



Multiplying Decimals

4.3 OBJECTIVES

1. Multiply two or more decimals
2. Use multiplication of decimals to solve application problems
3. Multiply a decimal by a power of ten
4. Use multiplication by a power of ten to solve an application problem

To start our discussion of the multiplication of decimals, let's write the decimals in common-fraction form and then multiply.

Example 1

Multiplying Two Decimals

$$0.32 \times 0.2 = \frac{32}{100} \times \frac{2}{10} = \frac{64}{1000} = 0.064$$

Here 0.32 has *two* decimal places, and 0.2 has *one* decimal place. The product 0.064 has *three* decimal places.

Note:

$2 + 1 = 3$
 ↑ ↑ ↗
 Places Place Places in the
 in in product
 0.32 0.2 0.064



CHECK YOURSELF 1

Find the product and the number of decimal places.

$$0.14 \times 0.054$$

You do not need to write decimals as common fractions to multiply. Our work suggests the following rule.

Step by Step: To Multiply Decimals

- Step 1** Multiply the decimals as though they were whole numbers.
- Step 2** Add the number of decimal places in the numbers being multiplied.
- Step 3** Place the decimal point in the product so that the number of decimal places in the product is the sum of the number of decimal places in the factors.

Example 2 illustrates this rule.

Multiplying Two Decimals

Multiply 0.23 by 0.7.

$$\begin{array}{r}
 0.23 \leftarrow \text{Two places} \\
 \times 0.7 \leftarrow \text{One place} \\
 \hline
 0.161 \leftarrow \text{Three places}
 \end{array}$$

**CHECK YOURSELF 2***Multiply 0.36×1.52 .*

You may have to affix zeros to the left in the product to place the decimal point. Consider our next example.

Example 3**Multiplying Two Decimals**

Multiply.

$$\begin{array}{r}
 0.136 \leftarrow \text{Three places} \\
 \times 0.28 \leftarrow \text{Two places} \\
 \hline
 1088 \\
 272 \\
 \hline
 0.03808 \leftarrow \text{Five places} \\
 \uparrow \\
 \text{Insert 0}
 \end{array}
 \quad
 \begin{array}{l}
 3 + 2 = 5 \\
 \\
 \text{Insert a 0 to mark off five decimal places.}
 \end{array}$$

**CHECK YOURSELF 3***Multiply 0.234×0.24 .*

Estimation is also helpful in multiplying decimals.

Example 4**Estimating the Product of Two Decimals**Estimate the product 24.3×5.8 .

$$\begin{array}{r}
 24.3 \\
 \times 5.8 \\
 \hline
 \end{array}
 \quad
 \begin{array}{c}
 \text{Round} \\
 \rightarrow
 \end{array}
 \quad
 \begin{array}{r}
 24 \\
 \times 6 \\
 \hline
 144
 \end{array}
 \quad
 \begin{array}{l}
 \\
 \text{Multiply for the estimate.}
 \end{array}$$

**CHECK YOURSELF 4***Estimate the product.*

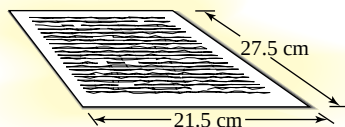
$$17.95 \times 8.17$$

Let's look at some applications of our work in multiplying decimals.

Example 5

An Application Involving the Multiplication of Two Decimals

A sheet of paper has dimensions 27.5 by 21.5 centimeters (cm). What is its area?



We multiply to find the required area.

NOTE Recall that area is length times width, so multiplication is the necessary operation.

$$\begin{array}{r} 27.5 \text{ cm} \\ \times 21.5 \text{ cm} \\ \hline 1375 \\ 275 \\ 550 \\ \hline 591.25 \text{ cm}^2 \end{array}$$

The area of the paper is 591.25 cm².



CHECK YOURSELF 5

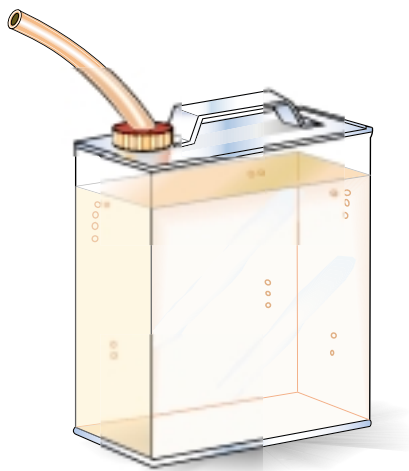
If 1 kilogram (kg) is 2.2 pounds (lb), how many pounds equal 5.3 kg?

Example 6

An Application Involving the Multiplication of Two Decimals

NOTE Usually in problems dealing with money we round the result to the nearest cent (hundredth of a dollar).

Jack buys 8.7 gallons (gal) of propane at 98.9 cents per gallon. Find the cost of the propane.



We multiply the cost per gallon by the number of gallons. Then we round the result to the nearest cent. Note that the units of the answer will be cents.

$$\begin{array}{r}
 98.9 \\
 \times 8.7 \\
 \hline
 6923 \\
 7912 \\
 \hline
 860.43
 \end{array}$$

The product 860.43 (cents) is rounded to 860 (cents), or \$8.60.

The cost of Jack's propane will be \$8.60.



CHECK YOURSELF 6

One liter (L) is approximately 0.265 gal. On a trip to Europe, the Bernards purchased 88.4 L of gas for their rental car. How many gallons of gas did they purchase, to the nearest tenth of a gallon?

Sometimes we will have to use more than one operation for a solution, as Example 7 shows.

Example 7

An Application Involving Two Operations

Steve purchased a television set for \$299.50. He agreed to pay for the set by making payments of \$27.70 for 12 months. How much extra did he pay on the installment plan?

First we multiply to find the amount actually paid.

$$\begin{array}{r}
 \$ 27.70 \\
 \times 12 \\
 \hline
 5540 \\
 2770 \\
 \hline
 \$332.40 \leftarrow \text{Amount paid}
 \end{array}$$

Now subtract the listed price. The difference will give the extra amount Steve paid.

$$\begin{array}{r}
 \$332.40 \\
 - 299.50 \\
 \hline
 \$ 32.90 \leftarrow \text{Extra amount}
 \end{array}$$

Steve will pay an additional \$32.90 on the installment plan.



CHECK YOURSELF 7

Sandy's new car had a list price of \$10,985. She paid \$1500 down and will pay \$305.35 per month for 36 months on the balance. How much extra will she pay with this loan arrangement?

There are enough applications involving multiplication by the powers of 10 to make it worthwhile to develop a special rule so you can do such operations quickly and easily. Look at the patterns in some of these special multiplications.

$$\begin{array}{r} 0.679 \\ \times 10 \\ \hline 6.790, \text{ or } 6.79 \end{array}$$

$$\begin{array}{r} 23.58 \\ \times 10 \\ \hline 235.80, \text{ or } 235.8 \end{array}$$

Do you see that multiplying by 10 has moved the decimal point *one place to the right*? Now let's look at what happens when we multiply by 100.

NOTE The rule will be used to multiply by 10, 100, 1000, and so on.

$$\begin{array}{r} 0.892 \\ \times 100 \\ \hline 89.200, \text{ or } 89.2 \end{array}$$

$$\begin{array}{r} 5.74 \\ \times 100 \\ \hline 574.00, \text{ or } 574 \end{array}$$

NOTE The digits remain the same. Only the *position* of the decimal point is changed.

Multiplying by 100 shifts the decimal point *two places to the right*. The pattern of these examples gives us the following rule:

NOTE Multiplying by 10, 100, or any other larger power of 10 makes the number *larger*. Move the decimal point *to the right*.

Rules and Properties: To Multiply by a Power of 10

Move the decimal point to the right the same number of places as there are zeros in the power of 10.

Example 8

Multiplying by Powers of Ten

$$2.356 \times 10 = 23.56$$

One
zero

The decimal point has
moved one place to the right.

$$34.788 \times 100 = 3478.8$$

Two
zeros

The decimal point has
moved two places to the right.

$$3.67 \times 1000 = 3670.$$

Three
zeros

The decimal point has moved three
places to the right. Note that we added a 0
to place the decimal point correctly.

NOTE Remember that 10^5 is just a 1 followed by five zeros.

$$0.005672 \times 10^5 = 567.2$$

Five
zeros

The decimal point has
moved five places to the right.

**CHECK YOURSELF 8***Multiply.*

(a) 43.875×100

(b) 0.0083×10^3

Example 9 is just one of many applications that require multiplying by a power of 10.

Example 9**An Application Involving Multiplication by a Power of 10**

NOTE There are 1000 meters in a kilometer.

To convert from kilometers to meters, multiply by 1000. Find the number of meters (m) in 2.45 kilometers (km).

NOTE If the result is a whole number, there is no need to write the decimal point.

$$2.45 \text{ km} = 2450. \text{ m}$$

Just move the decimal point three places right to make the conversion. Note that we added a zero to place the decimal point correctly.

**CHECK YOURSELF 9**

To convert from kilograms to grams, multiply by 1000. Find the number of grams (g) in 5.23 kilograms (kg).

CHECK YOURSELF ANSWERS

1. 0.00756, 5 decimal places 2. 0.5472 3. 0.05616 4. 144 5. 11.66 lb
 6. 23.4 gal 7. \$1507.60 8. **(a)** 4387.5; **(b)** 8.3 9. 5230 g

4.3

Exercises

Multiply.

$$\begin{array}{r} 1. \quad 2.3 \\ \times 3.4 \\ \hline \end{array}$$

$$\begin{array}{r} 2. \quad 6.5 \\ \times 4.3 \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad 8.4 \\ \times 5.2 \\ \hline \end{array}$$

$$\begin{array}{r} 4. \quad 9.2 \\ \times 4.6 \\ \hline \end{array}$$

$$\begin{array}{r} 5. \quad 2.56 \\ \times 72 \\ \hline \end{array}$$

$$\begin{array}{r} 6. \quad 56.7 \\ \times 35 \\ \hline \end{array}$$

$$\begin{array}{r} 7. \quad 0.78 \\ \times 2.3 \\ \hline \end{array}$$

$$\begin{array}{r} 8. \quad 9.5 \\ \times 0.45 \\ \hline \end{array}$$

$$\begin{array}{r} 9. \quad 15.7 \\ \times 2.35 \\ \hline \end{array}$$

$$\begin{array}{r} 10. \quad 28.3 \\ \times 0.59 \\ \hline \end{array}$$

$$\begin{array}{r} 11. \quad 0.354 \\ \times 0.8 \\ \hline \end{array}$$

$$\begin{array}{r} 12. \quad 0.624 \\ \times 0.85 \\ \hline \end{array}$$

$$\begin{array}{r} 13. \quad 3.28 \\ \times 5.07 \\ \hline \end{array}$$

$$\begin{array}{r} 14. \quad 0.582 \\ \times 6.3 \\ \hline \end{array}$$

$$\begin{array}{r} 15. \quad 5.238 \\ \times 0.48 \\ \hline \end{array}$$

$$\begin{array}{r} 16. \quad 0.372 \\ \times 58 \\ \hline \end{array}$$

$$\begin{array}{r} 17. \quad 1.053 \\ \times 0.552 \\ \hline \end{array}$$

$$\begin{array}{r} 18. \quad 2.375 \\ \times 0.28 \\ \hline \end{array}$$

$$\begin{array}{r} 19. \quad 0.0056 \\ \times 0.082 \\ \hline \end{array}$$

$$\begin{array}{r} 20. \quad 1.008 \\ \times 0.046 \\ \hline \end{array}$$

$$21. \quad 0.8 \times 2.376$$

$$22. \quad 3.52 \times 58$$

$$23. \quad 0.3085 \times 4.5$$

$$24. \quad 0.028 \times 0.685$$

Solve the following applications.

25. **Total cost.** Kurt bought four shirts on sale as pictured. What was the total cost of the purchase?



Name _____

Section _____ Date _____

ANSWERS

1. _____
2. _____
3. _____
4. _____
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11. _____
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25. _____

ANSWERS

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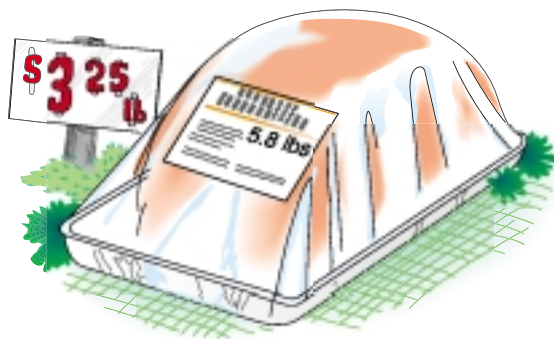
26. Total payments. Juan makes monthly payments of \$123.65 on his car. What will he pay in 1 year?

27. Weight. If 1 gallon (gal) of water weighs 8.34 pounds (lb), how much will 2.5 gal weigh?

28. Salary. Malik worked 37.4 hours (h) in 1 week. If his hourly rate of pay is \$6.75, what was his pay for the week?

29. Interest. To find the amount of simple interest on a loan at $9\frac{1}{2}$ percent, we have to multiply the amount of the loan by 0.095. Find the simple interest on a \$1500 loan for 1 year.

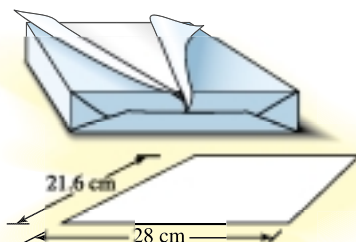
30. Cost. A beef roast weighing 5.8 lb costs \$3.25/lb. What is the cost of the roast?



31. State tax. Tom's state income tax is found by multiplying his income by 0.054. If Tom's income is \$23,450, find the amount of his tax.

32. Salary. Claudia earns \$6.40 per hour (h). For overtime (each hour over 40 h) she earns \$9.60. If she works 48.5 h in a week, what pay should she receive?

33. Area. A sheet of typing paper has dimensions shown below. What is its area?



34. Car rental. A rental car costs \$24 per day plus 18 cents per mile (mi). If you rent a car for 5 days and drive 785 mi, what will the total car rental bill be?

35. Metrics. One inch (in.) is approximately 2.54 centimeters (cm). How many centimeters does 5.3 in. equal? Give your answer to the nearest hundredth of a centimeter.

36. Fuel consumption. A light plane uses 5.8 gal/h of fuel. How much fuel is used on a flight of 3.2 h? Give your answer to the nearest tenth of a gallon.



37. Cost. The Hallstons select a carpet costing \$15.49 per square yard (yd^2). If they need 7.8 yd^2 of carpet, what is the cost to the nearest cent?

38. Car payment. Maureen's car payment is \$242.38 per month for 4 years. How much will she pay altogether?

39. Area. A classroom is 7.9 meters (m) wide and 11.2 m long. Estimate its area.

40. Cost. You buy a roast that weighs 6.2 lb and costs \$3.89 per pound. Estimate the cost of the roast.

Multiply.

41. 5.89×10

42. 0.895×100

43. 23.79×100

44. 2.41×10

45. 0.045×10

46. 5.8×100

47. 0.431×100

48. 0.025×10

49. 0.471×100

50. $0.95 \times 10,000$

51. 0.7125×1000

52. 23.42×1000

53. 4.25×10^2

54. 0.36×10^3

55. 3.45×10^4

56. 0.058×10^5

ANSWERS

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57.
58.
59.
60.

Solve the following applications.

- 57. Cost.** A store purchases 100 items at a cost of \$1.38 each. Find the total cost of the order.
- 58. Conversion.** To convert from meters (m) to centimeters (cm), multiply by 100. How many centimeters are there in 5.3 meters?
- 59. Conversion.** How many grams (g) are there in 2.2 kilograms (kg)? Multiply by 1000 to make the conversion.
- 60. Cost.** An office purchases 1000 pens at a cost of 17.8 cents each. What is the cost of the purchase in dollars?

Meyer's Office Supply			
371 Maple Dr., Treynor IA 50001			
Item	Quantity	Item Price	Total
Pens	1000	\$0.178	

Answers

1. 7.82 3. 43.68 5. 184.32 7. 1.794 9. 36.895 11. 0.2832
13. 16.6296 15. 2.51424 17. 0.581256 19. 0.0004592 21. 1.9008
23. 1.38825 25. \$39.92 27. 20.85 lb 29. \$142.50 31. \$1266.30
33. 604.8 cm² 35. 13.46 cm 37. \$120.82 39. 88 m² 41. 58.9
43. 2379 45. 0.45 47. 43.1 49. 47.1 51. 712.5 53. 425
55. 34,500 57. \$138 59. 2200 g



Using Your Calculator to Multiply Decimals

The steps for finding the product of decimals on a calculator are similar to the ones we used for multiplying whole numbers.

Example 1

Multiplying Two Decimals

To multiply 34.2×1.387 , enter

$$34.2 \times 1.387 =$$

Display 47.4354



CHECK YOURSELF 1

Multiply.

$$92.7 \times 2.36$$

To find the product of a group of decimals, just extend the process.

Example 2

Multiplying a Group of Decimals

To multiply $2.8 \times 3.45 \times 3.725$, enter

$$2.8 \times 3.45 \times 3.725 =$$

Display 35.9835



CHECK YOURSELF 2

Multiply $3.1 \times 5.72 \times 6.475$.

You can also easily find powers of decimals with your calculator by using a procedure similar to that in Example 2.

Finding the Power of a Decimal Number

Find $(2.35)^3$.

Enter

$$2.35 \times 2.35 \times 2.35 =$$

Display 12.977875

REMEMBER:

$$(2.35)^3 = 2.35 \times 2.35 \times 2.35$$

**CHECK YOURSELF 3**Evaluate $(6.2)^4$.

Some calculators have keys that will find powers more quickly. Look for keys marked x^2 or y^x . Other calculators have a power key marked $\wedge$.

Example 4**Finding the Power of a Decimal Number Using Power Keys**Find $(2.35)^3$.

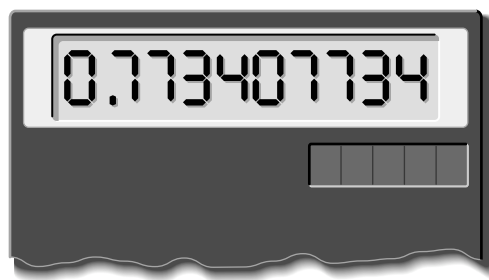
Enter

2.35 $\wedge$ 3 or 2.35 y^x 3

The result is 12.977875.

**CHECK YOURSELF 4**Find $(6.2)^4$.

How many places can your calculator display? Most calculators can display either 8, 9, or 10 digits. To find the display capability of your calculator, just enter digits until the calculator can accept no more numbers. For example, try entering

1 $\frac{\square}{\square}$ 0.226592266 $\frac{\square}{\square}$ 

Does your calculator display 10 digits? Now turn the calculator upside down. What does it say? (It may take a little imagination to see it.)

What happens when your calculator wants to display an answer that is too big to fit in the display? Let's try an experiment to see. Enter

10 $\times$ 10 $\frac{\square}{\square}$.

Now continue to multiply this answer by 10. Many calculators will let you do this by simply pressing $\frac{\square}{\square}$. Others require you to " $\times$ 10" for each calculation. Multiply by 10 until the display is no longer a 1 followed by a series of zeros. The new display represents the

power of 10 of the answer. It will be displayed as either

$$1^{10}$$

(which looks like 1 to the tenth power, but means 1 times 10^{10}) or

$$1 \text{ E } 10$$

(which also means 1 times 10^{10}).

Answers that are displayed in this way are said to be in **scientific notation**. This is a topic that you will study in your next math course. In this text we will avoid exercises with answers that are too large to display in the decimal notation that you already know. If you do get such an answer, you should go back and check your work. Do not be afraid to try experimenting with your calculator. It is amazing how much math you can (accidentally) learn while playing!

Example 5

Multiplying by a Power of Ten Using the Power Key on a Calculator

Find the product 3.485×10^4 .

Use your calculator to enter

$$3.485 \times 10 y^x 4 = \quad \text{or} \quad 3.485 \times 10 \wedge 4 =$$

The result will be 34850. Note that the decimal point has moved four places (the power of 10) to the right.



CHECK YOURSELF 5

Find the product 8.755×10^6 .

CHECK YOURSELF ANSWERS

1. 218.772 2. 114.8147 3. 1477.6336 4. 1477.6336 5. 8,755,000

Name _____

Section _____ Date _____



Calculator Exercises

Compute.

1. 0.08×7.375

2. 21.34×0.005

3. 21.38×13.75

4. 58.05×13.02

5. $127.85 \times 0.055 \times 15.84$

6. $18.28 \times 143.45 \times 0.075$

7. $(2.65)^2$

8. $(0.08)^3$

9. $(3.95)^3$

10. $(0.521)^2$

Find the following products using your calculator.

11. 3.365×10^3

12. 4.128×10^3

13. 4.316×10^5

14. 8.163×10^6

15. 7.236×10^8

16. 5.234×10^7

17. 32.136×10^5

18. 41.234×10^4

19. 31.789×10^4

20. 61.356×10^3

ANSWERS

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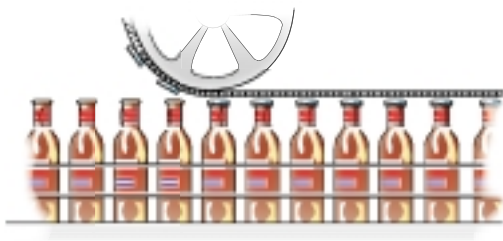
17.

18.

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20.

21. Find the area of a rectangle with length 3.75 in. and width 2.35 in.
22. Mark works 38.4 h in a given week. If his hourly rate of pay is \$5.85, what will he be paid for the week?
23. If fuel oil costs 87.5¢ per gallon, what will 150.4 gal cost?
24. To find the simple interest on a loan for 1 year at 12.5 percent, multiply the amount of the loan by 0.125. What simple interest will you pay on a loan of \$1458 at 12.5 percent for 1 year?
25. You are the office manager for Dr. Rogers. The increasing cost of making photocopies is a concern to Dr. Rogers. She wants to examine alternatives to the current financing plan. The office currently leases a copy machine for \$110 per month and \$0.025 per copy. A 3-year payment plan is available that costs \$125 per month and \$0.015 per copy.
- (a) If the office expects to run 100,000 copies per year, which is the better plan?
- (b) How much money will the better plan save over the other plan?
26. In a bottling company, a machine can fill a 2-liter (L) bottle in 0.5 seconds (s) and move the next bottle into place in 0.1 s. How many 2-L bottles can be filled by the machine in 2 hours?



27. The owner of a bakery sells a finished cake for \$8.99. The cost of baking 16 cakes is \$75.63. Write a plan to find out how much profit the baker can make on each cake sold.



21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27.  _____

Answers

1. 0.59 3. 293.975 5. 111.38292 7. 7.0225 9. 61.629875
11. 3365 13. 431,600 15. 723,600,000 17. 3,213,600 19. 317,890
21. 8.8125 in.² 23. \$131.60
25. (a) Current plan: \$11,460; 3-Year lease: \$9000; (b) Savings: \$2460
27.

