English Spanish

1.3 Properties of Addition and Multiplication

Essential Question Does the order in which you perform an operation matter?

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1 ACTIVITY: Does Order Matter?

Work with a partner. Place each statement in the correct oval.

a. Fasten 5 shirt buttons.
b. Put on a shirt and tie.
c. Fill and seal an envelope.
d. Floss your teeth.
e. Put on your shoes.
f. Chew and swallow.

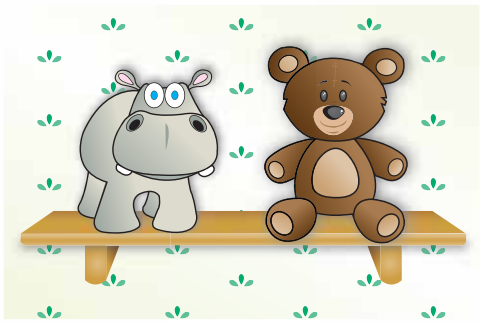
Order Matters

Order Doesn't Matter

Think of some math problems using the four operations where order matters and some where order doesn't matter.

The Meaning of a Word Commute

When you **commute** the positions of two stuffed animals on a shelf, you switch their positions.



2 ACTIVITY: Commutative Properties

Work with a partner.

a. Which of the following are true?

$3 + 5 \stackrel{?}{=} 5 + 3$ $\quad$ $3 - 5 \stackrel{?}{=} 5 - 3$

$9 \times 3 \stackrel{?}{=} 3 \times 9$ $\quad$ $9 \div 3 \stackrel{?}{=} 3 \div 9$

b. The true equations show the Commutative Properties of Addition and Multiplication. Why are they called "commutative?" Write the properties.

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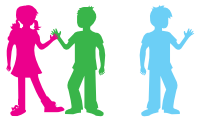
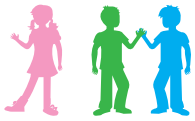
The Meaning of a Word • Associate

You have two best friends. Sometimes you **associate** with one of them.



And sometimes you **associate** with the other.



3 ACTIVITY: Associative Properties

Work with a partner.

a. Which of the following are true?

$8 + (3 + 1) \stackrel{?}{=} (8 + 3) + 1$ $\quad$ $8 - (3 - 1) \stackrel{?}{=} (8 - 3) - 1$

$12 \times (6 \times 2) \stackrel{?}{=} (12 \times 6) \times 2$ $\quad$ $12 \div (6 \div 2) \stackrel{?}{=} (12 \div 6) \div 2$

b. The true equations show the Associative Properties of Addition and Multiplication. Why are they called "associative?" Write the properties.

What Is Your Answer?

4. IN YOUR OWN WORDS Does the order in which you perform an operation matter?

5. MENTAL MATH Explain how you can use the Commutative and Associative Properties of Addition to add the sum in your head.

$$11 + 7 + 12 + 13 + 8 + 9$$

6. SECRET CODE The creatures on a distant planet use the symbols ■, ◆, ★, and ● for the four operations.

a. Use the codes to decide which symbol represents addition and which symbol represents multiplication. Explain your reasoning.

$3 \bullet 4 = 4 \bullet 3$

$3 \bigstar 4 = 4 \bigstar 3$

$2 \bullet (5 \bullet 3) = (2 \bullet 5) \bullet 3$

$2 \bigstar (5 \bigstar 3) = (2 \bigstar 5) \bigstar 3$

$0 \bullet 4 = 0$

$0 \bigstar 4 = 4$

b. Make up your own symbols for addition and multiplication. Write codes using your symbols. Trade codes with a classmate. Decide which symbol represents addition and which symbol represents multiplication.

Practice Use what you learned about the properties of addition and multiplication to complete Exercises 5–8 on page 18.

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1.3 Lesson

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Key Vocabulary
equivalent expressions, *p. 16*

Expressions with the same value, like $12 + 7$ and $7 + 12$, are **equivalent expressions**. The commutative and associative properties can be used to write equivalent expressions.

Key Ideas

Commutative Properties

Words Changing the order of addends or factors does not change the sum or product.

Numbers $5 + 8 = 8 + 5$ $\quad 5 \cdot 8 = 8 \cdot 5$

Algebra $a + b = b + a$ $\quad a \cdot b = b \cdot a$

Associative Properties

Words Changing the grouping of addends or factors does not change the sum or product.

Numbers $(7 + 4) + 2 = 7 + (4 + 2)$ $\quad (7 \cdot 4) \cdot 2 = 7 \cdot (4 \cdot 2)$

Algebra $(a + b) + c = a + (b + c)$ $\quad (a \cdot b) \cdot c = a \cdot (b \cdot c)$

EXAMPLE 1 Using Properties to Simplify Expressions

a. Simplify the expression $7 + (12 + x)$.

$7 + (12 + x) = (7 + 12) + x$ Associative Property of Addition

$= 19 + x$ Add 7 and 12.

b. Simplify the expression $(6.1 + x) + 8.4$.

$(6.1 + x) + 8.4 = (x + 6.1) + 8.4$ Commutative Property of Addition

$= x + (6.1 + 8.4)$ Associative Property of Addition

$= x + 14.5$ Add 6.1 and 8.4.

c. Simplify the expression $5(11y)$.

$5(11y) = (5 \cdot 11)y$ Associative Property of Multiplication

$= 55y$ Multiply 5 and 11.

On Your Own

Now You're Ready
Exercises 5–8

Simplify the expression. Explain each step.

1. $10 + (a + 9)$ **2.** $(c + 25.3) + 17.9$ **3.** $5(4n)$

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Key Ideas

Addition Property of Zero

Words The sum of any number and 0 is that number.

Numbers $7 + 0 = 7$ **Algebra** $a + 0 = a$

Multiplication Properties of Zero and One

Words The product of any number and 0 is 0.

The product of any number and 1 is that number.

Numbers $9 \times 0 = 0$ **Algebra** $a \cdot 0 = 0$

$4 \times 1 = 4$ $a \cdot 1 = a$

EXAMPLE 2 Using Properties to Simplify Expressions

a. Simplify the expression $9 \cdot 0 \cdot p$.

$9 \cdot 0 \cdot p = (9 \cdot 0) \cdot p$ Associative Property of Multiplication

$= 0 \cdot p = 0$ Multiplication Property of Zero

b. Simplify the expression $4.5 \cdot r \cdot 1$.

$4.5 \cdot r \cdot 1 = 4.5 \cdot (r \cdot 1)$ Associative Property of Multiplication

$= 4.5 \cdot r$ Multiplication Property of One

$= 4.5r$

EXAMPLE 3 Real-Life Application

You and six friends play on a basketball team. A sponsor paid $100 for the league fee, x dollars for each player's T-shirt, and $68.25 for trophies. Write an expression for the total amount paid by the sponsor.

Common Error

You **and** six friends are on the team, so use the expression $7x$, not $6x$, to represent the cost of the T-shirts.

Add the entry fee, the cost of the T-shirts, and the cost of the trophies.

$100 + 7x + 68.25 = 7x + 100 + 68.25$ Commutative Property of Addition

$= 7x + 168.25$ Add 100 and 68.25.

∴ An expression for the total amount is $7x + 168.25$.

On Your Own

Now You're Ready
Exercises 9–23

Simplify the expression. Explain each step.

4. $12 \cdot b \cdot 0$ **5.** $1 \cdot m \cdot 24$ **6.** $(t + 15) + 0$

7. WHAT IF? In Example 3, your sponsor paid $54.75 for trophies. Write an expression for the total amount paid by the sponsor.

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1.3 Exercises

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Vocabulary and Concept Check

1. **NUMBER SENSE** Write an example of a sum of fractions. Show that the Commutative Property of Addition is true for the sum.
2. **OPEN-ENDED** Write an algebraic expression that can be simplified using the Associative Property of Addition.
3. **OPEN-ENDED** Write an algebraic expression that can be simplified using the Associative Property of Multiplication and the Multiplication Property of One.
4. **WHICH ONE DOESN'T BELONG?** Which statement does *not* belong with the other three? Explain your reasoning.

$7 + (x + 4) = 7 + (4 + x)$

$(3 + b) + 2 = (b + 3) + 2$

$9 + (7 + w) = (9 + 7) + w$

$(4 + n) + 6 = (n + 4) + 6$

Practice and Problem Solving

Tell which property is illustrated by the statement.

1 **5.** $5 \cdot p = p \cdot 5$

6. $2 + (12 + r) = (2 + 12) + r$

7. $4 \cdot (x \cdot 10) = (4 \cdot x) \cdot 10$

8. $x + 7.5 = 7.5 + x$

2 **9.** $(c + 2) + 0 = c + 2$

10. $a \cdot 1 = a$

11. ERROR ANALYSIS Describe and correct the error in stating the property illustrated by the statement.

✗ $(7 + x) + 3 = (x + 7) + 3$
Associative Property of Addition

Simplify the expression. Explain each step.

12. $6 + (5 + x)$

13. $(14 + y) + 3$

14. $6(2b)$

15. $7(9w)$

16. $3.2 + (x + 5.1)$

17. $(0 + a) + 8$

18. $9 \cdot c \cdot 4$

19. $(18.6 \cdot d) \cdot 1$

20. $(3k + 4.2) + 8.6$

21. $(2.4 + 4n) + 9$

22. $(3s) \cdot 8$

23. $z \cdot 0 \cdot 12$

24. GEOMETRY The expression $12 + x + 4$ represents the perimeter of a triangle. Simplify the expression.

25. SCOUT COOKIES A case of Scout cookies has 10 cartons. A carton has 12 boxes. The amount you make on a whole case is $10(12x)$ dollars.

a. What does x represent?

b. Simplify the expression.

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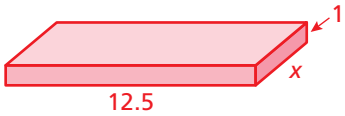
26. GEOMETRY The volume of the rectangular prism is $12.5 \cdot x \cdot 1$.



a. Simplify the expression.

b. Match $x = 0.25$, 12.5, and 144 with the object.

A. siding for a house **B.** ruler **C.** square floor tile

Write the phrase as an expression. Then, simplify the expression.

27. 7 plus the sum of a number x and 5

28. the product of 8 and a number y multiplied by 9

Copy and complete the statement using the specified property.

	Property	Statement
29.	Associative Property of Multiplication	$7(2y) =$
30.	Commutative Property of Multiplication	$13.2 \cdot (x \cdot 1) =$
31.	Associative Property of Addition	$17 + (6 + 2x) =$
32.	Addition Property of Zero	$2 + (c + 0) =$
33.	Multiplication Property of One	$1 \cdot w \cdot 16 =$

34. HATS You and a friend sell hats at a fair booth. You sell 16 hats on the first shift and 21 hats on the third shift. Your friend sells x hats on the second shift.

a. Write an expression for the number of hats sold.

b. The expression $37(14) + 10x$ represents the amount made for both of you. How can you tell that your friend was selling the hats for a discounted price?

c. Reasoning You took in more money than your friend. What can you say about the value of x?

Fair Game Review What you learned in previous grades & lessons

Evaluate the expression. SKILLS REVIEW HANDBOOK

35. $7(10 + 4)$ **36.** $12(10 - 1)$ **37.** $6(5 + 10)$ **38.** $8(30 - 5)$

Find the prime factorization of the number. SKILLS REVIEW HANDBOOK

39. 37 **40.** 144 **41.** 147 **42.** 205

43. MULTIPLE CHOICE A bag has 16 blue, 20 red, and 24 green marbles. What fraction of the marbles in the bag are blue? SKILLS REVIEW HANDBOOK

A $\frac{1}{5}$ **B** $\frac{4}{15}$ **C** $\frac{4}{11}$ **D** $\frac{11}{15}$