

1.1 Evaluating Algebraic Expressions

Essential Question How can you write and evaluate an expression that represents a real-life problem?

1 EXAMPLE: Reading and Re-Reading

You are babysitting for 3 hours. You will receive \$12. What is your hourly wage?

- Underline the numbers and units you need to solve the problem.

Write the problem.
Underline the important numbers and units.

Read the problem carefully a second time. Underline the key word for the question.

You are babysitting for 3 hours. You will receive \$12.
What is your hourly wage?

- Write each important number or word, with its units, on a piece of paper. Make five other pieces of paper with +, -, ×, ÷, and =.

3 h × + =
\$12 - ÷ hourly wage (\$ per hour)

- Arrange the pieces of paper to form an equation. Use it to answer the key word question “What is your hourly wage?”

hourly wage (\$ per hour) = \$12 ÷ 3 h
dollars per hour dollars per hour

Make sure the units for the key word are the same as the units in the expression.

- Evaluate the expression on the right side of the equation.

$$\begin{aligned} \text{Hourly wage} &= 12 \div 3 && \text{Write.} \\ &= 4 && \text{Evaluate.} \end{aligned}$$

• So, your hourly wage is \$4 per hour.

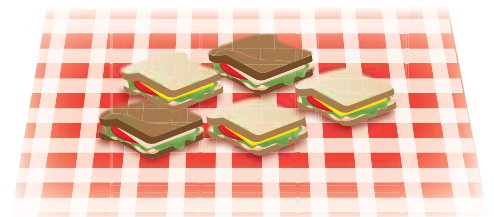
2 ACTIVITY: Reading and Re-Reading

Work with a partner. Use the strategy shown in Example 1 to write an expression for each problem. After you have written the expression, evaluate it using mental math or some other method.

- a. You are washing cars for 2 hours. You will receive \$6. How much will you earn per hour?



- b. You have \$60. You buy a pair of jeans and a shirt. The pair of jeans costs \$27. You come home with \$15. How much did you spend on the shirt?



- c. For lunch, you buy 5 sandwiches that cost \$3 each. How much do you spend?



- d. You are running a 4500-foot race. How much farther do you have left to go after running 2000 feet?

- e. A young rattlesnake grows at a rate of about 20 centimeters per year. How much does a young rattlesnake grow in 2 years?



What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you write and evaluate an expression that represents a real-life problem? Give one example with addition, one with subtraction, one with multiplication, and one with division.

Practice

Use what you learned about evaluating expressions to complete Exercises 4–7 on page 6.

1.1 Lesson

Key Vocabulary

numerical expression,
p. 4
algebraic expression,
p. 4
evaluate, p. 4

A **numerical expression** contains only numbers and operations. An **algebraic expression** may contain numbers, operations, and one or more variables. Here are some examples.

Numerical Expression

$$15 + 9 \cdot 3$$

Algebraic Expression

$$45 \div p - q$$

To **evaluate** an algebraic expression, substitute a number for each variable. Then use the order of operations to find the value of the numerical expression.

EXAMPLE 1 Evaluating Algebraic Expressions

a. Evaluate $k + 10$ when $k = 25$.

$$\begin{array}{l} \text{Substitute 25 for } k. \\ k + 10 = 25 + 10 \\ = 35 \end{array} \quad \begin{array}{l} \text{Add 25 and 10.} \end{array}$$

b. Evaluate $4 \cdot n$ when $n = 12$.

$$\begin{array}{l} \text{Substitute 12 for } n. \\ 4 \cdot n = 4 \cdot 12 \\ = 48 \end{array} \quad \begin{array}{l} \text{Multiply 4 and 12.} \end{array}$$

Study Tip

You can write the product of 4 and n in several ways.

$$\begin{array}{l} 4 \cdot n \\ 4n \\ 4(n) \end{array}$$

On Your Own

1. Evaluate $24 + c$ when $c = 9$.
2. Evaluate $d - 17$ when $d = 30$.

EXAMPLE 2 Evaluating an Expression with Two Variables

Evaluate $a \div b$ when $a = 27$ and $b = 3$.

$$\begin{array}{l} \text{Substitute 27 for } a. \\ a \div b = 27 \div 3 \\ = 9 \end{array} \quad \begin{array}{l} \text{Substitute 3 for } b. \\ \text{Divide 27 by 3.} \end{array}$$

On Your Own

Evaluate the expression when $p = 24$ and $q = 8$.

3. $p \div q$
4. $q + p$
5. $p - q$
6. pq

Now You're Ready
Exercises 8–19

EXAMPLE 3 Evaluating Expressions with Two Operations

a. Evaluate $3x - 14$ when $x = 5$.

$$\begin{aligned} 3x - 14 &= 3(5) - 14 && \text{Substitute 5 for } x. \\ &= 15 - 14 && \text{Using order of operations, multiply 3 and 5.} \\ &= 1 && \text{Subtract 14 from 15.} \end{aligned}$$

b. Evaluate $z^2 + 8.5$ when $z = 2$.

$$\begin{aligned} z^2 + 8.5 &= (2)^2 + 8.5 && \text{Substitute 2 for } z. \\ &= 4 + 8.5 && \text{Using order of operations, evaluate } 2^2. \\ &= 12.5 && \text{Add 4 and 8.5.} \end{aligned}$$

On Your Own

Now You're Ready
Exercises 25–33

Evaluate the expression when $y = 6$.

7. $5y + 1$

8. $30 - 24 \div y$

9. $y^2 - 7$

10. $1.5 + y^2$

EXAMPLE 4 Real-Life Application



You are saving for a skateboard. Your aunt gives you \$45 to start and you save \$3 each week. The expression $45 + 3w$ gives the amount of money you save after w weeks.

a. How much will you have after 4 weeks, 10 weeks, and 20 weeks?

b. After 20 weeks, can you buy the skateboard? Explain.

Substitute the given number of weeks for w .

a.

Number of Weeks, w	$45 + 3w$	Amount Saved
4	$45 + 3(4)$	$45 + 12 = \$57$
10	$45 + 3(10)$	$45 + 30 = \$75$
20	$45 + 3(20)$	$45 + 60 = \$105$

b. After 20 weeks, you have \$105. So, you cannot buy the \$125 skateboard.

On Your Own

11. **WHAT IF?** In Example 4, the expression for how much money you have after w weeks is $45 + 4w$. Can you buy the skateboard after 20 weeks? Explain.

Vocabulary and Concept Check

1. **VOCABULARY** Copy and complete the table.

Algebraic Expression	Numbers	Variables	Operations
$x - 8$	8	x	Subtraction
$3w + 9$			
$6y - 12$			

Sample

2. **NUMBER SENSE** Which step in the order of operations is first? second? third? fourth?

Add and subtract from left to right.

Multiply and divide from left to right.

Evaluate powers.

Evaluate expressions inside grouping symbols.

3. **NUMBER SENSE** Will the expression $20 - x$ get *larger*, *smaller*, or *stay the same* as x gets larger? Explain.

Practice and Problem Solving

Write and evaluate an expression for the problem.

- You receive \$8 for raking leaves for 2 hours. What is your hourly wage?
- Music lessons cost \$20 per week. How much do 6 weeks of lessons cost?
- The scores on your first two history tests were 82 and 95. By how many points did you improve on your second test?
- You buy a hat for \$12 and give the cashier a \$20 bill. How much change do you receive?

ALGEBRA Evaluate the expression when $a = 3$, $b = 2$, and $c = 12$.

- | | | | | | |
|---|---|--------------|----------------|-------------------|-----------------|
| 1 | 2 | 8. $6 + a$ | 9. $b \cdot 5$ | 10. $c - 1$ | 11. $27 \div a$ |
| | | 12. $12 - b$ | 13. $c + 5$ | 14. $2a$ | 15. $c \div 6$ |
| | | 16. $a + b$ | 17. $c - a$ | 18. $\frac{c}{a}$ | 19. $b \cdot c$ |

20. **ERROR ANALYSIS** Describe and correct the error in evaluating the expression when $m = 8$.

X

$$\begin{aligned} 5m + 3 &= 5 \cdot 8 + 3 \\ &= 5 \cdot 11 \\ &= 55 \end{aligned}$$

21. **LAWNS** You earn $15n$ dollars for mowing n lawns. How much do you earn for mowing one lawn? seven lawns?

22. **FINGERNAIL** After m months, the length of a fingernail is $10 + 3m$ millimeters. How long is the fingernail after eight months? three years?

Copy and complete the table.

23.

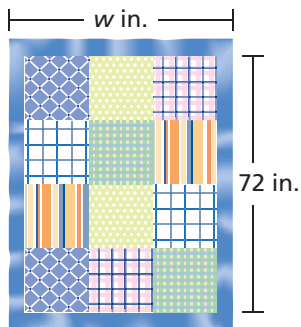
x	3	6	9
$x \cdot 8$			

24.

x	2	4	8
$64 \div x$			

ALGEBRA Evaluate the expression when $a = 10$, $b = 9$, and $c = 4$.

25. $2a + 3$ 26. $4c - 7.8$ 27. $\frac{a}{2} + 1$
28. $\frac{27}{b} + 8$ 29. $c^2 + 6$ 30. $a^2 - 18$
31. $a + 9c$ 32. $bc + 12.3$ 33. $3a + 2b - 6c$



34. **QUILT** You are bordering a quilt with a blue ribbon. Which expression tells you how much ribbon you will need? Draw a diagram to help explain your reasoning.

$$2(w + 72)$$

$$2w + 72$$

35. **DECK** Your deck has an area of 128 square feet. After adding a section, the area will be $s^2 + 128$ square feet. Draw a diagram of how this can happen.

36. **SCIENCE CENTER** The expression $20a + 13c$ is the cost for a adults and c students to enter the Science Center.

- a. Find the total cost for 4 adults and 24 students.
- b. You find the cost for a group. Then the numbers of adults and students in the group both double. Does the cost double? Explain your answer using an example.
- c. **Reasoning** In part (a), the number of adults doubles, but the number of students is cut in half. Is the cost the same? Explain your answer using an example.



Fair Game Review What you learned in previous grades & lessons

Plot the points in a coordinate plane. (*Skills Review Handbook*)

37. (3, 2) 38. (2, 3) 39. (5, 1) 40. (1, 8)

41. **MULTIPLE CHOICE** Which numbers have a least common multiple of 24?
(*Skills Review Handbook*)

- (A) 4, 6 (B) 2, 22 (C) 3, 8 (D) 6, 12