

## SECTION

## 1.4

## Multiplication of Whole Numbers

## OBJECTIVE A

To multiply a number by a single digit 

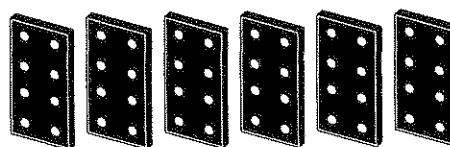
© iStockphoto.com/Ivan Bajic

Six boxes of CD players are ordered. Each box contains eight CD players. How many CD players are ordered?

This problem can be worked by adding 6 eights.

$$8 + 8 + 8 + 8 + 8 + 8 = 48$$

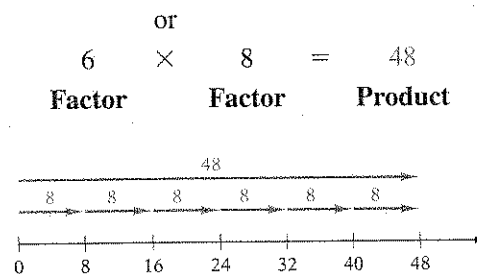
This problem involves repeated addition of the same number and can be worked by a shorter process called **multiplication**. Multiplication is the repeated addition of the same number.



$$8 + 8 + 8 + 8 + 8 + 8 = 48$$

The numbers that are multiplied are called **factors**. The result is called the **product**.

The product of  $6 \times 8$  can be represented on the number line. The arrow representing the whole number 8 is repeated 6 times. The result is the arrow representing 48.



The times sign “ $\times$ ” is only one symbol that is used to indicate multiplication. Each of the expressions that follow represents multiplication.

$$7 \times 8 \quad 7 \cdot 8 \quad 7(8) \quad (7)(8) \quad (7)8$$

As with addition, there are some useful properties of multiplication.

**Multiplication Property of Zero**

The product of a number and zero is zero.

$$0 \times 4 = 0$$

$$7 \times 0 = 0$$

**Multiplication Property of One**

The product of a number and one is the number.

$$1 \times 6 = 6$$

$$8 \times 1 = 8$$

**Commutative Property of Multiplication**

Two numbers can be multiplied in either order. The product will be the same.

$$4 \times 3 = 3 \times 4$$

$$12 = 12$$

**Associative Property of Multiplication**

Grouping the numbers to be multiplied in any order gives the same result. Do the multiplication inside the parentheses first.

$$\underbrace{(4 \times 2)}_8 \times 3 = 4 \times \underbrace{(2 \times 3)}_6$$

$$24 = 24$$

**Tips for Success**

Some students think that they can “coast” at the beginning of this course because the topic of Chapter 1 is whole numbers. However, this chapter lays the foundation for the entire course. Be sure you know and understand all the concepts presented. For example, study the properties of multiplication presented in this lesson.

The basic facts for multiplying one-digit numbers should be memorized. Multiplication of larger numbers requires the repeated use of the basic multiplication facts.

**HOW TO 1** Multiply:  $37 \times 4$ 

$$\begin{array}{r} 2 \\ 37 \\ \times 4 \\ \hline 8 \end{array}$$

- $4 \times 7 = 28$  (2 tens + 8 ones).  
Write the 8 in the ones column and carry the 2 to the tens column.

$$\begin{array}{r} 2 \\ 37 \\ \times 4 \\ \hline 148 \end{array}$$

- The 3 in 37 is 3 tens.  
 $4 \times 3$  tens = 12 tens  
Add the carry digit.  $+ 2$  tens  
14 tens
- Write the 14. The product is 148.

The phrases below are used to indicate the operation of multiplication. An example is shown at the right of each phrase.

times	7 times 3	$7 \cdot 3$
the product of	the product of 6 and 9	$6 \cdot 9$
multiplied by	8 multiplied by 2	$2 \cdot 8$

**EXAMPLE 1**Multiply:  $735 \times 9$ **Solution**

$$\begin{array}{r} 34 \\ 735 \\ \times 9 \\ \hline 6615 \end{array}$$

- $9 \times 5 = 45$   
Write the 5 in the ones column. Carry the 4 to the tens column.
- $9 \times 3 = 27$ ,  $27 + 4 = 31$
- $9 \times 7 = 63$ ,  $63 + 3 = 66$

**YOU TRY IT 1**Multiply:  $648 \times 7$ **Your solution**

Solution on p. S2

**OBJECTIVE B** To multiply larger whole numbers

Note the pattern when the following numbers are multiplied.

Multiply the nonzero part of the factors.

Now attach the same number of zeros to the product as the total number of zeros in the factors.

$$\begin{array}{r} 4 \times 2 \\ 4 \times 2 \\ \hline 8 \end{array}$$

zero

$$\begin{array}{r} 4 \times 2 \\ 4 \times 2 \\ \hline 8 \end{array}$$

zeros

$$\begin{array}{r} 4 \times 2 \\ 4 \times 2 \\ \hline 8 \end{array}$$

zeros

$$\begin{array}{r} 12 \times 5 \\ 12 \times 5 \\ \hline 60 \end{array}$$

zeros

**HOW TO 2**

Find the product of 47 and 23.

Multiply by the ones digit.

$$\begin{array}{r} 47 \\ \times 23 \\ \hline 141 \end{array} \quad (= 47 \times 3)$$

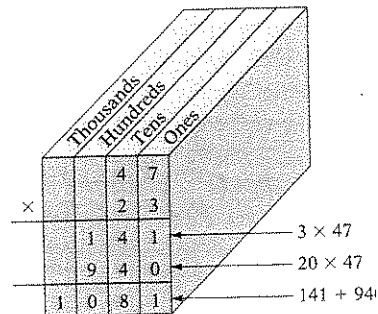
Multiply by the tens digit.

$$\begin{array}{r} 47 \\ \times 23 \\ \hline 940 \end{array} \quad (= 47 \times 20)$$

Add.

$$\begin{array}{r} 47 \\ \times 23 \\ \hline 141 \\ 940 \\ \hline 1081 \end{array}$$

Writing the 0 is optional.



The place-value chart on the right above illustrates the placement of the products.

Note the placement of the products when we are multiplying by a factor that contains a zero.

**HOW TO 3**Multiply:  $439 \times 206$ 

$$\begin{array}{r} 439 \\ \times 206 \\ \hline 2634 \\ 000 \\ 878 \\ \hline 90,434 \end{array} \quad 0 \times 439$$

When working the problem, we usually write only one zero. Writing this zero ensures the proper placement of the products.

$$\begin{array}{r} 439 \\ \times 206 \\ \hline 2634 \\ 8780 \\ \hline 90,434 \end{array}$$

**EXAMPLE 2**

Find 829 multiplied by 603.

**Solution**

$$\begin{array}{r} 829 \\ \times 603 \\ \hline 2487 \\ 49740 \\ \hline 499,887 \end{array}$$

- $3 \times 829 = 2487$
- Write a zero in the tens column for  $0 \times 829$ .
- $6 \times 829 = 4974$

**YOU TRY IT 2**Multiply:  $756 \times 305$ **Your solution**

Solution on p. 27

**ESTIMATION****Estimating the Product of Two Whole Numbers**Calculate  $3267 \times 389$ . Then use estimation to determine whether the product is reasonable.

Multiply to find the exact product.

$$3267 \times 389 = 1,270,863$$

To estimate the product, round each number so that it has only one nonzero digit. Then multiply. The estimated answer is 1,200,000, which is very close to the exact product 1,270,863.

$$\begin{array}{r} 3267 \approx 3000 \\ \times 389 \approx \times 400 \\ \hline 1,200,000 \end{array}$$

**OBJECTIVE C** To solve application problems**EXAMPLE 3**

An auto mechanic receives a salary of \$1050 each week. How much does the auto mechanic earn in 4 weeks?

**Strategy**

To find the mechanic's earnings for 4 weeks, multiply the weekly salary (1050) by the number of weeks (4).

**Solution**

$$\begin{array}{r} 1050 \\ \times 4 \\ \hline 4200 \end{array}$$

The mechanic earns \$4200 in 4 weeks.

**YOU TRY IT 3**

A new-car dealer receives a shipment of 37 cars each month. Find the number of cars the dealer will receive in 12 months.

**Your strategy****Your solution****EXAMPLE 4**

A press operator earns \$640 for working a 40-hour week. This week the press operator also worked 7 hours of overtime at \$26 an hour. Find the press operator's total pay for the week.

**Strategy**

To find the press operator's total pay for the week:

- Find the overtime pay by multiplying the hours of overtime (7) by the overtime rate of pay (26).
- Add the weekly salary (640) to the overtime pay.

**Solution**

$$\begin{array}{r} 26 \\ \times 7 \\ \hline 182 \text{ overtime pay} \end{array} \qquad \begin{array}{r} 640 \\ + 182 \\ \hline 822 \end{array}$$

The press operator earned \$822 this week.

**YOU TRY IT 4**

The buyer for Ross Department Store can buy 80 men's suits for \$4800. Each sports jacket will cost the store \$23. The manager orders 80 men's suits and 25 sports jackets. What is the total cost of the order?

**Your strategy****Your solution**

## 1.4 EXERCISES

**OBJECTIVE A** To multiply a number by a single digit

For Exercises 1 to 4, write the expression as a product.

1.  $2 + 2 + 2 + 2 + 2 + 2$

2.  $4 + 4 + 4 + 4 + 4$

3.  $7 + 7 + 7 + 7$

4.  $18 + 18 + 18$

For Exercises 5 to 39, multiply.

5. 
$$\begin{array}{r} 3 \\ \times 4 \\ \hline \end{array}$$

6. 
$$\begin{array}{r} 2 \\ \times 8 \\ \hline \end{array}$$

7. 
$$\begin{array}{r} 5 \\ \times 7 \\ \hline \end{array}$$

8. 
$$\begin{array}{r} 6 \\ \times 4 \\ \hline \end{array}$$

9. 
$$\begin{array}{r} 5 \\ \times 5 \\ \hline \end{array}$$

10. 
$$\begin{array}{r} 7 \\ \times 7 \\ \hline \end{array}$$

11. 
$$\begin{array}{r} 0 \\ \times 7 \\ \hline \end{array}$$

12. 
$$\begin{array}{r} 8 \\ \times 0 \\ \hline \end{array}$$

13. 
$$\begin{array}{r} 8 \\ \times 9 \\ \hline \end{array}$$

14. 
$$\begin{array}{r} 7 \\ \times 6 \\ \hline \end{array}$$

15. 
$$\begin{array}{r} 66 \\ \times 3 \\ \hline \end{array}$$

16. 
$$\begin{array}{r} 70 \\ \times 4 \\ \hline \end{array}$$

17. 
$$\begin{array}{r} 67 \\ \times 5 \\ \hline \end{array}$$

18. 
$$\begin{array}{r} 127 \\ \times 9 \\ \hline \end{array}$$

19. 
$$\begin{array}{r} 623 \\ \times 4 \\ \hline \end{array}$$

20. 
$$\begin{array}{r} 802 \\ \times 5 \\ \hline \end{array}$$

21. 
$$\begin{array}{r} 607 \\ \times 9 \\ \hline \end{array}$$

22. 
$$\begin{array}{r} 300 \\ \times 5 \\ \hline \end{array}$$

23. 
$$\begin{array}{r} 600 \\ \times 7 \\ \hline \end{array}$$

24. 
$$\begin{array}{r} 906 \\ \times 8 \\ \hline \end{array}$$

25. 
$$\begin{array}{r} 703 \\ \times 9 \\ \hline \end{array}$$

26. 
$$\begin{array}{r} 127 \\ \times 5 \\ \hline \end{array}$$

27. 
$$\begin{array}{r} 632 \\ \times 3 \\ \hline \end{array}$$

28. 
$$\begin{array}{r} 559 \\ \times 4 \\ \hline \end{array}$$

29. 
$$\begin{array}{r} 632 \\ \times 8 \\ \hline \end{array}$$

30. 
$$\begin{array}{r} 524 \\ \times 4 \\ \hline \end{array}$$

31. 
$$\begin{array}{r} 337 \\ \times 5 \\ \hline \end{array}$$

32. 
$$\begin{array}{r} 841 \\ \times 6 \\ \hline \end{array}$$

33. 
$$\begin{array}{r} 6709 \\ \times 7 \\ \hline \end{array}$$

34. 
$$\begin{array}{r} 360 \\ \times \\ \hline \end{array}$$

35. 
$$\begin{array}{r} 8568 \\ \times 7 \\ \hline \end{array}$$

36. 
$$\begin{array}{r} 5495 \\ \times 4 \\ \hline \end{array}$$

37. 
$$\begin{array}{r} 4780 \\ \times 4 \\ \hline \end{array}$$

38. 
$$\begin{array}{r} 3690 \\ \times 5 \\ \hline \end{array}$$

39. 
$$\begin{array}{r} 989 \\ \times \\ \hline \end{array}$$



40. True or false? The product of two one-digit whole numbers must be a two-digit whole number.

41. Find the product of 5, 7, and 4.

42. Find the product of 6, 2, and 9.

43. What is 3208 multiplied by 7?

44. What is 5009 multiplied by 4?

45. What is 3105 times 6?

46. What is 8957 times 8?

**OBJECTIVE B** To multiply larger whole numbers

For Exercises 47 to 78, multiply.

47. 
$$\begin{array}{r} 16 \\ \times 21 \\ \hline \end{array}$$

48. 
$$\begin{array}{r} 18 \\ \times 24 \\ \hline \end{array}$$

49. 
$$\begin{array}{r} 35 \\ \times 26 \\ \hline \end{array}$$

50. 
$$\begin{array}{r} 27 \\ \times 72 \\ \hline \end{array}$$

51. 
$$\begin{array}{r} 693 \\ \times 91 \\ \hline \end{array}$$

52. 
$$\begin{array}{r} 581 \\ \times 72 \\ \hline \end{array}$$

53. 
$$\begin{array}{r} 419 \\ \times 80 \\ \hline \end{array}$$

54. 
$$\begin{array}{r} 727 \\ \times 60 \\ \hline \end{array}$$

55. 
$$\begin{array}{r} 8279 \\ \times 46 \\ \hline \end{array}$$

56. 
$$\begin{array}{r} 9577 \\ \times 35 \\ \hline \end{array}$$

57. 
$$\begin{array}{r} 6938 \\ \times 78 \\ \hline \end{array}$$

58. 
$$\begin{array}{r} 8875 \\ \times 67 \\ \hline \end{array}$$

59. 
$$\begin{array}{r} 7035 \\ \times 57 \\ \hline \end{array}$$

60. 
$$\begin{array}{r} 6702 \\ \times 48 \\ \hline \end{array}$$

61. 
$$\begin{array}{r} 3009 \\ \times 35 \\ \hline \end{array}$$

62. 
$$\begin{array}{r} 6003 \\ \times 57 \\ \hline \end{array}$$

63. 
$$\begin{array}{r} 809 \\ \times 530 \\ \hline \end{array}$$

64. 
$$\begin{array}{r} 607 \\ \times 460 \\ \hline \end{array}$$

65. 
$$\begin{array}{r} 800 \\ \times 325 \\ \hline \end{array}$$

66. 
$$\begin{array}{r} 700 \\ \times 274 \\ \hline \end{array}$$

3  
5  
—

67. 
$$\begin{array}{r} 987 \\ \times 349 \\ \hline \end{array}$$

68. 
$$\begin{array}{r} 688 \\ \times 674 \\ \hline \end{array}$$

69. 
$$\begin{array}{r} 312 \\ \times 134 \\ \hline \end{array}$$

70. 
$$\begin{array}{r} 423 \\ \times 427 \\ \hline \end{array}$$

5  
2  
—

71. 
$$\begin{array}{r} 379 \\ \times 500 \\ \hline \end{array}$$

72. 
$$\begin{array}{r} 684 \\ \times 700 \\ \hline \end{array}$$

73. 
$$\begin{array}{r} 985 \\ \times 408 \\ \hline \end{array}$$

74. 
$$\begin{array}{r} 758 \\ \times 209 \\ \hline \end{array}$$

75. 
$$\begin{array}{r} 3407 \\ \times 309 \\ \hline \end{array}$$

76. 
$$\begin{array}{r} 5207 \\ \times 902 \\ \hline \end{array}$$

77. 
$$\begin{array}{r} 4258 \\ \times 986 \\ \hline \end{array}$$

78. 
$$\begin{array}{r} 6327 \\ \times 876 \\ \hline \end{array}$$

79. Find a one-digit number and a two-digit number whose product is a number that ends in two zeros.

80. What is 5763 times 45?
81. What is 7349 times 27?
82. Find the product of 2, 19, and 34.
83. Find the product of 6, 73, and 43.
84. What is 376 multiplied by 402?
85. What is 842 multiplied by 309?



For Exercises 86 to 93, use a calculator to multiply. Then use estimation to determine whether the product is reasonable.

$$\begin{array}{r} 86. \quad 8745 \\ \times \quad 63 \\ \hline \end{array}$$

$$\begin{array}{r} 87. \quad 4732 \\ \times \quad 93 \\ \hline \end{array}$$

$$\begin{array}{r} 88. \quad 2937 \\ \times \quad 206 \\ \hline \end{array}$$

$$\begin{array}{r} 89. \quad 8941 \\ \times \quad 726 \\ \hline \end{array}$$

$$\begin{array}{r} 90. \quad 3097 \\ \times \quad 1025 \\ \hline \end{array}$$

$$\begin{array}{r} 91. \quad 6379 \\ \times \quad 2936 \\ \hline \end{array}$$

$$\begin{array}{r} 92. \quad 32,508 \\ \times \quad 591 \\ \hline \end{array}$$

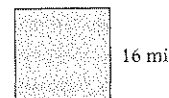
$$\begin{array}{r} 93. \quad 62,504 \\ \times \quad 923 \\ \hline \end{array}$$

### OBJECTIVE C To solve application problems

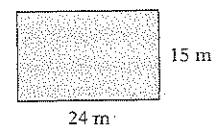


94. The price of Braeburn apples is \$1.29 per pound, and the price of Cameo apples is \$1.79 per pound. Which of the following represents the price of 3 pounds of Braeburn apples and 2 pounds of Cameo apples?
- (i)  $(3 \times 1.29) + (3 \times 1.79)$     (ii)  $(2 \times 1.29) + (3 \times 1.79)$   
 (iii)  $5 \times (1.29 + 1.79)$     (iv)  $(3 \times 1.29) + (2 \times 1.79)$

95. **Fuel Efficiency** Rob Hill owns a compact car that averages 43 miles on 1 gallon of gas. How many miles could the car travel on 12 gallons of gas?



96. **Fuel Efficiency** A plane flying from Los Angeles to Boston uses 865 gallons of jet fuel each hour. How many gallons of jet fuel were used on a 6-hour flight?



97. **Geometry** The perimeter of a square is equal to four times the length of a side of the square. Find the perimeter of a square whose side measures 16 miles.

98. **Geometry** The area of a rectangle is equal to the product of the length of the rectangle times its width. Find the area of a rectangle that has a length of 24 meters and a width of 15 meters. The area will be in square meters.



99. **Matchmaking Services** See the news clipping at the right. **a.** How many marriages occur between eHarmony members each week? **b.** How many marriages occur each year? Use a 365-day year.

#### In the News

##### Find Your Match Online

eHarmony, the online matchmaking service, boasts marriages among its members at the rate of 90 a day.

Source: *Time*, January 17, 2008

100. **College Education** See the news clipping at the right. **a.** Find the average cost of tuition, room, and board for 4 years at a public college. **b.** Find the average cost of tuition, room, and board for 4 years at a private college. **c.** Find the difference in cost for tuition, room, and board between 4 years at a private college and 4 years at a public college.

**In the News****Comparing Tuition Costs**

The average annual cost of tuition, room, and board at a four-year public college is \$12,796. At a four-year private college, the average cost is \$30,367.

Source: Kiplinger.com,  
January 24, 2007

**Construction** The table at the right shows the hourly wages of four different job classifications at a small construction company. Use this table for Exercises 101 to 103.

101. The owner of this company wants to provide the electrical installation for a new house. On the basis of the architectural plans for the house, it is estimated that it will require 3 electricians, each working 50 hours, to complete the job. What is the estimated cost for the electricians' labor?
102. Carlos Vasquez, a plumbing contractor, hires 4 plumbers from this company at the hourly wage given in the table. If each plumber works 23 hours, what are the total wages paid by Carlos?
103. The owner of this company estimates that remodeling a kitchen will require 1 electrician working 30 hours and 1 plumber working 33 hours. This project also requires 3 hours of clerical work and 4 hours of bookkeeping. What is the total cost for these four components of this remodeling?

Electrician	\$34
Plumber	\$30
Clerk	\$16
Bookkeeper	\$20

**Applying the Concepts**

104. Determine whether each of the following statements is always true, sometimes true, or never true.
- A whole number times zero is zero.
  - A whole number times one is the whole number.
  - The product of two whole numbers is greater than either one of the whole numbers.
105. **Safety** According to the National Safety Council, in a recent year a death resulting from an accident occurred at the rate of 1 every 5 minutes. At this rate, how many accidental deaths occurred each hour? Each day? Throughout the year? Explain how you arrived at your answers.
106. **Demographics** According to the Population Reference Bureau, in the world today, 261 people are born every minute and 101 people die every minute. Using this statistic, what is the increase in the world's population every hour? Every day? Every week? Every year? Use a 365-day year. Explain how you arrived at your answers.

