Are They Saying the Same Thing?

4

Verifying Equivalent Expressions

WARM UP

Determine which pairs of ratios are equivalent. Explain how you know.

1. 5:7 and 100:140

2. 42:48 and 14:15

3. 105:100 and 20:21

4. 9:12 and 60:80

LEARNING GOALS

- Compare expressions using properties, tables, and graphs.
- Identify when two expressions are equivalent.
- Determine if two expressions are equivalent.

You know how to use the Distributive Property and combine like terms to write equivalent expressions. How can you determine if two given expressions are equivalent?

Getting Started

Property Sort

Cut out the Property Cards located at the end of the lesson.

On each card is one representation of a property of numbers or operations that you have used in the past to rewrite and evaluate numeric expressions.

1. **Sort the cards according to the property named or illustrated on the cards. Create a table that shows your final sorting.**

2. **Using complete sentences, write an explanation for how each picture illustrates its property.**

ACTIVITY 4.1

Determining Whether Expressions Are Equivalent

NOTES

Two algebraic expressions are **equivalent expressions** if, when any values are substituted for the variables, the results are equal.

While it's not realistic to test each expression for every possible value for the unknown, you can examine the characteristics of each expression in the different representations:

- a table of values
- rewritten expressions using the properties
- a graph of both expressions

Let's explore each representation.

Consider the two expressions $2(x + 2) + 3x$ and $5x + 4$.

1. Use a table to evaluate each expression for different values of the variable.

a. Complete the table of values for each value of x.

x	$2(x + 2) + 3x$	$5x + 4$
0		
1		
2		
3		

b. What can you determine based on the values in the table?

c. What would you need to know to be able to verify that the two expressions are equivalent?

2. **Rewrite the given expression and identify the property applied at each step.**

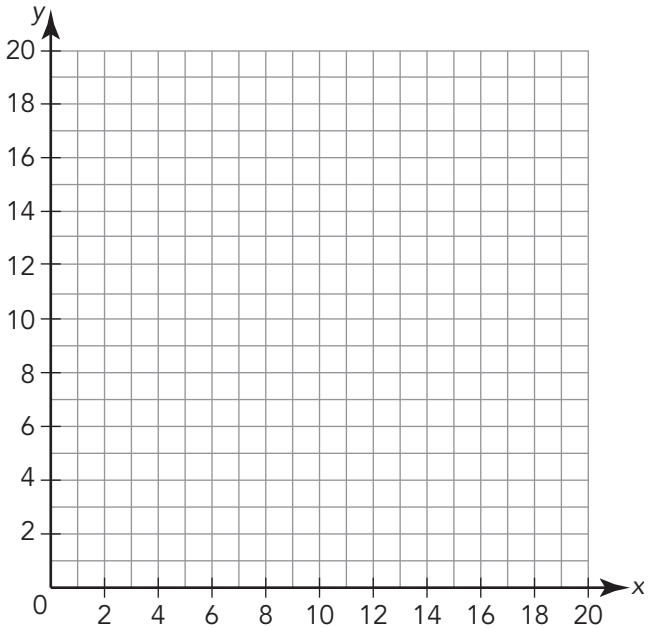
$2(x + 2) + 3x$	Given
$= 2x +$ _____ $+ 3x$	_____
$=$ _____ $x + 4$	Combine Like Terms/Addition

3. **Are the two expressions equivalent? Explain.**

You can also use a graph to determine or verify if two expressions are equivalent.

4. **Use the table of values to sketch the graph of both expressions on the coordinate plane.**

   a. **Plot the values for each expression on the coordinate plane. Use a □ to represent the values from the first expression and a △ for the values from the second expression. Then, connect the results for each expression with a line.**



   b. **How does the graph demonstrate that the two expressions are equivalent?**

NOTES

Now, let's consider the expressions $2x + 5$ and $2(x + 5)$.

5. Use a table to evaluate each expression for different values of the variable.

a. Complete the table of values for each value of x.

x	$2x + 5$	$2(x + 5)$
0		
2		
4		
5		

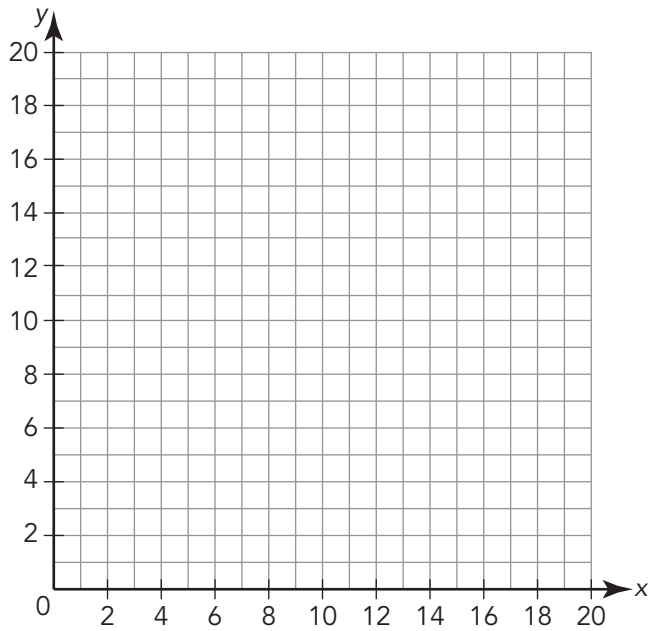
b. What can you determine based on the values in the table?

6. Use the Distributive Property to rewrite the second expression.

7. Are the two expressions equivalent? Explain your reasoning.

8. **Use the table of values to sketch the graph of both expressions on the coordinate plane.**

   a. **Plot the values for each expression on the coordinate plane. Use a □ to represent the values from the first expression and a △ for the values from the second expression. Then, connect the results for each expression with a line.**



   b. **What does the graph tell you about the equivalence of the two expressions?**

For each pair of expressions, use a table, properties, and a graph to determine if the expressions are equivalent.

9. **$(3x + 8) + (6 - x)$ and $4x + 14$**

   a.

x	$(3x + 8) + (6 - x)$	$4x + 14$
0		
1		
2		

b. $(3x + 8) + (6 - x)$ — Given

$= (3x + 8) + (6 - x)$ — Commutative Property of Addition

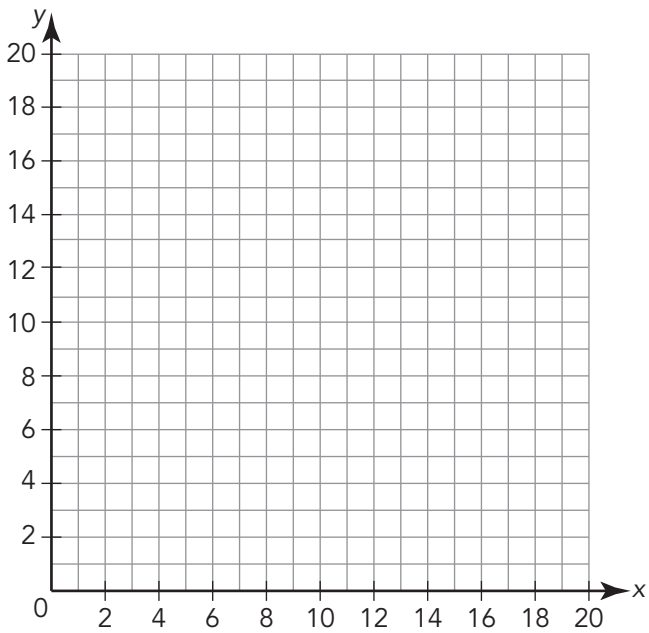
$= 3x + (8 + 6) - x$ — _____

$= 3x +$ _____ $- x$ — Combine Like Terms

$=$ _____ $+ 3x - x$ — _____

$=$ _____ — _____

c.



d. Are the two expressions equivalent? Explain using all three representations.

10. $x + 3(2x + 1)$ and $7x + 3$

a.

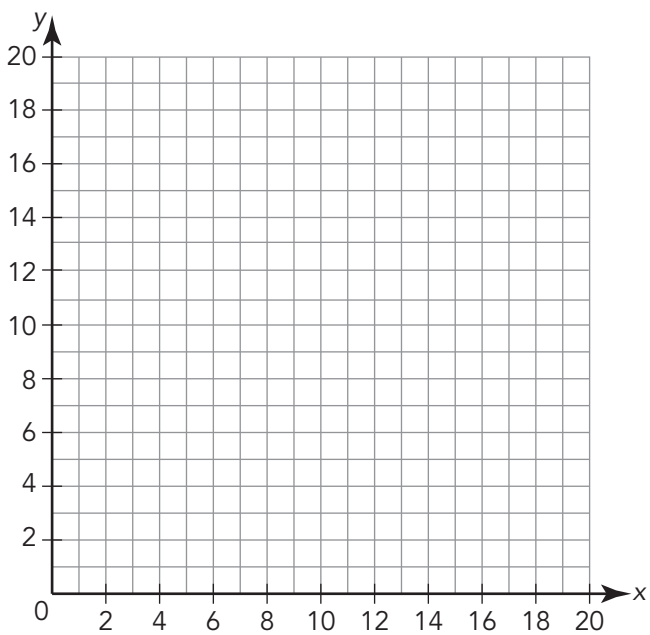
x	$x + 3(2x + 1)$	$7x + 3$
0		
1		
2		

b. $x + 3\ (2x + 1)$ _____ Given _____

$= x +$ _____

$=$ _____ _____

c.



d. Are the two expressions equivalent? Explain using all three representations.

NOTES

TALK the TALK

Property Management

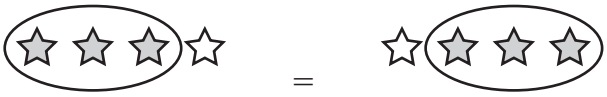
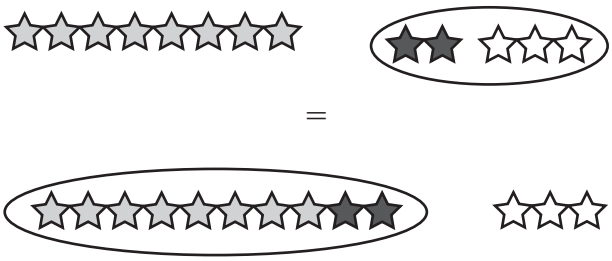
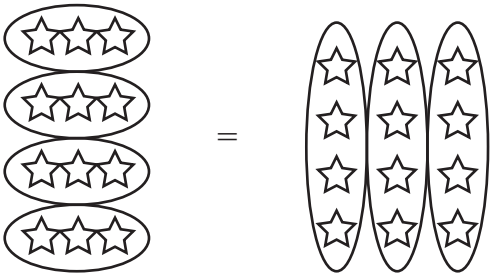
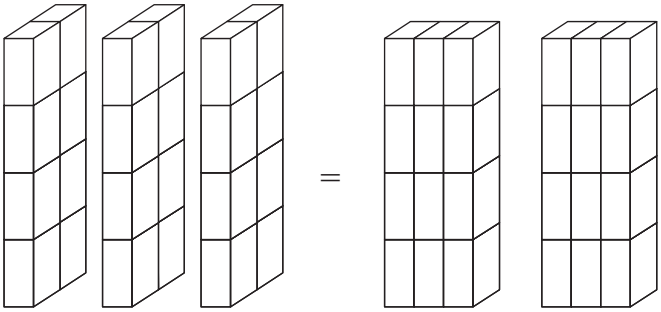
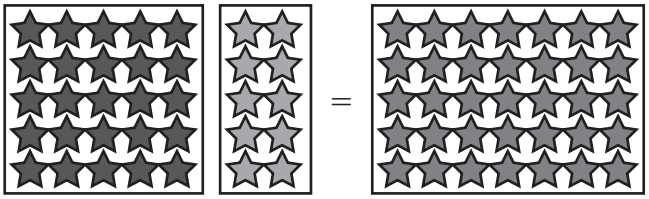
For each step of the simplification of the expression, identify the property or operation applied.

	Number Property or Operation
1. $10 \cdot 4x + 3(2x + 1)$	Given
$= (10 \cdot 4)x + 3(2x + 1)$	
$= 40x + 3(2x + 1)$	Multiplication
$= 40x + 6x + 3$	
$= 46x + 3$	
2. $20 + (6 + x) + 7$	Given
$= 20 + (x + 6) + 7$	
$= 20 + x + (6 + 7)$	Associative Property of Addition
$= 20 + x + 13$	
$= x + 20 + 13$	
$= x + 33$	
3. $7x + \frac{12x - 8}{4} + 5x$	Given
$= 7x + 3x - 2 + 5x$	
$= 10x - 2 + 5x$	
$= 10x + 5x - 2$	
$= 15x - 2$	

NOTES

4. Rewrite $\frac{2(x + 5) - 4}{2} - x$ using the fewest terms possible. Justify each step with a property or operation.

5. How can you use another representation to check that your answer in Question 4 is equivalent to $\frac{2(x + 5) - 4}{2} - x$?

Commutative Property of Addition	Associative Property of Multiplication	$a(b + c) = ab + ac$	
Distributive Property	Commutative Property of Multiplication	$(13 \cdot 2) \cdot 5 = 13 \cdot (2 \cdot 5)$	
$6 \cdot 5 = 5 \cdot 6$	Associative Property of Addition	$5(10 + 2) = 5 \cdot 10 + 5 \cdot 2$	
$a + b = b + a$	$x \cdot y = y \cdot x$	$(3 + 4) + 6 = 3 + (4 + 6)$	
$2 + 3 = 3 + 2$	$(j \cdot k) \cdot l = j \cdot (k \cdot l)$	$(l + m) + n = l + (m + n)$	

Assignment

Write

Match each term to the best definition.

1. Commutative Property of Addition
2. Commutative Property of Multiplication
3. Associative Property of Addition
4. Associative Property of Multiplication
5. like terms

a. For any numbers a and b, $a + b = b + a$

b. For any numbers a, b, and c, $(ab)c = a(bc)$

c. Two or more terms that have the same variable raised to the same power.

d. For any numbers a and b, $ab = ba$

e. For any numbers a, b, and c, $(a + b) + c = a + (b + c)$

6. Explain what it means for two expressions to be equivalent.

Remember

To determine if two expressions are equivalent, you can create a table of values, graph the expressions, or rewrite the expressions using number properties.

Practice

Determine if the two expressions are equivalent. Use properties, a table, and a graph in each problem to verify your answer.

1. $2(3x + 2) - 2x$ and $4x + 2$
2. $1 + 3(3 + x)$ and $4(3 + x)$
3. $2x + 1$ and $2\left(x + \frac{1}{2}\right)$
4. $\frac{(6x + 9)}{3} + 4$ and $2(x + 3.5)$

Stretch

Determine if the two expressions are equivalent. Use properties, a table, and a graph in each problem to verify your answer.

1. $(x + 5)(2x + 1)$ and $2x^2 + 5$
2. $(x + 1)(x - 1)$ and $x^2 - 1$

Review

Use the Distributive Property and combine like terms to rewrite each expression.

1. $9(6m + 3) + 6(1 - 4m)$
2. $\frac{3(4x + 8y)}{6} + 2y - x$

Determine the better buy.

3. 6 car washes for $50 or 4 car washes for $36
4. 10 markers for $2.40 or 32 markers for $7.00

Determine the least common multiple (LCM) of each pair of numbers.

5. 6 and 10
6. 7 and 12