

# 3.1 Algebraic Expressions

## Essential Question How can you simplify an algebraic expression?

### 1 ACTIVITY: Simplifying Algebraic Expressions

Work with a partner.

- a. Evaluate each algebraic expression when  $x = 0$  and when  $x = 1$ . Use the results to match each expression in the left table with its equivalent expression in the right table.



	Expression	Value When	
		$x = 0$	$x = 1$
A.	$3x + 2 - x + 4$		
B.	$5(x - 3) + 2$		
C.	$x + 3 - (2x + 1)$		
D.	$-4x + 2 - x + 3x$		
E.	$-(1 - x) + 3$		
F.	$2x + x - 3x + 4$		
G.	$4 - 3 + 2(x - 1)$		
H.	$2(1 - x + 4)$		
I.	$5 - (4 - x + 2x)$		
J.	$5x - (2x + 4 - x)$		



	Expression	Value When	
		$x = 0$	$x = 1$
a.	4		
b.	$-x + 1$		
c.	$4x - 4$		
d.	$2x + 6$		
e.	$5x - 13$		
f.	$-2x + 10$		
g.	$x + 2$		
h.	$2x - 1$		
i.	$-2x + 2$		
j.	$-x + 2$		

- b. Compare each expression in the left table with its equivalent expression in the right table. In general, how do you think you obtain the equivalent expression in the right column?

#### Algebraic Expressions

In this lesson, you will

- apply properties of operations to simplify algebraic expressions.
- solve real-life problems.

2

**ACTIVITY: Writing a Math Lesson****Math Practice****Communicate Precisely**

What can you do to make sure that you are communicating exactly what is needed in the Key Idea?

Work with a partner. Use your results from Activity 1 to write a lesson on simplifying an algebraic expression.

Describe steps you can use to simplify an expression.

**Simplifying an Algebraic Expression**

**Key Idea** Use the following steps to simplify an algebraic expression.

- 1.
- 2.
- 3.

Write 3 examples. Use expressions from Activity 1.

**Examples**

a.

b.

c.

Write 3 exercises. Use expressions different from the ones in Activity 1.

**Exercises**

Simplify the expression.

- 1.
- 2.
- 3.

**What Is Your Answer?**

3. **IN YOUR OWN WORDS** How can you simplify an algebraic expression? Give an example that demonstrates your procedure.
4. **REASONING** Why would you want to simplify an algebraic expression? Discuss several reasons.

**Practice**

Use what you learned about simplifying algebraic expressions to complete Exercises 12–14 on page 84.

**Key Vocabulary**

like terms, p. 82  
simplest form, p. 82

Parts of an algebraic expression are called *terms*. **Like terms** are terms that have the same variables raised to the same exponents. Constant terms are also like terms. To identify terms and like terms in an expression, first write the expression as a sum of its terms.

**EXAMPLE 1** Identifying Terms and Like Terms

Identify the terms and like terms in each expression.

a.  $9x - 2 + 7 - x$

Rewrite as a sum of terms.

$$9x + (-2) + 7 + (-x)$$

**Terms:**  $9x$ ,  $-2$ ,  $7$ ,  $-x$

**Like terms:**  $9x$  and  $-x$ ,  $-2$  and  $7$

b.  $z^2 + 5z - 3z^2 + z$

Rewrite as a sum of terms.

$$z^2 + 5z + (-3z^2) + z$$

**Terms:**  $z^2$ ,  $5z$ ,  $-3z^2$ ,  $z$

**Like terms:**  $z^2$  and  $-3z^2$ ,  $5z$  and  $z$

An algebraic expression is in **simplest form** when it has no like terms and no parentheses. To *combine* like terms that have variables, use the Distributive Property to add or subtract the coefficients.

**EXAMPLE 2** Simplifying an Algebraic Expression

**Study Tip**

To subtract a variable term, add the term with the opposite coefficient.

Simplify  $\frac{3}{4}y + 12 - \frac{1}{2}y - 6$ .

$$\frac{3}{4}y + 12 - \frac{1}{2}y - 6 = \frac{3}{4}y + 12 + \left(-\frac{1}{2}y\right) + (-6) \quad \text{Rewrite as a sum.}$$

$$= \frac{3}{4}y + \left(-\frac{1}{2}y\right) + 12 + (-6) \quad \text{Commutative Property of Addition}$$

$$= \left[\frac{3}{4} + \left(-\frac{1}{2}\right)\right]y + 12 + (-6) \quad \text{Distributive Property}$$

$$= \frac{1}{4}y + 6 \quad \text{Combine like terms.}$$

**On Your Own**

Identify the terms and like terms in the expression.

1.  $y + 10 - \frac{3}{2}y$       2.  $2r^2 + 7r - r^2 - 9$       3.  $7 + 4p - 5 + p + 2q$

Simplify the expression.

4.  $14 - 3z + 8 + z$       5.  $2.5x + 4.3x - 5$       6.  $\frac{3}{8}b - \frac{3}{4}b$

**Now You're Ready**  
Exercises 5–10  
and 12–17

### EXAMPLE 3 Simplifying an Algebraic Expression

Simplify  $-\frac{1}{2}(6n + 4) + 2n$ .

$$-\frac{1}{2}(6n + 4) + 2n = -\frac{1}{2}(6n) + \left(-\frac{1}{2}\right)(4) + 2n \quad \text{Distributive Property}$$

$$= -3n + (-2) + 2n \quad \text{Multiply.}$$

$$= -3n + 2n + (-2) \quad \text{Commutative Property of Addition}$$

$$= (-3 + 2)n + (-2) \quad \text{Distributive Property}$$

$$= -n - 2 \quad \text{Simplify.}$$

#### On Your Own

Now You're Ready  
Exercises 18–20

Simplify the expression.

7.  $3(q + 1) - 4$

8.  $-2(g + 4) + 7g$

9.  $7 - 4\left(\frac{3}{4}x - \frac{1}{4}\right)$

### EXAMPLE 4 Real-Life Application



**ROYAL CINEMAS**

<b>Evening Tickets</b>	\$7.50
<b>REFRESHMENTS</b>	
<b>Drinks</b>	
	Small \$1.75
	Medium \$2.75
	Large \$3.50
<b>Popcorn</b>	
	Small \$3.00
	Large \$4.00

Each person in a group buys a ticket, a medium drink, and a large popcorn. Write an expression in simplest form that represents the amount of money the group spends at the movies. Interpret the expression.

**Words** Each is each medium is and each large is \$4.  
ticket \$7.50, drink \$2.75, popcorn

**Variable** The same number of each item is purchased. So,  $x$  can represent the number of tickets, the number of medium drinks, and the number of large popcorns.

**Expression**  $7.50x + 2.75x + 4x$

$$7.50x + 2.75x + 4x = (7.50 + 2.75 + 4)x \quad \text{Distributive Property}$$
$$= 14.25x \quad \text{Add coefficients.}$$

❖ The expression  $14.25x$  indicates that the total cost per person is \$14.25.

#### On Your Own

10. **WHAT IF?** Each person buys a ticket, a large drink, and a small popcorn. How does the expression change? Explain.

## Vocabulary and Concept Check

- WRITING** Explain how to identify the terms of  $3y - 4 - 5y$ .
- WRITING** Describe how to combine like terms in the expression  $3n + 4n - 2$ .
- VOCABULARY** Is the expression  $3x + 2x - 4$  in simplest form? Explain.
- REASONING** Which algebraic expression is in simplest form? Explain.

$$5x - 4 + 6y$$

$$4x + 8 - x$$

$$3(7 + y)$$

$$12n - n$$

## Practice and Problem Solving

Identify the terms and like terms in the expression.

5.  $t + 8 + 3t$
6.  $3z + 4 + 2 + 4z$
7.  $2n - n - 4 + 7n$
8.  $-x - 9x^2 + 12x^2 + 7$
9.  $1.4y + 5 - 4.2 - 5y^2 + z$
10.  $\frac{1}{2}s - 4 + \frac{3}{4}s + \frac{1}{8} - s^3$
11. **ERROR ANALYSIS** Describe and correct the error in identifying the like terms in the expression.



$$3x - 5 + 2x^2 + 9x = 3x + 2x^2 + 9x - 5$$

Like Terms:  $3x$ ,  $2x^2$ , and  $9x$

Simplify the expression.

12.  $12g + 9g$
13.  $11x + 9 - 7$
14.  $8s - 11s + 6$
15.  $4.2v - 5 - 6.5v$
16.  $8 + 4a + 6.2 - 9a$
17.  $\frac{2}{5}y - 4 + 7 - \frac{9}{10}y$
18.  $4(b - 6) + 19$
19.  $4p - 5(p + 6)$
20.  $-\frac{2}{3}(12c - 9) + 14c$

21. **HIKING** On a hike, each hiker carries the items shown. Write an expression in simplest form that represents the weight carried by  $x$  hikers. Interpret the expression.



22. **STRUCTURE** Evaluate the expression  $-8x + 5 - 2x - 4 + 5x$  when  $x = 2$  before and after simplifying. Which method do you prefer? Explain.
23. **REASONING** Are the expressions  $8x^2 + 3(x^2 + y)$  and  $7x^2 + 7y + 4x^2 - 4y$  equivalent? Explain your reasoning.
24. **CRITICAL THINKING** Which solution shows a correct way of simplifying  $6 - 4(2 - 5x)$ ? Explain the errors made in the other solutions.

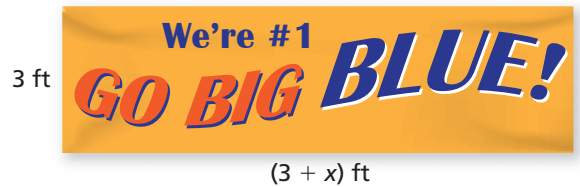
(A)  $6 - 4(2 - 5x) = 6 - 4(-3x) = 6 + 12x$

(B)  $6 - 4(2 - 5x) = 6 - 8 + 20x = -2 + 20x$

(C)  $6 - 4(2 - 5x) = 2(2 - 5x) = 4 - 10x$

(D)  $6 - 4(2 - 5x) = 6 - 8 - 20x = -2 - 20x$

25. **BANNER** Write an expression in simplest form that represents the area of the banner.



	Car	Truck
Wash	\$8	\$10
Wax	\$12	\$15

26. **CAR WASH** Write an expression in simplest form that represents the earnings for washing and waxing  $x$  cars and  $y$  trucks.

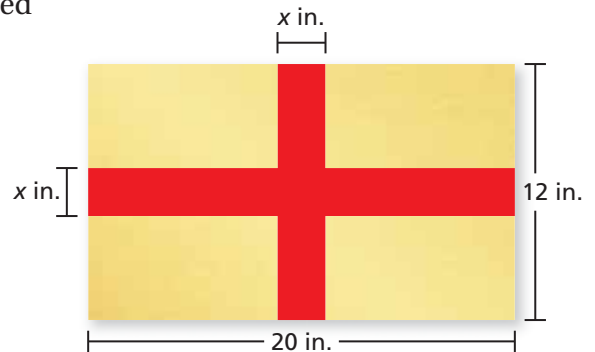
**MODELING** Draw a diagram that shows how the expression can represent the area of a figure. Then simplify the expression.

27.  $5(2 + x + 3)$

28.  $(4 + 1)(x + 2x)$

29. **Critical Thinking** You apply gold foil to a piece of red poster board to make the design shown.

- Write an expression in simplest form that represents the area of the gold foil.
- Find the area of the gold foil when  $x = 3$ .
- The pattern at the right is called "St. George's Cross." Find a country that uses this pattern as its flag.



## Fair Game Review what you learned in previous grades & lessons

Order the lengths from least to greatest. (*Skills Review Handbook*)

30. 15 in., 14.8 in., 15.8 in., 14.5 in., 15.3 in.    31. 0.65 m, 0.6 m, 0.52 m, 0.55 m, 0.545 m

32. **MULTIPLE CHOICE** A bird's nest is 12 feet above the ground. A mole's den is 12 inches below the ground. What is the difference in height of these two positions? (*Section 1.3*)

(A) 24 in.

(B) 11 ft

(C) 13 ft

(D) 24 ft