# Lesson 17 Introduction Equivalent Expressions

# **Use What You Know**

In Lesson 16, you learned to read, write, and evaluate expressions with variables. Now, take a look at this problem.

Write an expression that is equivalent to (3 + 14) + 27.

Use the math you know to answer the question
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- **a.** Which two terms in (3 + 14) + 27 could you add to get a multiple of ten?
- **b.** Rewrite the expression so that these two terms are next to each other.
- **c.** Did rewriting the expression change its value? Explain.
- **d.** Rewrite the expression with parentheses to show that the two terms with the sum that is a multiple of 10 should be added first.
- **e.** Did rewriting the expression change its value? Explain.
- **f.** What is the common factor of the numbers in parentheses?
- **g.** Rewrite the expression so that it is a number plus the product of a number and a sum.
- **h.** Does rewriting the expression this way change its value? Which property of operations supports your answer?
- i. Explain why you might want to write an equivalent expression.

# >> Find Out More

In the problem on the previous page, you applied properties of operations to an expression with all constant terms to create equivalent expressions.

$$(3 + 14) + 27 = (14 + 3) + 27$$

#### **Commutative property of addition**

Reordering the terms does not change the value of the expression.

$$(14 + 3) + 27 = 14 + (3 + 27)$$

#### **Associative property of addition**

Regrouping the terms does not change the value of the expression.

$$14 + (3 + 27) = 14 + 3(1 + 9)$$

#### **Distributive property**

Distributing the common factor does not change the value of the expression.

The same is true for expressions with variable terms. You can apply properties of operations to a variable expression to create equivalent variable expressions.

$$(3x + 14) + 27 = (14 + 3x) + 27$$

(3x + 14) + 27 = (14 + 3x) + 27 Commutative property of addition

$$(14 + 3x) + 27 = 14 + (3x + 27)$$

Associative property of addition

$$14 + (3x + 27) = 14 + 3(x + 9)$$

Distributive property

### Reflect

1	Henry says that you can apply the commutative and associative properties to $5x + 10$
	and get $10x + 5$ . Is Henry correct? Explain.

# **Learn About** Properties of Operations

Read the problem below. Then explore how to use properties of operations to write equivalent expressions with variables.

Jamie has 4 bags of apples. Ashley has 3 bags of apples. Each bag has the same number of apples in it.

Write an expression for the total number of apples. Then simplify it to create an equivalent expression.

#### Picture It Draw a picture of the bags of apples.



### Model It Model the bags of apples with math tiles.



# **Connect It** Now solve the problem. 2 In both *Picture It* and *Model It* on the previous page, what does x represent? Write an expression for Jamie's total number of apples. \_\_\_\_\_ Write an expression for Ashley's total number of apples. \_\_\_\_\_ Write an expression for the combined total of Jamie's and Ashley's apples. When two or more terms in a variable expression have the same variable factors, they are called **like terms**. You can use the distributive property to simplify an expression with like terms. 4 What is the common factor for each term in your expression from problem 3? \_\_\_\_ 5 Distribute the common factor and simplify the expression. 6 What does the simplified expression mean? \_ **7** Explain how to simplify an expression with like terms, such as 6g + 5g. Try It Use what you just learned about writing equivalent expressions to solve these problems. Show your work on a separate sheet of paper. 8 A school cafeteria has 30 boxes of Wheaty Squares cereal and 20 boxes of Mighty O's cereal. Each box has the same number of ounces of cereal. Write an expression to represent the total ounces of cereal. Then simplify it to create an equivalent expression. 9 The inspector at a bottling plant checks 25 bottles. Two bottles do not pass inspection. All the bottles hold the same number of milliliters of sports drink. Write an

expression for the milliliters of sports drink that pass inspection. Then simplify it to

create an equivalent expression.

# Learn About Properties of Equivalent Expressions

Read the problem below. Then continue exploring how to use properties of operations to write equivalent expressions with variables.

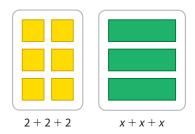
Javier creates a rectangular painting. The painting is 3 feet long and more than 2 feet wide. The expression 3(2 + x) represents the area of the painting.

Write an expression equivalent to 3(2 + x).

**Model It** The multiplication expression 3(2 + x) means three groups of 2 + x. Use math tiles to model three groups of 2 + x.

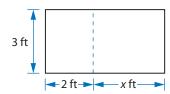


Reorder and regroup the tiles.



Compare 3(2 + x) and (2 + 2 + 2) + (x + x + x).

Picture It Draw and label a picture of Javier's painting. Imagine dividing the painting into two smaller rectangles.



The area of the whole painting is 3(2 + x).

# Connect It Now solve the problem.

10 The expression 3(2 + x) is a product of the factors 3 and \_\_\_\_\_\_.

- 11 In Model It, what expression is equivalent to 3(2 + x)? Explain.
- 12 Look at *Picture It*. Explain why the area of the whole painting is 3(2 + x).
- In *Picture It*, the area of the left side of the rectangle is \_\_\_\_\_\_. The area of the right side is \_\_\_\_\_\_. Write an expression for the area of the whole painting: \_\_\_\_\_\_.
- 14 Compare 3(2 + x) to the equivalent expression in 13. What property did you apply?
- 15 Simplify the expression from problem 14.
- 16 Is 3(2 + x) equivalent to your simplified expression? Explain.

**Try It** Use what you just learned about using the distributive property to write an equivalent expression to solve these problems. Show your work on a separate sheet of paper.

- Use the distributive property to write an expression that is equivalent to 5(2x-1).
- 18 Use the distributive property to write an expression that is equivalent to 18 + 24x.



# Learn About Determining Whether Expressions **Are Equivalent**

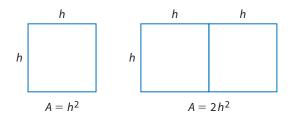
Read the problem below. Then explore how to determine if expressions are equivalent.

Is  $5h + 2h^2$  equivalent to 7h? Explain.

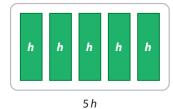
**Picture It** Imagine line segments that are h, 5h, and 7h units long.

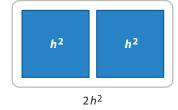


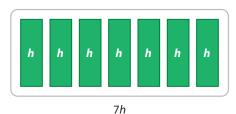
Imagine rectangles that are  $h^2$  and  $2h^2$  square units in area.



**Model It** Use math tiles to model 5h,  $2h^2$ , and 7h.







# Connect It Now solve the problem.

Look at *Picture It*. If you combine the line that is 5h units long and the rectangle that is  $2h^2$  units in area, do you get a figure that looks like the line that is 7h units long?

- Look at *Model It*. If you put the tiles representing 5h together with the tiles representing  $2h^2$ , do you get a set of tiles that represents 7h?
- Richard says that 5h and  $2h^2$  are like terms because they both have the variable h. Is Richard correct? Explain.

- Is  $5h + 2h^2 = 7h$  a true statement? Substitute a value other than 0 or 1 for h and evaluate  $5h + 2h^2$  and 7h to support your answer.
- 23 Apply the distributive property to write an expression that is equivalent to  $5h + 2h^2$ . Show your work.

# **Try It** Use what you just learned to solve these problems. Show your work on a separate sheet of paper.

- 24 Are 3x + 6 + x and 2(2x + 3) equivalent expressions? Use substitution to check your answer.
- Are 8(w + 6) and 5 + 8w + 1 equivalent expressions? Use substitution to check your answer.



# Practice Determining Whether Expressions Are Equivalent

Study the example below. Then solve problems 26-28.

#### Example

Are y + 2y - 3 and 3(y - 1) equivalent expressions? Explain.

Look at how you can apply the properties of operations to show your answer.

$$y + 2y - 3 = y(1 + 2) - 3$$
  
=  $3y - 3$   
=  $3(y - 1)$ 

Solution Yes; I can apply the properties of operations to

y + 2y - 3 without changing its value and get 3(y - 1). If I let

$$y = 2$$
,  $y + 2y - 3 = 2 + 2(2) - 3 = 2 + 4 - 3 = 6 - 3 = 3$ 

and 
$$3(y-1) = 3(2-1) = 3(1) = 3$$
. Since  $3 = 3$ , I know

$$y + 2y - 3 = 3(y - 1).$$

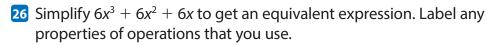


Two expressions are equivalent if you can simplify one expression and get the other expression.



#### Pair/Share

Which property of operations allows you to combine like terms without changing the value of an expression?



Show your work.



If the terms of an expression have a common factor, you can apply the distributive property to simplify the expression.



#### Pair/Share

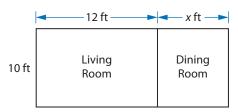
Are  $6x^3$  and  $6x^2$  like terms? Why or why not?

**Solution** 

Dalia's living room is 12 feet long and 10 feet wide. Her dining room is also 10 feet wide. Write two equivalent expressions that each represent the combined area of the two rooms.



Show your work.



Draw and label a picture to help you organize the given information.

How

#### Pair/Share

How could you show that the two expressions are equivalent?

Solution

Which expression is equivalent to 2 + 3n + 2 + 9n?



**B** 
$$3n + 8$$

**C** 
$$4(3n + 1)$$

**D** 
$$4(3n + 4)$$

Anya chose **D** as the correct answer. How did she get that answer?



Combine like terms and apply properties of operations to simplify an expression.

## Pair/Share

How could Anya check her answer?

# **Practice**

# **Determining Whether Expressions Are Equivalent**

#### Solve the problems.

- 1 The expression 0.25(2d + 1) represents the fine for a book that is d days overdue. Which expression is equivalent to 0.25(2d + 1)?
  - **A** 0.252d + 1
  - **B** 0.50d + 0.25
  - **C** 2d + 0.25
  - **D** 0.50d + 1
- 2 A game company makes a board game that comes with 2 dice and a card game that comes with 3 dice. Which expression shows the total number of dice in b boxes of the board game and b boxes of the card game?
  - **A** 5b
  - **B** 5(2*b*)
  - **C** 5 + b
  - **D** 2b + 3
- 3 Look at the equations below. Choose *True* or *False* for each equation.
  - **a.** f + f + f = 3f

- True **False**
- **b.**  $4 \times n \times n \times n \times n = 4n^4$
- True False
- **c.** 10h 10 = 10 10h
- True False
- **d.**  $x^2 + 3v = (x + x) + v \times v \times v$
- True False
- **e.**  $6 \times (2 + 7) = (6 \times 2) + 7$
- True **False**

4	Look at each expression below. Is it equivalent to $42x - 56y$ ? Select Yes or No for
	expressions A–D.

a.	7(6x - 8y)	Yes

**b.** 
$$40(2x - 16y)$$
 Yes No

**c.** 
$$14(x + 2x + 7y - 3y)$$
 Yes No

**d.** 
$$42(x + 14y)$$
 Yes No

5	laylor writes an expression with 5 terms. All 5 terms are like terms. How many terms are in
	the equivalent expression with the <i>least</i> number of terms? Explain.

No

Kari uses substitution to decide whether $x^2 + x$ is equivalent to $x(2x + 1)$ . She says the expressions are equivalent because they have the same value when $x = 0$ . Is Kari correct? Explain.

Self Check Go back and see what you can check off on the Self Check on page 143.