

## 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  $-3$ .

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

↑ ↑  
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.  $(a + 2)(a + 3)$

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

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

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

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

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

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

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

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

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

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

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

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

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

**Multiply 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.  $wy^3$