4–5 Multiplying Polynomials by Monomials

Objective: To multiply a polynomial by a monomial.

Example 1   Multiply: $x(x + 4)$

Solution 1 $x(x + 4) = x(x) + x(4)$
                  $= x^2 + 4x$

Solution 2 $\begin{array}{r} x + 4 \\ \underline{ x} \\ x^2 + 4x \end{array}$ Multiply each term by x.

Multiply.

1. $3(x - 2)$ 2. $-2(x + 3)$ $c(c - 4)$ 4. $a(3 - 2a)$

5. $-2b(3 - 4b)$ 6. $-3c(4c + 1)$ 7. $5y(y + 6)$ 8. $-z(4 - 5z)$

Example 2   Multiply: $-2x(3x^2 - 2x + 1)$

Solution 1   Multiply each term of the polynomial $3x^2 - 2x + 1$ by the monomial $-2x$.

$$-2x(3x^2 - 2x + 1) = -2x(3x^2) - 2x(-2x) - 2x(1)$$
$$= -6x^3 + 4x^2 - 2x$$

Solution 2 $\begin{array}{r} 3x^2 - 2x + 1 \\ \underline{-2x } \\ -6x^3 + 4x^2 - 2x \end{array}$

Multiply.

9. $3x(x^2 - x - 2)$ 10. $-2x(x^2 - 4x + 5)$ 11. $-4x(2x^2 - 3x - 7)$

12. $5x^2(x^2 + x - 3)$ 13. $-6x^2(x^2 - x - 12)$ 14. $4x^3(x^2 - 3x - 6)$

15. $\begin{array}{r} 3a^2 - 4a - 6 \\ \underline{2a } \end{array}$ 16. $\begin{array}{r} 4a^2 - 5a - 7 \\ \underline{5a } \end{array}$ 17. $\begin{array}{r} 5x^2 - x - 3 \\ \underline{2x^2 } \end{array}$ 18. $\begin{array}{r} 2k^2 - 3k - 5 \\ \underline{-4k^3 } \end{array}$

Example 3   Multiply: $4x^2y(5x^2 - 3xy + 2y^2)$

Solution   Multiply each term of the polynomial by $4x^2y$.

$$4x^2y(5x^2 - 3xy + 2y^2) = 4x^2y(5x^2) + 4x^2y(-3xy) + 4x^2y(2y^2)$$
$$= 20x^4y - 12x^3y^2 + 8x^2y^3$$

Multiply.

19. $3x^2y(4x^2 - 5xy - 2y^2)$ 20. $xy^2(x^2 - 4xy - 5y^2)$

21. $-2xy(4x^2 - 3xy + y^2)$ 22. $\frac{1}{3}x^2y(6x^2 - 12xy + 9y^2)$

61

4-5 Multiplying Polynomials by Monomials (continued)

Multiply.

23. $2xy^2(3x^2 - 7xy - 2y^2)$

24. $-4x^3y(x^2 - 3xy - 6y^2)$

25. $5xy(2x^2 - 4xy + y^2)$

26. $\frac{1}{2}x^2y^2(6x^2 - 4xy - 8y^2)$

Example 4 Simplify $3n(n + 2) + n(5 - n)$.

Solution $3n(n + 2) + n(5 - n) = 3n(n) + 3n(2) + n(5) - n(n)$ $\begin{cases} \text{Use the distributive} \\ \text{property.} \end{cases}$
$= 3n^2 + 6n + 5n - n^2$
$= 2n^2 + 11n$ Combine similar terms.

Simplify.

27. $2x(x - 3) + 3x(x + 2)$

28. $4x(3 - 2x) + 5x(x - 1)$

29. $5x^2(2x - 1) - 2x(3x^2 - 4x)$

30. $3y(4y^2 - 3y) - 2y^2(y + 1)$

31. $2n^2(4n - 5) - 3n(2n^2 - 7n)$

32. $2x(5x^2 - 3x) - x^2(x + 6)$

Example 5 Solve $n(2 - 3n) + 3(n^2 - 4) = 0$.

Solution $n(2 - 3n) + 3(n^2 - 4) = 0$ Use the distributive property.
$2n - 3n^2 + 3n^2 - 12 = 0$ Combine similar terms.
$2n - 12 = 0$ $\begin{cases} \text{To undo the subtraction of 12 from } 2n, \text{ add 12 to} \\ \text{each side. To undo the multiplication of } n \text{ by 2,} \\ \text{divide each side by 2.} \end{cases}$
$2n = 12$
$n = 6$
The solution set is $\{6\}$.

Solve.

33. $2(x - 1) + 3 = 7$

34. $3(y - 2) + 1 = 10$

35. $2(2m - 3) - 3(2m - 1) = 9$

36. $4(3a - 1) - 5(1 - a) = 8$

37. $y(3 - 2y) + 2(y^2 - 6) = 0$

38. $0 = 3(1 - 2x) - 5(3 - x)$

39. $x(2 - 3x) + 3(x^2 - 6) = 0$

40. $2x(1 - 3x) + 6(x^2 - 2) = 0$

Mixed Review Exercises

Simplify.

1. $(2xy^2)^3$

2. $(-4a^4b^3)^2$

3. $(-2n)^4$

4. $(2a^2b)^2(3ab^2)^3$

5. $(3x^2)(4x^3) + (2x^3)(5x^2)$

6. $(4n^3)n^2 - n^3(3n^2)$

7. $(6p - 2q + 4) + (2p + 3q)$

8. $(3x + y - 2) - (y - x - 3)$

9. $(4x^3)^2(2x^2y)^3$

10. $(7x^5)(2x) + (6x^4)(4x^2)$