

MULTIPLYING POLYNOMIALS To multiply two polynomials, you multiply each term of the first polynomial by each term of the second polynomial.

EXAMPLE 3 Multiply polynomials vertically and horizontally

- a. Multiply $-2y^2 + 3y - 6$ and $y - 2$ in a vertical format.
 b. Multiply $x + 3$ and $3x^2 - 2x + 4$ in a horizontal format.

Solution

a.

$$\begin{array}{r} -2y^2 + 3y - 6 \\ \times \quad \quad y - 2 \\ \hline 4y^2 - 6y + 12 \\ -2y^3 + 3y^2 - 6y \\ \hline -2y^3 + 7y^2 - 12y + 12 \end{array}$$

Multiply $-2y^2 + 3y - 6$ by -2 .

Multiply $-2y^2 + 3y - 6$ by y .

Combine like terms.

b. $(x + 3)(3x^2 - 2x + 4) = (x + 3)3x^2 - (x + 3)2x + (x + 3)4$
 $= 3x^3 + 9x^2 - 2x^2 - 6x + 4x + 12$
 $= 3x^3 + 7x^2 - 2x + 12$

EXAMPLE 4 Multiply three binomials

Multiply $x - 5$, $x + 1$, and $x + 3$ in a horizontal format.

$$\begin{aligned} (x - 5)(x + 1)(x + 3) &= (x^2 - 4x - 5)(x + 3) \\ &= (x^2 - 4x - 5)x + (x^2 - 4x - 5)3 \\ &= x^3 - 4x^2 - 5x + 3x^2 - 12x - 15 \\ &= x^3 - x^2 - 17x - 15 \end{aligned}$$

PRODUCT PATTERNS Some binomial products occur so frequently that it is worth memorizing their patterns. You can verify these product patterns by multiplying.

KEY CONCEPT

For Your Notebook

Special Product Patterns

Sum and Difference

$$(a + b)(a - b) = a^2 - b^2$$

Example

$$(x + 4)(x - 4) = x^2 - 16$$

Square of a Binomial

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

Example

$$(y + 3)^2 = y^2 + 6y + 9$$

$$(3z^2 - 5)^2 = 9z^4 - 30z^2 + 25$$

Cube of a Binomial

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

$$(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$

Example

$$(x + 2)^3 = x^3 + 6x^2 + 12x + 8$$

$$(p - 3)^3 = p^3 - 9p^2 + 27p - 27$$

AVOID ERRORS

In general,
 $(a \pm b)^2 \neq a^2 \pm b^2$
 and
 $(a \pm b)^3 \neq a^3 \pm b^3$.