Example 2 Identifying Properties of Addition and Multiplication

For each of the following equations, state the property illustrated, and show that the statement is true for the value given for the variable by substituting the value in the equation and evaluating.

a. $x+14=14+x$ given that $x=-4$

b. $(3\cdot 6)x=3(6x)$ given that $x=5$

c. $12(y+3)=12y+36$ given that $y=-2$

Solutions

a. The commutative property of addition is illustrated.

$$(-4)+14=10 \text{ and } 14+(-4)=10$$

b. The associative property of multiplication is illustrated.

$$(3\cdot 6)\cdot 5=18\cdot 5=90 \text{ and } 3\cdot(6\cdot 5)=3\cdot 30=90$$

c. The distributive property is illustrated.

$$12(-2+3)=12(1)=12 \text{ and } 12(-2)+36=-24+36=12$$

Now work margin exercise 2.

2. State the property illustrated and show that the statement is true for the value given for the variable.

a. $x+21=21+x$ given that $x=-7$

b. $(5\cdot 4)x=5(4x)$ given that $x=2$

c. $11(y+3)=11y+33$ given that $y=-4$

Margin Exercise Answers

1. a. associative property of multiplication **b.** distributive property **c.** zero factor law **d.** associative property of addition **e.** commutative property of multiplication **f.** additive identity **g.** additive inverse **2. a.** commutative property of addition $(-7)+21=14$ and $21+(-7)=14$ **b.** associative property of multiplication $(5\cdot 4)\cdot 2=40$ and $5\cdot(4\cdot 2)=40$ **c.** distributive property $11(-4+3)=-11$ and $11(-4)+33=-11$

1.5 Exercises

Fill-in-the-Blank. Complete the sentences using information found in this section.

1. The multiplicative inverse of a number is its _____.
2. The _____ _____ of all numbers is 1.
3. Zero multiplied by a number or variable is an example of the _____-_____ law.
4. The distributive property involves two operations, _____ and _____.
5. The additive inverse of a number is the _____ of that number.
6. In the term $8x$, the 8 is the _____ of the variable.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

7. Changing the order of the numbers in an addition problem is allowed because of the associative property of addition.

8. The equation is an example of the associative property of multiplication.

9. The additive identity of all numbers is 1.

10. The commutative property works for division and subtraction.

Practice

Complete the expressions using the given property. Do not simplify.

1.	$7+3=$ _____	commutative property of addition
2.	$(6\cdot 9)\cdot 3=$ _____	associative property of multiplication
3.	$19\cdot 4=$ _____	commutative property of multiplication
4.	$18+5=$ _____	commutative property of addition
5.	$6(5+8)=$ _____	distributive property
6.	$16+(9+11)=$ _____	associative property of addition
7.	$2\cdot(3x)=$ _____	associative property of multiplication
8.	$3(x+5)=$ _____	distributive property
9.	$3+(x+7)=$ _____	associative property of addition
10.	$9(x+5)=$ _____	distributive property
11.	$6\cdot 0=$ _____	zero-factor law
12.	$6\cdot 1=$ _____	multiplicative identity
13.	$0+(x+7)=$ _____	additive identity
14.	$0\cdot(-13)=$ _____	zero-factor law
15.	$2(x-12)=$ _____	distributive property
16.	$(-5)+5=$ _____	additive inverse
17.	$6.3+(-6.3)=$ _____	additive inverse
18.	$3\cdot\frac{1}{3}=$ _____	multiplicative inverse

State the name of each property illustrated. See Example 1.

19. $5+16=16+5$

20. $5\cdot 16=16\cdot 5$

21. $32 \cdot 1 = 32$

22. $32 + 0 = 32$

23. $5 + (3 + 1) = (5 + 3) + 1$

24. $5 + (3 + 1) = (3 + 1) + 5$

25. $13(y + 2) = (y + 2) \cdot 13$

26. $13(y + 2) = 13y + 26$

27. $6(2 \cdot 9) = (2 \cdot 9) \cdot 6$

28. $6(2 \cdot 9) = (6 \cdot 2) \cdot 9$

29. $5 \cdot \frac{1}{5} = 1$

30. $14 \cdot \frac{1}{14} = 1$

31. $7.1 + (-7.1) = 0$

32. $(-9) + 9 = 0$

33. $1 \cdot 14.2 = 14.2$

34. $(5 \cdot 3) \cdot (-7) = 5(3 \cdot (-7))$

35. $5.68 \cdot 0 = 0 \cdot 5.68 = 0$

36. $0 + 5.68 = 5.68$

37. $2 + (x + 6) = (2 + x) + 6$

38. $2(x + 6) = 2x + 12$

First evaluate each expression using the rules for order of operations and then use the distributive property to evaluate the same expression. The value must be the same.

39. $6(3 + 8)$

40. $7(8 - 5)$

41. $10(2 - 9)$

42. $13(5 + 3)$

For each of the following equations, state the property illustrated, and show that the statement is true for the value of $x = 4$, $y = -2$, or $z = 3$ by substituting the corresponding value in the equation and evaluating. See Example 2.

43. $6 \cdot x = x \cdot 6$

44. $19 + z = z + 19$

45. $8 + (5 + y) = (8 + 5) + y$

46. $(2 \cdot 7) \cdot x = 2 \cdot (7x)$

47. $5(x + 18) = 5x + 90$

48. $(2z + 14) + 3 = 2z + (14 + 3)$

49. $(6 \cdot y) \cdot 9 = 6 \cdot (y \cdot 9)$

50. $11 \cdot x = x \cdot 11$

51. $z + (-34) = -34 + z$

52. $3(y + 15) = 3y + 45$

53. $2(3 + x) = 2(x + 3)$

54. $(y + 2)(y - 4) = (y - 4)(y + 2)$

55. $5 + (x - 15) = (x - 15) + 5$

56. $z + (4 + x) = (4 + x) + z$

57. $(3x) \cdot 5 = 3 \cdot (x \cdot 5)$

58. $(x + y) + z = x + (y + z)$

Applications

Solve

59. Jessica works part-time at a retail store and makes \$11 an hour. During one week, she worked $6\frac{1}{2}$ hours on Monday and $4\frac{1}{4}$ hours on Thursday.

a. Determine the amount of money she earned during the week by evaluating the expression $\$11 \cdot \left(6\frac{1}{2} + 4\frac{1}{4}\right)$.

b. Rewrite this expression to remove the parentheses using one of the properties talked about in this section.

c. What property did you use in Part **b.** to rewrite the expression?

60. Robin went to the grocery store to buy a few items she needed in order to cook dinner. She bought milk for $3.99, rolls for $2.25, a package of steaks for $12.01, and some marinade for $1.75. Before getting to the checkout line, Robin remembered that she only had $20 in her purse. Did she have enough money to buy the food items if the store does not charge sales tax on food?

a. Write an expression to find the total of Robin's food purchases. Do not simplify.

b. Robin doesn't have a calculator to determine the total cost of her items. She wants to make sure that she has enough money to buy them. Rearrange the expression from Part **a.** so that she could quickly find the total using mental math.

c. What properties did you use in Part **b.** to rewrite the expression?

d. Did Robin have enough money to purchase all of the items?

61. Jordan didn't balance his checking account during the week and ended up overdrawing his account. He had a starting balance of $85.04 and wrote checks for two bills for the amounts of $28.79 and $50.00. He also used his debit card to purchase lunch for $12.16. In order to avoid an overdraft fee, Jordan must deposit enough money today to bring his balance back to a minimum of zero.

a. Write an expression to find the current balance of Jordan's checking account. Do not simplify.

b. Evaluate the expression from Part **a.** to determine the current balance of Jordan's checking account.

c. Write an equation to show Jordan's current checking account balance plus the amount he must deposit today to bring the balance to zero.

d. What property is illustrated in Part **c.**?

Writing and Thinking

62. a. The distributive property illustrated as $a(b+c) = ab + ac$ is said to "distribute multiplication over addition." Explain, in your own words, the meaning of this phrase.

b. What would an expression that "distributes addition over multiplication" look like? Explain why this would or would not make sense.