# 55 Factoring Expressions

Learning Target: Success Criteria:

**Learning Target:** Factor numerical and algebraic expressions.

- I can use the Distributive Property to factor numerical expressions.
- I can identify the greatest common factor of terms including variables.
- I can use the Distributive Property to factor algebraic expressions.
- I can interpret factored expressions in real-life problems.

# EXPLORATION 1

## **Finding Dimensions**

#### Work with a partner.

**a.** The models show the area (in square units) of each part of a rectangle. Use the models to find missing values that complete the expressions. Explain your reasoning.



- **b.** In part (a), check that the original expressions are equivalent to the expressions you wrote. Explain your reasoning.
- **c.** Explain how you can use the Distributive Property to rewrite a sum of two whole numbers with a common factor.

# **Math Practice**

Evaluate Results Do your answers in the first two models seem reasonable? How can you check your answers?

# 5.5 Lesson

### Key Vocabulary

factoring an expression, p. 228



#### **Factoring an Expression**

Words Writing a numerical expression or algebraic expression as a product of factors is called **factoring the expression**. You can use the Distributive Property to factor expressions.

**Numbers**  $3 \cdot 7 + 3 \cdot 2 = 3(7 + 2)$  **Algebra** ab + ac = a(b + c) $3 \cdot 7 - 3 \cdot 2 = 3(7 - 2)$ ab - ac = a(b - c)

## EXAMPLE 1

## **Factoring Numerical Expressions**

#### a. Factor 18 + 30 using the GCF.

One way to find the GCF of 18 and 30 is to list their factors.

Factors of 18: (1),(2),(3),(6), 9, 18

Factors of 30: (1),(2),(3), 5,(6), 10, 15, 30

The GCF of 18 and 30 is 6.

Write each term of the expression as a product of the GCF and the remaining factor. Then use the Distributive Property to factor the expression.

18 + 30 = 6(3) + 6(5)	Rewrite using GCF.
= 6(3 + 5)	Distributive Property

#### b. Factor 20 - 12 using the GCF.

One way to find the GCF of 20 and 12 is to list their factors.

Factors of 20: (1),(2),(4), 5, 10, 20

Factors of 12: (1),(2), 3,(4), 6, 12

Circle the common factors.

Circle the common factors.

The GCF of 20 and 12 is 4.

Write each term of the expression as a product of the GCF and the remaining factor. Then use the Distributive Property to factor the expression.

20 -	12	=	4(5) - 4(3)
		=	4(5-3)

**Rewrite using GCF.** 

**Distributive Property** 

## *Try It* Factor the expression using the GCF.

**1.** 9 + 15 **2.** 60 + 45 **3.** 30 - 20

When you factor an expression, you can factor out any common factor.

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## EXAMPLE 2

#### **Factoring Algebraic Expressions**

a. Factor 3x + 42 using the GCF.

You can find the GCF of 3*x* and 42 by writing their prime factorizations.

$$3x = 3 \cdot x$$
$$42 = 2 \cdot 3 \cdot 7$$

Circle the common prime factor.

The GCF of 3*x* and 42 is 3. Use the GCF to factor the expression.

$$3x + 42 = 3(x) + 3(14)$$
 Rewrite using GCF.

= 3(x + 14)**Distributive Property** 

#### b. Factor 63z - 27y using the GCF.

You can find the GCF of 63z and 27y by writing their prime factorizations.

$63z = 3 \cdot 3 \cdot 7 \cdot z$	
$27y = 3 \cdot 3 \cdot 3 \cdot 1$	Circle the common prime factors.
$2iy = 0 \cdot 0 \cdot 3 \cdot y$	

The GCF of 63z and 27y is  $3 \cdot 3 = 9$ . Use the GCF to factor the expression.

$$63z - 27y = 9(7z) - 9(3y)$$
 Rewrite using GCF.  
= 9(7z - 3y) Distributive Property

## *Try It* Factor the expression using the GCF.



Solve each exercise. Then rate your understanding of the success criteria in your journal.

#### **FACTORING EXPRESSIONS** Factor the expression using the GCF.

- **7.** 16 + 24 **8.** 49 - 28 **9.** 8y + 14
- 10. WHICH ONE DOESN'T BELONG? Which expression does not belong with the other three? Explain your reasoning.

3(8n+12)4(6n + 9)6(4n+3)

12(2n+3)

- **11. WP REASONING** Use what you know about factoring to explain how you can factor the expression 18x + 30y + 9z. Then factor the expression.
- **12. CRITICAL THINKING** Identify the GCF of the terms  $(x \cdot x)$  and  $(4 \cdot x)$ . Explain your reasoning. Then use the GCF to factor the expression  $x^2 + 4x$ .

# EXAMPLE 3 Modeling Real Life

You receive a discount on each book you buy for your electronic reader. The original price of each book is x dollars. You buy 5 books for a total of (5x - 15) dollars. Factor the expression. What can you conclude about the discount?



To factor 5x - 15, you can find the GCF of 5x and 15 by writing their prime factorizations.

 $5x = 5 \cdot x$  $15 = 5 \cdot 3$ 

Circle the common prime factor.

So, the GCF of 5*x* and 15 is 5. Use the GCF to factor the expression.

**Check** Suppose that the original price of each book is \$6. Verify that each expression has the same value when x = 6.

5x - 15 = 5(6) - 15 = 155(x - 3) = 5(6 - 3) = 15 5x - 15 = 5(x) - 5(3) Rewrite using GCF. = 5(x - 3) Distributive Property

The factor 5 represents the number of books purchased. The factor (x - 3) represents the discounted price of each book. This factor is a difference of two terms, showing that the original price, x, of each book is decreased by 3.

So, the factored expression shows a \$3 discount for every book you buy. The original expression shows a total savings of \$15.

# Self-Assessment for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.



- **13.** A youth club receives a discount on each pizza purchased for a party. The original price of each pizza is x dollars. The club leader purchases 8 pizzas for a total of (8x 32) dollars. Factor the expression. What can you conclude about the discount?
- 14. Three crates of food are packed on a shuttle departing for the Moon. Each crate weighs *x* pounds. On the Moon, the combined weight of the crates is (3x 81) pounds. What can you conclude about the weight of each crate on the Moon?

# 5.5 Practice





Use the Distributive Property to simplify the expression.

1.	2(n + 8)	<b>2.</b> 3(4 +	- <i>m</i> ) <b>3.</b>	7(b-3)	<b>4.</b> $10(4-w)$	
Writ	e the phrase as an	express	ion.			
5.	5 plus a number p		6.	18 less than a n	number <i>r</i>	
7.	11 times a number	d	8.	a number <i>c</i> div	ided by 25	
Deci	ide whether the ra	tes are e	quivalent.			
9.	84 feet in 12 secon	ds	10.	12 cups of soda	a for every 54 cups o	ofjuice
	217 feet in 31 seco	nds		8 cups of soda	for every 36 cups of	juice
Mate		•.	·····			

# 11. 0.36 12. 3.6 13. 0.0036 14. 0.036 A. 0.36% B. 360% C. 36% D. 3.6%

# 🕪 Concepts, Skills, & Problem Solving

**FINDING DIMENSIONS** The model shows the area (in square units) of each part of a rectangle. Use the model to find missing values that complete the expression. **Explain your reasoning.** (See Exploration 1, p. 227.)



#### **FACTORING NUMERICAL EXPRESSIONS** Factor the expression using the GCF.

17.	7 + 14	<b>18.</b> 12 + 42	<b>19.</b> 22 + 11	20.	70 + 95
21.	60 - 36	<b>22.</b> 100 - 80	<b>23.</b> 84 + 28	24.	48 + 80
25.	19 + 95	<b>26.</b> 44 - 11	<b>27.</b> 18 – 12	28.	48 + 16
29.	98 - 70	<b>30.</b> 58 + 28	<b>31.</b> 72 – 39	32.	69 + 84

**33.** WP **REASONING** The whole numbers *a* and *b* are divisible by *c*, where *b* is greater than *a*. Is a + b divisible by *c*? Is b - a divisible by *c*? Explain your reasoning.

**34. MULTIPLE CHOICE** Which expression is *not* equivalent to 81x + 54?

**A.** 27(3x+2) **B.** 3(27x+18) **C.** 9(9x+6) **D.** 6(13x+9)

#### **FACTORING ALGEBRAIC EXPRESSIONS** Factor the expression using the GCF.

35.	2x + 10	36.	15x + 6	37.	26x - 13	38.	50x - 60
39.	36x + 9	40.	14x - 98	41.	18p + 26	42.	16m + 40
43.	24 + 72n	44.	50 + 65h	45.	76 <i>d</i> – 24	46.	27 - 45c
47.	18t + 38x	48.	90y + 65z	49.	10x - 25y	50.	24y + 88x

**51. OPEN-ENDED** Use the Distributive Property to write two expressions that are equivalent to 8x + 16.

#### **MATCHING** Match the expression with an equivalent expression.

52.	8x + 16y	<b>53.</b> $4x + 8y$	<b>54.</b> $16x + 8y$	<b>55.</b> $8x + 4y$
	<b>A.</b> $4(2x + y)$	<b>B.</b> $2(4y+2x)$	<b>C.</b> $4(2x + 4y)$	<b>D.</b> $8(y+2x)$

**56. YOU BE THE TEACHER** Your friend factors the expression 24x + 56. Is your friend correct? Explain your reasoning.

6	24x + 56 = 8(3x) + 8(7)
0	$= (8+8) \cdot (3x+7)$
2	= 16(3 <i>x</i> + 7)

**57. MODELING REAL LIFE** You sell soup mixes for a fundraiser. For each soup mix you sell, the company that makes the soup receives *x* dollars, and you receive the remaining amount. You sell 16 soup mixes for a total of (16x + 96) dollars. How much money do you receive for each soup mix that you sell?



- **58.** WP PROBLEM SOLVING A clothing store is having a sale on holiday socks. Each pair of socks costs *x* dollars. You leave the store with 6 pairs of socks and spend a total of (6x 14) dollars. You pay with \$40. How much change do you receive? Explain your reasoning.
- **59. (MP) STRUCTURE** You buy 37 concert tickets for \$8 each, and then sell all 37 tickets for \$11 each. The work below shows two ways you can determine your profit. Describe each solution method. Which do you prefer? Explain your reasoning.

Profit = 37(11) - 37(8)Profit = 37(11) - 37(8)= 407 - 296= 37(11 - 8)= \$111= 37(3)= \$111

**60. WP NUMBER SENSE** The prime factorizations of two numbers are shown, where *a* and *b* represent prime numbers. Write the sum of the two numbers as an expression of the form 14(p + p). Explain your reasoning.

**Number 1:**  $2 \cdot 11 \cdot 5 \cdot a$  **Number 2:**  $7 \cdot b \cdot 3 \cdot 3$