

# 1-3 Study Guide and Intervention

## Properties

**Properties of Addition and Multiplication** In algebra, there are certain statements called **properties** that are true for any numbers.

Property	Explanations	Example
Commutative Property of Addition	$a + b = b + a$	$6 + 3 = 3 + 6$ $9 = 9$
Commutative Property of Multiplication	$a \cdot b = b \cdot a$	$4 \cdot 5 = 5 \cdot 4$ $20 = 20$
Associative Property of Addition	$(a + b) + c =$ $a + (b + c)$	$(3 + 4) + 7 = 3 + (4 + 7)$ $14 = 14$
Associative Property of Multiplication	$(a \cdot b) \cdot c =$ $a \cdot (b \cdot c)$	$(2 \cdot 5) \cdot 8 = 2 \cdot (5 \cdot 8)$ $80 = 80$
Additive Identity	$a + 0 = 0 + a = a$	$10 + 0 = 0 + 10 = 10$
Multiplicative Identity	$a \cdot 1 = 1 \cdot a = a$	$5 \cdot 1 = 1 \cdot 5 = 5$
Multiplicative Property of Zero	$a \cdot 0 = 0 \cdot a = 0$	$15 \cdot 0 = 0 \cdot 15 = 0$

**Example 1** Is subtraction of whole numbers associative? If not, give a counterexample.

$$(9 - 4) - 2 \stackrel{?}{=} 9 - (4 - 2) \quad \text{State the conjecture.}$$

$$5 - 2 \stackrel{?}{=} 9 - 2 \quad \text{Simplify.}$$

$$3 \stackrel{?}{=} 7 \quad \text{Simplify.}$$

This is a counterexample. So, subtraction of whole numbers is not associative.

**Example 2** Name the property shown by the statement.

$$15 \times b = b \times 15 \quad \text{The order of the numbers and variables changed. This is the Commutative Property of Multiplication.}$$

## Exercises

- State whether the following conjecture is true or false: The multiplicative identity applies to division also. If false, give a counterexample.

Name the property shown by each statement.

2.  $75 + 25 = 25 + 75$

3.  $2 \cdot (3 \cdot 4) = (2 \cdot 3) \cdot 4$

4.  $14 \cdot 1 = 14$

5.  $p \cdot 0 = 0$

**1-3 Study Guide and Intervention** *(continued)***Properties**

**Simplify Algebraic Expressions** To **simplify** an algebraic expression, perform all possible operations. Properties can be used to help simplify an expression that contains variables.

**Example** Simplify each expression.

**a.  $(9 + r) + 7$**

$$\begin{aligned} (9 + r) + 7 &= (r + 9) + 7 && \text{Commutative Property of Addition} \\ &= r + (9 + 7) && \text{Associative Property of Addition} \\ &= r + 16 && \text{Add 9 and 7.} \end{aligned}$$

**b.  $3 \cdot (x \cdot 5)$**

$$\begin{aligned} 3 \cdot (x \cdot 5) &= 3 \cdot (5 \cdot x) && \text{Commutative Property of Multiplication} \\ &= (3 \cdot 5) \cdot x && \text{Associative Property of Multiplication} \\ &= 15x && \text{Multiply 3 and 5.} \end{aligned}$$

**Exercises**

Simplify each expression.

- |                           |                            |
|---------------------------|----------------------------|
| 1. $24 + (x + 6)$         | 2. $3 \cdot (4a)$          |
| 3. $9 + (12 + c)$         | 4. $13d \cdot 0$           |
| 5. $(3 + f) + 17$         | 6. $11 + (m + 5)$          |
| 7. $(b + 0) + 7$          | 8. $15(a \cdot 1)$         |
| 9. $4w(6)$                | 10. $(n + 7) + 12$         |
| 11. $(7 \cdot x) \cdot 8$ | 12. $21 \cdot (s \cdot 0)$ |