, ... 69. 15, 1.5, 0.15, 0.015, ...
70. 0.04, 0.02, 0.01, 0.005, ... 71. 5, 7.5, 11.25, 16.875, ...

72. **DIG DEEPER!** You are preparing for a trip to Canada. At the time of your trip, each U.S. dollar is worth 1.293 Canadian dollars and each Canadian dollar is worth 0.773 U.S. dollar.

- You exchange 150 U.S. dollars for Canadian dollars. How many Canadian dollars do you receive?
- You spend 120 Canadian dollars on the trip. Then you exchange the remaining Canadian dollars for U.S. dollars. How many U.S. dollars do you receive?

73. **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 the dinner cost?



74. **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.