

# Multiplying Polynomials

Now that we have reviewed several laws of exponents and used them to multiply monomials, we will extend the ideas to multiplying polynomials.

Do you remember how to multiply and simplify something like this? **F O I L**

$$\begin{aligned} (2x + 4)(3x - 7) &\Rightarrow (2x)(3x) + (2x)(-7) + (4)(3x) + (4)(-7) \\ &= 6x^2 - 14x + 12x - 28 \\ &= 6x^2 - 2x - 28 \end{aligned}$$

**Break for Practice:** Simplify.

$$\begin{aligned} 1. (a + 2)(3a - 5) &= 3a^2 - 5a + 6a - 10 \\ &= 3a^2 + a - 10 \end{aligned}$$

$$\begin{aligned} 2. (7y + z)(2y + 5z) &= 14y^2 + 35yz + 2yz + 5z^2 \\ &= 14y^2 + 37yz + 5z^2 \end{aligned}$$

+/- inside ()'s  
you CANNOT distribute!

$$\begin{aligned} 3. (y + 6)^2 &\Rightarrow (y + 6)(y + 6) \\ &= y^2 + 6y + 6y + 36 \\ &= y^2 + 12y + 36 \end{aligned}$$

$$\begin{aligned} 4. (2a - 3)^2 &\Rightarrow (2a - 3)(2a - 3) \\ &= 4a^2 - 6a - 6a + 9 \\ &= 4a^2 - 12a + 9 \end{aligned}$$

For multiplying larger polynomials, there are a couple of different techniques that can be used.

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

Horizontal Method

$$\begin{aligned} (2x - 1)(x^2 - 3x + 5) &= 2x^3 - 6x^2 + 10x - x^2 + 3x - 5 \\ &= 2x^3 - 7x^2 + 13x - 5 \end{aligned}$$

Vertical Method

$$\begin{array}{r} x^2 - 3x + 5 \\ 2x - 1 \\ \hline -x^2 + 3x - 5 \\ 2x^3 - 6x^2 + 10x \\ \hline 2x^3 - 7x^2 + 13x - 5 \end{array}$$

**Break for Practice:** Simplify

$$\begin{aligned} (x^2 + 3)(x^4 + 2x^2 - 1) &= x^6 + 2x^4 - x^2 + 3x^4 + 6x^2 - 3 \\ &= x^6 + 5x^4 + 5x^2 - 3 \end{aligned}$$

**Extended Practice:** Simplify

1. $(4z + 3)(3z - 4)$  $12z^2 - 7z - 12$	2. $(4k - 5)^2$  $16k^2 - 40k + 25$
3. $(7t + 2)(2t - 1)$  $14t^2 - 3t - 2$	4. $(9 - 5t)(5t - 9)$  $-25t^2 + 90t - 81$
5. $(2p + 3q)(3p - 2q)$  $6p^2 + 5pq - 6q^2$	6. $(p^2 - 2q^2)(p^2 + 2q^2)$  $p^4 - 4q^4$
7. $(2x^2 - 5)^2$  $4x^4 - 20x^2 + 25$	8. $t(t - 2)(t + 1)$  $t^3 - t^2 - 2t$
9. $mn(m - n)(m - 2n)$  $m^3n - 3m^2n^2 + 2mn^3$	10. $(x + 2)(x^2 + 3x - 5)$  $x^3 + 5x^2 + x - 10$
11. $(3 - k^2)(2 - k^2 - k^4)$  $k^6 - 2k^4 - 5k^2 + 6$	12. $(a + 2b)(a^3 - 2a^2b - b^3)$  $a^4 - 4a^2b^2 - ab^3 - 2b^4$