

4-6 Multiplying Polynomials

Objective: To multiply polynomials.

Example 1 Multiply: $(2x - 3)(x^2 - 4x - 5)$

Solution You can find the product by arranging your work in vertical form. Each term of one polynomial must be multiplied by each term of the other polynomial.

Step 1:
Multiply by $2x$.

$$\begin{array}{r} x^2 - 4x - 5 \\ 2x - 3 \\ \hline 2x^3 - 8x^2 - 10x \end{array}$$

Step 2:
Multiply by -3 .

$$\begin{array}{r} x^2 - 4x - 5 \\ 2x - 3 \\ \hline 2x^3 - 8x^2 - 10x \\ - 3x^2 + 12x + 15 \\ \hline - 3x^2 + 12x + 15 \end{array}$$

↑ ↑
Align similar terms.

Step 3:
Add the results of Steps 1 and 2.

$$\begin{array}{r} x^2 - 4x - 5 \\ 2x - 3 \\ \hline 2x^3 - 8x^2 - 10x \\ - 3x^2 + 12x + 15 \\ \hline 2x^3 - 11x^2 + 2x + 15 \end{array}$$

Multiply. Use the vertical form.

1. $\begin{array}{r} 2a + 1 \\ a + 6 \\ \hline \end{array}$

2. $\begin{array}{r} 3n + 6 \\ 2n - 5 \\ \hline \end{array}$

3. $\begin{array}{r} 3x - 7 \\ 2x + 1 \\ \hline \end{array}$

4. $\begin{array}{r} 4t - 1 \\ 3t - 2 \\ \hline \end{array}$

5. $\begin{array}{r} 3x - 4y \\ 5x - 2y \\ \hline \end{array}$

6. $\begin{array}{r} 2c - 5d \\ 3c + d \\ \hline \end{array}$

7. $\begin{array}{r} 5c - 3d \\ 2c + d \\ \hline \end{array}$

8. $\begin{array}{r} 3x^2 - x - 4 \\ x + 4 \\ \hline \end{array}$

9. $\begin{array}{r} a^2 - 5a - 7 \\ 3a + 2 \\ \hline \end{array}$

10. $\begin{array}{r} 4y^2 - 5y - 2 \\ 2y - 1 \\ \hline \end{array}$

11. $\begin{array}{r} a^2 - ab + b^2 \\ a + b \\ \hline \end{array}$

12. $\begin{array}{r} 2x^2 - xy + y^2 \\ 2x + y \\ \hline \end{array}$

Example 2 Multiply: $(3x - 2)(2x + 5)$

Solution $(3x - 2)(2x + 5) = (3x - 2)2x + (3x - 2)5$ Use the distributive property.
 $= 6x^2 - 4x + 15x - 10$ Combine like terms.
 $= 6x^2 + 11x - 10$

Multiply. Use the horizontal form.

13. $(a + 2)(a + 3)$

15. $(x - 3)(x + 8)$

17. $(2a - 1)(a + 4)$

19. $(2a + 3)(5a - 1)$

21. $(x - 1)(2x^2 + 3x + 4)$

23. $(t - 3)(3t^2 + 3t - 4)$

25. $(2x - 3)(3x^2 - 4x - 2)$

14. $(b + 4)(b + 5)$

16. $(c + 1)(c - 4)$

18. $(3a + 4)(a - 1)$

20. $(4k - 5)(2k + 6)$

22. $(2a + 1)(a^2 + 2a + 5)$

24. $(t - 2)(2t^2 - 3t - 4)$

26. $(3x - 4)(2x^2 - x + 1)$

4-6 Multiplying Polynomials (continued)

CAUTION It often is helpful to rearrange the terms of a polynomial so that the degrees of a particular variable are in either increasing order or decreasing order. For example:

In order of decreasing degree of x :

$$x^4 - 2x^3 - 5x + 6$$

In order of increasing degree of x :

$$6 - 5x - 2x^3 + x^4$$

In order of decreasing degree of x and increasing degree of y :

$$x^4 - 5x^3y + 3x^2y^2 - 6xy^3 + 9y^4$$

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

Solution

$$\begin{array}{r} x^3 - y^3 + 2x^2y + 3xy^2 \\ y + 3x \\ \hline \end{array}$$

Rearrange in order of decreasing degree of x and increasing degree of y .

$$\begin{array}{r} x^3 + 2x^2y + 3xy^2 - y^3 \\ 3x + y \\ \hline 3x^4 + 6x^3y + 9x^2y^2 - 3xy^3 \\ \quad x^3y + 2x^2y^2 + 3xy^3 - y^4 \\ \hline 3x^4 + 7x^3y + 11x^2y^2 - y^4 \end{array}$$

Therefore $(y + 3x)(x^3 - y^3 + 2x^2y + 3xy^2) = 3x^4 + 7x^3y + 11x^2y^2 - y^4$.

Multiplying using either the horizontal or vertical form. Arrange the terms in each factor in order of decreasing or increasing degree of one of the variables.

27. $(1 + y)(y^2 + 2y - 3)$

28. $(4 + x)(x^2 - 4x + 3)$

29. $(2 + 3y)(3y - 5 + y^2)$

30. $(3y + 4)(y - 2y^2 + 5)$

31. $(3x + y)(x^2 + 4y^2 + 2xy)$

32. $(1 + 2a)(a^2 - 4 + a)$

33. $(2x - y)(x^2 + 3y^2 - 4xy)$

34. $(y - 3x)(2x^2 + y^2 - 2xy)$

Mixed Review Exercises

Solve.

1. $2(x - 1) = 8$

2. $3(x - 2) - 2 = 7$

3. $4(2a + 3) = 5(a - 6)$

Evaluate if $w = -1$, $x = 2$, and $y = 4$.

4. $x + |w| - y$

5. $w + x + y$

6. $w - |y - x|$

7. $(x + y)^2$

8. $(-x)^2x^2$

9. wy^3