

# Commutative and Associative Properties

(Pages 14–18)

You can use the commutative and associative properties to evaluate or simplify expressions. To **simplify** an expression, eliminate all parentheses first and then add, subtract, multiply, or divide. When you add or multiply **whole numbers**, 0, 1, 2, and so on, the sum or product is a whole number. This is an example of the **Closure Property**.

<b>Commutative Property</b>	The order in which you add or multiply two numbers does not change their sum or product. For any numbers $a$ and $b$ , $a + b = b + a$ and $a \cdot b = b \cdot a$ .
<b>Associative Property</b>	The way you group three numbers when you add or multiply them does not change their sum or product. For any numbers $a$ , $b$ , and $c$ , $(a + b) + c = a + (b + c)$ and $(ab)c = a(bc)$ .
<b>Closure Property of Whole Numbers</b>	Because the sum or product of two whole numbers is also a whole number, the set of whole numbers is closed under addition and multiplication.

You can show that a statement is false, such as *Whole numbers are closed under division*, by using a **counterexample**. Since  $1 \div 3 = \frac{1}{3}$ , and  $\frac{1}{3}$  is a fraction, whole numbers are not closed under division.

## EXAMPLES

**A** Name the property shown by  
 $ab + c = c + ab$ .  
*Commutative (+)*

**B** Simplify the expression  $9 + (c + 4)$ .  
 Identify the properties used in each step.

$$\begin{aligned} 9 + (c + 4) &= 9 + (4 + c) && \text{Commutative (+)} \\ &= (9 + 4) + c && \text{Associative (+)} \\ &= 13 + c && \text{Substitution (=)} \end{aligned}$$

## PRACTICE

**Name the property shown by each statement.**

1.  $g + h + 2 = g + 2 + h$       2.  $(2 + 5) + 7 = 2 + (5 + 7)$       3.  $(6 \cdot 5)x = 6(5x)$

**Simplify each expression. Identify the properties used in each step.**

4.  $9 + n + 3$                       5.  $12 \cdot t \cdot 4$                       6.  $11 \cdot (8g)$   
 7.  $(k + 18) + 1$                       8.  $2p + (6 + p)$                       9.  $(7 \cdot 4) \cdot 25$

10. State whether the statement *Subtraction of whole numbers is associative* is *true* or *false*. If false, provide a counterexample.



11. **Standardized Test Practice** Name the property or properties illustrated by the statement  $s + t = t + s$ .

- A** associative only                      **B** commutative only  
**C** associative and commutative                      **D** neither associative nor commutative

Answers: 1. Commutative (+) 2. Commutative (+) 3. Associative (+) 4-9. See Answer Key. 10. False; 4 - (2 - 1) ≠ (4 - 2) - 1