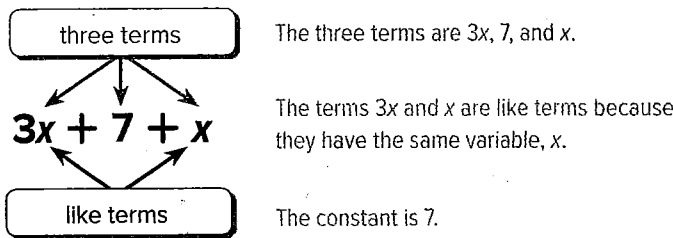


# Equivalent Expressions

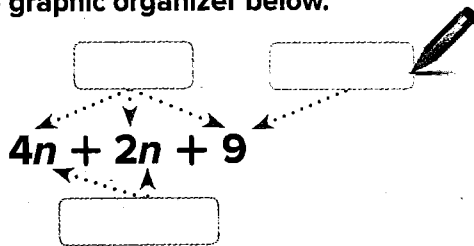
## Vocabulary Start-Up



When addition or subtraction signs separate an algebraic expression into parts, each part is called a **term**. The numerical factor of a term that contains a variable is called the **coefficient**. A term without a variable is called a **constant**. **Like terms** are terms that contain the same variables, such as  $x$ ,  $2x$ , and  $3x$ .



Label the graphic organizer below.



### Essential Question

HOW is it helpful to write numbers in different ways?



### Vocabulary

term  
coefficient  
constant  
like terms



### Common Core State Standards

**Content Standards**  
6.EE.2, 6.EE.2b, 6.EE.3, 6.EE.4

**MP Mathematical Practices**  
1, 3, 4, 5, 7



## Real-World Link

**Games** Andrew's mother gave him a computer game and \$10 for his birthday. His aunt gave him two computer games and \$5. The expression  $x + 10 + 2x + 5$ , where  $x$  represents the cost of each game, can be used to represent Andrew's birthday gifts.

1. What is the coefficient of the term  $2x$ ?
2. How many terms are in the expression  $x + 10 + 2x + 5$ ?

Which **MP Mathematical Practices** did you use?

Shade the circle(s) that applies.

- |  |   |
|--|---|
| <input type="checkbox"/> 1 Persevere with Problems | <input type="checkbox"/> 5 Use Math Tools         |
| <input type="checkbox"/> 2 Reason Abstractly       | <input type="checkbox"/> 6 Attend to Precision    |
| <input type="checkbox"/> 3 Construct an Argument   | <input type="checkbox"/> 7 Make Use of Structure  |
| <input type="checkbox"/> 4 Model with Mathematics  | <input type="checkbox"/> 8 Use Repeated Reasoning |



# Simplify Expressions with One Variable

To simplify an algebraic expression, use properties to write an equivalent expression that has no like terms and no parentheses.

### Numbers

$$3 + 3 = 2(3) \text{ or } 6$$

### Variables

$$x + x = 2x$$

## Equivalent Expressions

Two expressions are equivalent when the expressions have the same value, no matter what value is substituted for  $x$ . So,  $24x$  is equivalent to  $4(6x)$ .

Show your work.

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

Tutor

## 1. Simplify the expression $4(6x)$ .

$$\begin{aligned} 4(6x) &= 4 \cdot (6 \cdot x) && \text{Parentheses indicate multiplication.} \\ &= (4 \cdot 6) \cdot x && \text{Associative Property} \\ &= 24x && \text{Multiply 4 and 6.} \end{aligned}$$

## Got It? Do these problems to find out.

Simplify each expression.

- a.  $(3 \cdot x) \cdot 11$       b.  $x + x + x$       c.  $7x + 8 + x$



## Example

Tutor

## 2. Three friends will pay $\$x$ each for admission to the museum plus $\$1$ each to view the mummy exhibit. A fourth friend will pay admission but will not view the mummy exhibit. Write and simplify an expression that represents the total cost.

The expression  $3(x + 1) + x$  represents the total cost.

cost of admission and exhibit for three friends

cost of admission for the fourth friend

$$\begin{aligned} 3(x + 1) + x &= 3x + 3 + x && \text{Distributive Property} \\ &= 3x + x + 3 && \text{Commutative Property} \\ &= 4x + 3 && \text{Combine like terms.} \end{aligned}$$

So, the total cost is  $\$4x + \$3$ .

## Got It? Do this problem to find out.

- d. Write and simplify an expression for the total cost of six friends to go to the museum if only four friends view the mummy exhibit.

d. \_\_\_\_\_

# Simplify Expressions with Two Variables

Properties can be used to simplify or to factor expressions with two variables.

Compare the effects of operations on numbers to the effects of operations on variables.

| Numbers                | Variables            |
|------------------------|----------------------|
| $3 + 3 + 4 = 2(3) + 4$ | $x + x + y = 2x + y$ |

## Examples

Tutor

### 3. Simplify the expression $(14y + x) + 22y$ .

$$\begin{aligned} (14y + x) + 22y &= (x + 14y) + 22y && \text{Commutative Property} \\ &= x + (14y + 22y) && \text{Associative Property} \\ &= x + 36y && \text{Combine like terms.} \end{aligned}$$

### 4. Simplify $4(2x + y)$ using the Distributive Property.

$$\begin{aligned} 4(2x + y) &= 4(2x) + 4(y) && \text{Distributive Property} \\ &= 8x + 4y && \text{Multiply.} \end{aligned}$$

### 5. Factor $27x + 18y$ .

**Step 1** Find the GCF of  $27x$  and  $18y$ .

$$\begin{aligned} 27x &= 3 \cdot \underbrace{3} \cdot \underbrace{3} \cdot x && \text{Write the prime factorization of } 27x \text{ and } 18y. \\ 18y &= 2 \cdot \underbrace{3} \cdot \underbrace{3} \cdot y && \text{Circle the common factors.} \end{aligned}$$

The GCF of  $27x$  and  $18y$  is  $3 \cdot 3$  or  $9$ .

**Step 2** Write each term as a product of the GCF and its remaining factor. Then use the Distributive Property to *factor out* the GCF.

$$\begin{aligned} 27x + 18y &= 9(3x) + 9(2y) && \text{Rewrite each term using the GCF.} \\ &= 9(3x + 2y) && \text{Distributive Property} \end{aligned}$$

## Got It? Do these problems to find out.

- Simplify  $3x + 9y + 2x$ .
- Simplify  $7(3x + y)$ .
- Factor  $12x + 8y$ .

Show your work.

e. \_\_\_\_\_

f. \_\_\_\_\_

g. \_\_\_\_\_



- 6.** The farmer's market sells fruit baskets. Each basket has 3 apples and 1 pear. Use  $a$  to represent the cost of each apple and  $p$  to represent the cost of each pear. Write and simplify an expression that represents the total cost of 5 baskets.

Use the expression  $3a + p$  to represent the cost of each basket.

Use  $5(3a + p)$  to represent the cost of 5 baskets.

Use the Distributive Property to rewrite  $5(3a + p)$ .

$$\begin{aligned} 5(3a + p) &= 5(3a) + 5(p) && \text{Distributive Property} \\ &= 15a + 5p && \text{Multiply.} \end{aligned}$$

So, the total cost of five baskets is  $15a + 5p$ .

## Guided Practice



**Simplify each expression.** (Examples 1, 3, and 4)

1.  $5(6x) =$  \_\_\_\_\_

2.  $2x + 5y + 7x =$  \_\_\_\_\_

3.  $4(2x + 5y) =$  \_\_\_\_\_



4. Factor  $35x + 28y$ . (Example 5) \_\_\_\_\_

5. Mikayla bought five skirts at  $\$x$  each. Three of the five skirts came with a matching top for an additional  $\$9$  each. Write and simplify an expression that represents the total cost of her purchase. (Example 2)

\_\_\_\_\_

6. The gift bag from Claire Cosmetics includes 5 bottles of nail polish and 2 tubes of lip gloss. Use  $p$  to represent the cost of each bottle of nail polish and  $g$  to represent the cost of each tube of lip gloss. Write and simplify an expression that represents the total cost of 8 gift bags. (Example 6)

\_\_\_\_\_

7.  **Building on the Essential Question** How can properties help to write equivalent algebraic expressions?

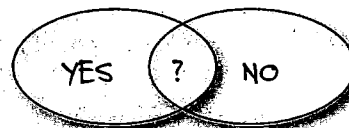
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Rate Yourself!

Are you ready to move on?  
Shade the section that applies.



For more help, go online to access a Personal Tutor.



# Independent Practice

Go online for Step-by-Step Solutions

eHelp


**Simplify each expression.** (Examples 1, 3, and 4)

1.  $x + 4x + 6x =$  \_\_\_\_\_

2.  $3x + 4x + 5x =$  \_\_\_\_\_

3.  $9(5x) =$  \_\_\_\_\_

 Show  
your  
work.

4.  $3x + 8y + 13x =$  \_\_\_\_\_

5.  $7(3x + 5y) =$  \_\_\_\_\_

6.  $3x + 6x + 2x =$  \_\_\_\_\_

**Factor each expression.** (Example 5)

7.  $24x + 18y =$  \_\_\_\_\_

8.  $16x + 40y =$  \_\_\_\_\_

9. Eight friends went to a hockey game. The price of admission per person was \$ $x$ . Four of the friends paid an extra \$6 each for a player guide book. Write and simplify an expression that represents the total cost. (Example 2)
- \_\_\_\_\_

10. Gabriella is  $x$  years old. Her sister, Felicia, is six years older than she is. Their mother is twice as old as Felicia. Their aunt, Tanya, is  $x$  years older than their mother. Write and simplify an expression that represents Tanya's age in years. (Example 2)
- \_\_\_\_\_

11. A DVD box set includes 3 thriller movies and 2 comedies. Use  $t$  to represent the cost of each thriller and  $c$  to represent the cost of each comedy. Write and simplify an expression that represents the total cost of 6 box sets. (Example 6)
- \_\_\_\_\_

12. A fall candle gift set has 4 vanilla candles and 6 pumpkin spice candles. Use  $v$  to represent the cost of each vanilla candle and  $p$  to represent the cost of each pumpkin candle. Write and simplify an expression that represents the total cost of 4 sets. (Example 6)
- \_\_\_\_\_

Find the value of  $y$  that makes each equation true for all values of  $x$ .

13.  $3x + 6x = yx$  \_\_\_\_\_

14.  $x + 5 + 11x = 12x + y$  \_\_\_\_\_

15. **MP Use Math Tools** Pizza Palace charges  $\$x$  for a large cheese pizza and an additional fee based on the number of toppings ordered.

a. Two large cheese pizzas and three large pepperoni pizzas are ordered. Write and simplify an expression that represents the total cost. \_\_\_\_\_

b. Write and simplify an expression that represents the total cost of eight large pizzas, if two are cheese and six have four toppings each.  
\_\_\_\_\_

c. Elsa orders three large cheese pizzas, a large pepperoni and mushroom pizza, and a large green pepper and onion pizza. Write and simplify an expression that represents the total cost.  
\_\_\_\_\_

| Pizza          | Price (\$) |
|----------------|------------|
| large cheese   | $x$        |
| add 1 topping  | add \$0.75 |
| add 2 toppings | add \$1.50 |
| add 3 toppings | add \$2.25 |
| add 4 toppings | add \$3.00 |



**H.O.T. Problems** Higher Order Thinking

16. **MP Identify Structure** Write an expression that, when simplified, is equivalent to  $15x + 7$ . \_\_\_\_\_

17. **MP Reason Inductively** Explain why the expressions  $y + y + y$  and  $3y$  are equivalent.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**MP Persevere with Problems** For Exercises 18 and 19, simplify each expression.

18.  $7x + 5(x + 3) + 4x + x + 2$  \_\_\_\_\_

19.  $6 + 2(x + 8) + 3x + 11 + x$  \_\_\_\_\_

20. **MP Reason Abstractly** The algebraic expression shown below is missing two whole-number constants. Determine the constants so that the expression simplifies to  $14x + 11$ .

$$4x + 8(x + \square) + \square + 2x$$