

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**.

Commutative Property	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 $a \cdot b = b \cdot a$.
Associative Property	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 $(ab)c = a(bc)$.
Closure Property of Whole Numbers	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