Multiplying Decimals

**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**

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

Note:

\[
2 + 1 = 3
\]

Places in the product

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

**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.

**Example 2**

**Multiplying Two Decimals**

Multiply 0.23 by 0.7.

\[
\begin{array}{c}
0.23 \\ \times 0.7 \text{ Two places} \\
0.161 \text{ Three places}
\end{array}
\]

\[
0.23 \times 0.7 = 0.161
\]
CHECK YOURSELF 2

Multiply 0.36 \times 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.

\[
\begin{array}{c}
0.136 \quad \text{Three places} \\
\times 0.28 \quad \text{Two places} \\
\hline
1088 \\
+ 272 \quad \text{Five places} \\
\hline
0.03808 \\
\end{array}
\]

Insert 0 to mark off five decimal places.

CHECK YOURSELF 3

Multiply 0.234 \times 0.24.

Estimation is also helpful in multiplying decimals.

Example 4

Estimating the Product of Two Decimals

Estimate the product 24.3 \times 5.8.

\[
\begin{array}{c}
24.3 \quad \rightarrow \quad 24 \\
\times 5.8 \quad \times 6 \\
\hline
144 \\
\end{array}
\]

Multiply for the estimate.

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.

\[
\begin{array}{c}
27.5 \text{ cm} \\
\times 21.5 \text{ cm} \\
\end{array} \\
\hline
137.5 \\
275 \\
550 \\
\hline
591.25 \text{ cm}^2 \\
\end{array}
\]

The area of the paper is 591.25 cm\(^2\).

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

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

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

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

\[
\begin{array}{c}
98.9 \\
\times \ 8.7 \\
6923 \\
7912 \\
\hline
860.43 \quad \text{The product 860.43 (cents) is rounded to 860 (cents), or $8.60.}
\end{array}
\]

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.

\[
\begin{array}{c}
27.70 \\
\times \ 12 \\
5540 \\
2770 \\
\hline
332.40 \quad \text{Amount paid}
\end{array}
\]

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

\[
\begin{array}{c}
332.40 \\
-299.50 \\
\hline
32.90 \quad \text{Extra amount}
\end{array}
\]

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?*
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.

0.005672 \times 10^5 = 567.2

Five zeros

The decimal point has moved five places to the right.

NOTE Remember that $10^5$ is just a 1 followed by five zeros.
CHECK YOURSELF 8

Multiply.

(a) $43.875 \times 100$  
(b) $0.0083 \times 10^3$

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

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

NOTE There are 1000 meters in a kilometer.

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

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

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

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

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.

1. \[ 2.3 \times 3.4 \]
2. \[ 6.5 \times 4.3 \]
3. \[ 8.4 \times 5.2 \]

4. \[ 9.2 \times 4.6 \]
5. \[ 2.56 \times 72 \]
6. \[ 56.7 \times 35 \]

7. \[ 0.78 \times 2.3 \]
8. \[ 9.5 \times 0.45 \]
9. \[ 15.7 \times 2.35 \]

10. \[ 28.3 \times 0.59 \]
11. \[ 0.354 \times 0.8 \]
12. \[ 0.624 \times 0.85 \]

13. \[ 3.28 \times 5.07 \]
14. \[ 0.582 \times 6.3 \]
15. \[ 5.238 \times 0.48 \]

16. \[ 0.372 \times 58 \]
17. \[ 1.053 \times 0.552 \]
18. \[ 2.375 \times 0.28 \]

19. \[ 0.0056 \times 0.082 \]
20. \[ 1.008 \times 0.046 \]
21. \[ 0.8 \times 2.376 \]

22. \[ 3.52 \times 58 \]
23. \[ 0.3085 \times 4.5 \]
24. \[ 0.028 \times 0.685 \]

Solve the following applications.

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

\$9.98 EACH
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 $\frac{1}{2}$ 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 (yd²). If they need 7.8 yd² 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. $5.89 \times 10$

42. $0.895 \times 100$

43. $23.79 \times 100$

44. $2.41 \times 10$

45. $0.045 \times 10$

46. $5.8 \times 100$

47. $0.431 \times 100$

48. $0.025 \times 10$

49. $0.471 \times 100$

50. $0.95 \times 10,000$

51. $0.7125 \times 1000$

52. $23.42 \times 1000$

53. $4.25 \times 10^2$

54. $0.36 \times 10^3$

55. $3.45 \times 10^4$

56. $0.058 \times 10^5$
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?

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**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 $34.2 \times 1.387$, 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.

**Example 3**

**Finding the Power of a Decimal Number**

**REMEMBER:**

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

Find $(2.35)^3$.

Enter

$2.35 \times 2.35 \times 2.35$

Display $12.977875$
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 $\text{yx}$.

Example 4
Finding the Power of a Decimal Number Using Power Keys

Find $(2.35)^3$.

Enter
$2.35 \ x^3$  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

$1 \ \underline{0.226592266}$

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

$10 \ \underline{10}$.

Now continue to multiply this answer by 10. Many calculators will let you do this by simply pressing $\text {EE }$. 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
Example 5

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

Find the product $3.485 \times 10^4$.

Use your calculator to enter $3.485 \times 10^4$ or $3.485 \times 10^4$.

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 $8.755 \times 10^6$.

CHECK YOURSELF ANSWERS

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

A power of 10 of the answer. It will be displayed as either $10^4$ (which looks like 1 to the tenth power, but means 1 times $10^4$) or 1 E 10 (which also means 1 times $10^4$).

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 (accidently) learn while playing!
Calculator Exercises

Compute.

1. $0.08 \times 7.375$
2. $21.34 \times 0.005$
3. $21.38 \times 13.75$
4. $58.05 \times 13.02$
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. $3.365 \times 10^3$
12. $4.128 \times 10^3$
13. $4.316 \times 10^5$
14. $8.163 \times 10^6$
15. $7.236 \times 10^8$
16. $5.234 \times 10^7$
17. $32.136 \times 10^5$
18. $41.234 \times 10^4$
19. $31.789 \times 10^4$
20. $61.356 \times 10^3$
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.
Answers

1. 0.59  
3. 293.975  
5. 111.38292  
7. 7.0225  
9. 61.62975  
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.