[6-1]G Multiplying Polynomials

(Vertical Form)

$(2x+1)(x+6)$

① $2x+1$ and $x+6$

$2x^2+x+12x+6$

$\boxed{2x^2+13x+6}$

② $(3x-7)(2x+1)$

$3x+-7$ and $2x+1$

$6x^2+-14x+3x+-7$

$\boxed{6x^2+-11x+-7}$

③ $3x+-4y$ and $5x+2y$

$15x^2+-20xy+-6xy+8y^2$

$\boxed{15x^2+-26xy+8y^2}$

(Horizontal Form)

④ $(2x+-1)(x+4)$

$2x^2+8x+-1x+-4$

$\boxed{2x^2+7x+-4}$

⑤ $(x+-3)(x+8)$

$x^2+8x+-3x+-24$

$\boxed{x^2+5x+-24}$

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~~4-6~~ Multiplying Polynomials

Evens only

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 $2x$.

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

Step 2: Multiply by -3.

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

Align similar terms.

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

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

Multiply. Use the vertical form.

1. $\begin{array}{r} 2a + 1 \\ \underline{a + 6} \end{array}$
2. $\begin{array}{r} 3n + 6 \\ \underline{2n - 5} \end{array}$
3. $\begin{array}{r} 3x - 7 \\ \underline{2x + 1} \end{array}$
4. $\begin{array}{r} 4t - 1 \\ \underline{3t - 2} \end{array}$
5. $\begin{array}{r} 3x - 4y \\ \underline{5x - 2y} \end{array}$
6. $\begin{array}{r} 2c - 5d \\ \underline{3c + d} \end{array}$
7. $\begin{array}{r} 5c - 3d \\ \underline{2c + d} \end{array}$
8. $\begin{array}{r} 3x^2 - x - 4 \\ \underline{x + 4} \end{array}$
9. $\begin{array}{r} a^2 - 5a - 7 \\ \underline{3a + 2} \end{array}$
10. $\begin{array}{r} 4y^2 - 5y - 2 \\ \underline{2y - 1} \end{array}$
11. $\begin{array}{r} a^2 - ab + b^2 \\ \underline{a + b} \end{array}$
12. $\begin{array}{r} 2x^2 - xy + y^2 \\ \underline{2x + y} \end{array}$

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

Solution

$$\begin{aligned} (3x - 2)(2x + 5) &= (3x - 2)2x + (3x - 2)5 && \text{Use the distributive property.} \\ &= 6x^2 - 4x + 15x - 10 \\ &= 6x^2 + 11x - 10 && \text{Combine like terms.} \end{aligned}$$

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

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

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

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

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

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