

Multiplying Polynomials

To multiply two polynomials, multiply each term of the first polynomial by each term of the second polynomial. You can use a vertical or a horizontal format.

Example 1 Find (a) $5x(x^2 - 2x - 4)$ and (b) $(x - 1)(x + 3)$.

a. Use a horizontal format. Distribute $5x$ to each term of $x^2 - 2x - 4$.

$$\begin{aligned} 5x(x^2 - 2x - 4) &= 5x(x^2) + 5x(-2x) + 5x(-4) \\ &= 5x^3 - 10x^2 - 20x \end{aligned}$$

b. Use a vertical format.

\times	$x - 1$	
	$x + 3$	Align like terms vertically.
	$3x - 3$	Distributive Property: Multiply $3(x - 1)$.
	$x^2 - x$	Distributive Property: Multiply $x(x - 1)$.
	$x^2 + 2x - 3$	Combine like terms.

In Example 1(b), you multiplied two binomials. Another way to multiply two binomials is to use the Distributive Property systemically. Find the sum of the products of the *First* terms, the *Outer* terms, the *Inner* terms, and the *Last* terms of the binomials. This is called the **FOIL Method**.

You can also use the patterns shown to find the square of a binomial, or the product of the sum and difference of two terms.

Square of a Binomial Pattern	Sum and Difference Pattern
$(a + b)^2 = a^2 + 2ab + b^2$	$(a + b)(a - b) = a^2 - b^2$
$(a - b)^2 = a^2 - 2ab + b^2$	

Example 2 Find (a) $(x + 4)(2x + 1)$, (b) $(3x + 5)^2$, and (c) $(x + 2)(x - 2)$.

a. Use the FOIL Method.

F O I L

$$\begin{aligned} (x + 4x)(2x + 1) &= 2x^2 + x + 8x + 4 \\ &= 2x^2 + 9x + 4 \end{aligned}$$

b. $(3x + 5)^2 = (3x)^2 + 2(3x)(5) + 5^2$
 $= 9x^2 + 30x + 25$

c. $(x + 2)(x - 2) = x^2 - 2^2$
 $= x^2 - 4$

Practice

Find the product.

Check your answers at BigIdeasMath.com.

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|--|---|---|
| 1. $4x(x + 7)$
$4x^2 + 28x$ | 2. $2x(3x - 8)$
$6x^2 - 16x$ | 3. $8x(x^2 + 5x + 4)$
$8x^3 + 40x^2 + 32x$ |
| 4. $5x(7 - x - 3x^2)$
$-15x^3 - 5x^2 + 35x$ | 5. $(x + 1)(x + 4)$
$x^2 + 5x + 4$ | 6. $(x - 3)(x - 5)$
$x^2 - 8x + 15$ |
| 7. $(2x + 7)(3x - 1)$
$6x^2 + 19x - 7$ | 8. $(5 - 3x)(4 - x)$
$3x^2 - 17x + 20$ | 9. $(x - 1)(9 - x)$
$-x^2 + 10x - 9$ |
| 10. $(x + 6)(x - 6)$
$x^2 - 36$ | 11. $(x + 5)^2$
$x^2 + 10x + 25$ | 12. $(2x - 1)^2$
$4x^2 - 4x + 1$ |
| 13. $(2 - 5x)^2$
$25x^2 - 20x + 4$ | 14. $(8x + 3)^2$
$64x^2 + 48x + 9$ | 15. $(2x + 3)(3x - 3)$
$6x^2 + 3x - 9$ |