2–5 The Distributive Property

Objective: To use the distributive property to simplify expressions.

Vocabulary

Equivalent expressions Expressions that represent the same number.

Simplifying an expression Replacing an expression containing variables by an equivalent expression with as few terms as possible.

Distributive Property
Distributive Property of Multiplication (with respect to addition) For all real numbers a, b, and c, $\qquad a(b + c) = ab + ac \qquad$ and $(b + c)a = ba + ca$. For example, $\qquad\qquad\qquad 6(9 + 4) = 6 \cdot 9 + 6 \cdot 4$ and $(9 + 4)6 = 9 \cdot 6 + 4 \cdot 6$
Distributive Property of Multiplication (with respect to subtraction) For all real numbers a, b, and c, $\qquad a(b - c) = ab - ac \qquad$ and $(b - c)a = ba - ca$. For example, $\qquad\qquad\qquad 8(12 - 2) = 8 \cdot 12 - 8 \cdot 2$ and $(12 - 2)8 = 12 \cdot 8 - 2 \cdot 8$

CAUTION When using the distributive properties, be sure to multiply *both* of the numbers inside the parentheses by the number outside the parentheses. For example,

$6(13 - 3) = 6 \cdot 13 - 6 \cdot 3$ *not* $6 \cdot 13 - 3$.

Example 1 Simplify: **a.** $5 \cdot 48$ **b.** $8(7.5)$ **c.** $6\left(4\frac{1}{3}\right)$ **d.** $(11 - 5)9$

Solution Use the distributive property to multiply.

a. $5 \cdot 48 = 5(40 + 8)$
$= (5 \cdot 40) + (5 \cdot 8)$
$= 200 + 40$
$= 240$

b. $8(7.5) = 8(7 + 0.5)$
$= (8 \cdot 7) + (8 \cdot 0.5)$
$= 56 + 4$
$= 60$

c. $6\left(4\frac{1}{3}\right) = 6\left(4 + \frac{1}{3}\right)$
$= (6 \cdot 4) + \left(6 \cdot \frac{1}{3}\right)$
$= 24 + 2$
$= 26$

d. $(11 - 5)9 = (11 - 5)9$
$= (11 \cdot 9) - (5 \cdot 9)$
$= 99 - 45$
$= 54$

Simplify. Use the distributive property.

1. $6 \cdot 35$ **210**
2. $5 \cdot 52$ **260**
3. $4(8.5)$ **34**
4. $8(6.25)$ **50**
5. $12\left(2\frac{1}{3}\right)$ **28**
6. $10\left(2\frac{1}{5}\right)$ **22**
7. $15\left(3\frac{2}{3}\right)$ **55**
8. $12 \cdot 25$ **300**
9. $5(20 - 1)$ **95**
10. $6(60 - 2)$ **348**
11. $9(30 - 1)$ **261**
12. $8(40 - 3)$ **296**
13. $(9 - 4)6$ **30**
14. $(12 - 3)8$ **72**
15. $(20 - 1)5$ **95**
16. $(30 - 7)6$ **138**

2–5 The Distributive Property (continued)

Example 2 Simplify: **a.** $64 \cdot 19 + 36 \cdot 19$ **b.** $(3.8)(25) - (1.8)(25)$

Solution **a.** $64 \cdot 19 + 36 \cdot 19 = (64 + 36)19$
$= (100)19$
$= 1900$

b. $(3.8)(25) - (1.8)(25) = (3.8 - 1.8)25$
$= (2)25$
$= 50$

Simplify.

17. $20 \cdot 19 + 80 \cdot 19$ **1900**
18. $13 \cdot 53 + 87 \cdot 53$ **5300**
19. $(17 \cdot 24) - (17 \cdot 24)$ **0**
20. $(63 \cdot 71) + (37 \cdot 71)$ **7100**
21. $(0.65)(28) + (0.35)(28)$ **28**
22. $(4.3)(25) - (2.3)(25)$ **50**

Example 3 Write an equivalent expression without parentheses.

a. $5(n - 2)$ **b.** $(5y + 6)2$

Solution **a.** $5(n - 2) = 5 \cdot n - 5 \cdot 2$
$= 5n - 10$

b. $(5y + 6)2 = (5y)2 + (6)2$
$= 10y + 12$

For each expression write an equivalent expression without parentheses.

23. $2(x + 3)$ **2x + 6**
24. $6(a + 5)$ **6a + 30**
25. $5(n - 1)$ **5n − 5**
26. $7(b - 5)$ **7b − 35**
27. $3(6n + 2)$ **18n + 6**
28. $8(5n - 3)$
29. $3(x - y)$ **3x − 3y**
30. $2(4x - y)$ **8x − 2y**
31. $(4n - 7)4$
32. $(3x + 4)5$
33. $(3x + 4y)8$
34. $(5m + 7n)2$
28. **40n − 24**
31. **16n − 28**
32. **15x + 20**
33. **24x + 32y**
34. **10m + 14n**

Example 4 Simplify: **a.** $8x + 6x$ **b.** $9y - 2y$ **c.** $5n - 6 + 3n$

Solution **a.** $8x + 6x = (8 + 6)x = 14x$
b. $9y - 2y = 9y + (-2)y = (9 - 2)y = 7y$
c. $5n - 6 + 3n = 5n + 3n - 6 = 8n - 6$

Simplify.

35. $6a + 4a$ **10a**
36. $5m + 7m$ **12m**
37. $15y - 6y$ **9y**
38. $3x - (-9)x$ **12x**
39. $(-4)n + 9n$ **5n**
40. $(-7)n - 8n$
41. $2a + 9 + 5a$
42. $7n + 1 + 3n$
43. $9n - 5 + 2n$
44. $3x + 8 - 2x$
45. $9y - 6 + 5y$
46. $10n - 7 + 6n$
40. **(−15)n**
41. **7a + 9**
42. **10n + 1**
43. **11n − 5**
44. **x + 8**
45. **14y − 6**
46. **16n − 7**

Mixed Review Exercises

Evaluate if $a = -2$, $b = -3$, $c = 4$, $x = 6$, and $y = 8$.

1. $4x + y - c$ **28**
2. $(x \cdot x + c) \div 8$ **5**
3. $3y - (2x \div c)$ **21**
4. $|a| + |b| + (-y)$ **−3**
5. $c + |a| + |-y|$ **14**
6. $2|a| - 3|b|$ **−5**
7. $-(x - b) + c$ **−5**
8. $x + y + (-5)$ **9**
9. $a + b + (-c)$ **−9**
10. $c - (a - b)$ **3**
11. $-a + b - c$ **−5**
12. $|b - a| - c$ **−3**