



Multiply POLYNOMIALS

Learning Objective

We will multiply polynomials.

CFU

What are we going to do?

Activate Prior Knowledge

Use the distributive property to multiply.

$$1. 5x(2x^2 - 3) = 10x^3 - 15x$$

$$2. 3x(4x^3 - 1) = 12x^4 - 3x$$

Note: When multiplying like bases, add the exponents.

$$x^2 \cdot x^5 = x^{(2+5)} = x^7$$

$$x \cdot x^3 = x^1 \cdot x^3 = x^{(1+3)} = x^4$$

Make Connection

Students, you already know how to use the distributive property to multiply. Now, we will use the distributive property to multiply polynomials.

Concept Development

To multiply polynomials¹, use the distributive property then combine like terms.

Multiplying Polynomials

$$(5x + 3)(2x^2 + 10x - 6)$$

1. Distribute: $5x(2x^2) + 5x(10x) + 5x(-6) + 3(2x^2) + 3(10x) + 3(-6)$

$$\begin{array}{cccccc} \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 10x^3 & + 50x^2 & - 30x & + 6x^2 & + 30x & - 18 \end{array}$$

2. Combine like terms:

$$\begin{array}{cccccc} \underline{10x^3} & + \underline{50x^2} & + \underline{6x^2} & - \underline{30x} & + \underline{30x} & - \underline{18} \\ & & & & & \\ 10x^3 & + 56x^2 & - 18 & & & \end{array}$$

In the final answer, write the terms in descending² exponent order.

Recall:

When multiplying like bases,
add the exponents.

CFU

Which polynomials are getting multiplied? How do you know? Why is the other option wrong?

A $(x + 2) + (x^2 + 3x + 4)$

B $(x + 2)(x^2 + 3x + 4)$

Just like $(4)(5)$ means 4 times 5, answer b means $(x + 2)$ times $(x^2 + 3x + 4)$.

Which final answer is in descending exponent order? How do you know? Why is the other option wrong?

A $10x + 8 + 5x^2 + x^3$

B $x^3 + 5x^2 + 10x + 8$

Exponents in descending order, greatest to least.

Vocabulary

¹ expressions of two or more items

² ordering from greatest to least

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.
Write the product ordering exponents from greatest to least.

CFU

- 1 How did I/you multiply the polynomials?
- 2 How did I/you combine the like terms?
- 3 How did I/you write the product?

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

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

$$12x^3 + 9x^2 - 6x + 8x^2 + 6x - 4$$

$$\begin{array}{r} 9x^2 \\ + 8x^2 \\ \hline 17x^2 \end{array} \quad \begin{array}{r} -6x \\ + 6x \\ \hline 0 \end{array}$$

$$12x^3 + 17x^2 - 4$$

$$2. \quad (4x + 3)(2x^2 + 4x - 3) =$$

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

$$8x^3 + 16x^2 - 12x + 6x^2 + 12x - 9$$

$$\begin{array}{r} 16x^2 \\ + 6x^2 \\ \hline 22x^2 \end{array} \quad \begin{array}{r} -12x \\ + 12x \\ \hline 0 \end{array}$$

$$8x^3 + 22x^2 - 9$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.
Write the product ordering exponents from greatest to least.

CFU

- 1 How did I/you multiply the polynomials?
- 2 How did I/you combine the like terms?
- 3 How did I/you write the product?

$$3. \quad (4m^3 + 3)(2m^3 - 5m^2 + 2m - 3) =$$

$$4m^3(2m^3) + 4m^3(-5m^2) + 4m^3(2m) + 4m^3(-3) + 3(2m^3) + 3(-5m^2) + 3(2m) + 3(-3)$$

$$8m^6 - 20m^5 + 8m^4 - \overbrace{12m^3 + 6m^3} - 15m^2 + 6m - 9 \quad \begin{array}{r} -12m^3 \\ +6m^3 \\ -6m^3 \end{array}$$

$$8m^6 - 20m^5 + 8m^4 - 6m^3 - 15m^2 + 6m - 9$$

$$4. \quad (6n^3 + 4)(3n^3 - 7n^2 + 5n - 3) =$$

$$6n^3(3n^3) + 6n^3(-7n^2) + 6n^3(5n) + 6n^3(-3) + 4(3n^3) + 4(-7n^2) + 4(5n) + 4(-3)$$

$$18n^6 - 42n^5 + 30n^4 - \overbrace{18n^3 + 12n^3} - 28n^2 + 20n - 12 \quad \begin{array}{r} -18n^3 \\ +12n^3 \\ -6n^3 \end{array}$$

$$18n^6 - 42n^5 + 30n^4 - 6n^3 - 28n^2 + 20n - 12$$

To multiply polynomials, use the distributive property then combine like terms.

- 1 *Multiplying polynomials will help you with more complex mathematics.*

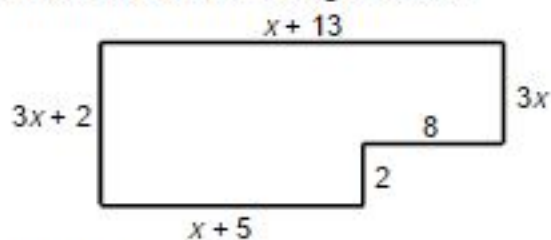
$$2(x^2 + 13 + 3x + 2) + 5x(2x^2 + 5 + 2 + 3 + 3x)$$

$$10x^3 + 8x^2 + 65x$$

- 2 *Multiplying polynomials will help you do well on tests.*

Sample Test Question:

52. What is the area of the figure below?



- A $41x + 10$
 B $3x^2 + 38x + 10$
 C $8x + 30$
 D $8x^2 + 30$

CFU

Does anyone else have another reason why it is relevant to multiply polynomials? (Pair-Share) Why is it relevant to multiply polynomials? You may give one of my reasons or one of your own. Which reason is more relevant to you? Why?

To multiply polynomials, use the distributive property then combine like terms.

Skill Closure

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

1. $(3m + 4)(7m^2 + 5m - 2) =$

$$3m(7m^2) + 3m(5m) + 3m(-2) + 4(7m^2) + 4(5m) + 4(-2)$$

$$21m^3 + 15m^2 - 6m + 28m^2 + 20m - 8$$

$$21m^3 + 43m^2 + 14m - 8$$

2. $(6x^3 + x)(3x^2 - 4x + 3) =$

$$6x^3(3x^2) + 6x^3(-4x) + 6x^3(3) + x(3x^2) + x(-4x) + x(3)$$

$$18x^5 - 24x^4 + 18x^3 + 3x^3 - 4x^2 + 3x$$

$$18x^5 - 24x^4 + 21x^3 - 4x^2 + 3x$$

Summary Closure

What did you learn today about multiplying polynomials? (Pair-Share)

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

1. $(5x + 6)(5x^4 - 6x + 5) =$

$$5x(5x^4) + 5x(-6x) + 5x(5) + 6(5x^4) + 6(-6x) + 6(5)$$

$$25x^5 - 30x^2 + 25x + 30x^4 - 36x + 30$$

$$25x^5 + 30x^4 - 30x^2 - 11x + 30$$

2. $(7x + 2)(7x^3 + 6x - 5) =$

$$7x(7x^3) + 7x(6x) + 7x(-5) + 2(7x^3) + 2(6x) + 2(-5)$$

$$49x^4 + 42x^2 - 35x + 14x^3 + 12x - 10$$

$$49x^4 + 14x^3 + 42x^2 - 23x - 10$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least

$$3. \quad (4m^3 - m)(6m^3 - 3m^2 + 5m + 2) =$$

$$4m^3(6m^3) + 4m^3(-3m^2) + 4m^3(5m) + 4m^3(2) + -m(6m^3) + -m(-3m^2) + -m(5m) + -m(2)$$

$$24m^6 - 12m^5 + 20m^4 + 8m^3 - 6m^4 + 3m^3 - 5m^2 - 2m$$

$$24m^6 - 12m^5 + 14m^4 + 11m^3 - 5m^2 - 2m$$

$$4. \quad (8x^5 - x)(4x^5 + 3x^3 - 7x - 3) =$$

$$8x^5(4x^5) + 8x^5(3x^3) + 8x^5(-7x) + 8x^5(-3) + -x(4x^5) + -x(3x^3) + -x(-7x) + -x(-3)$$

$$32x^{10} + 24x^8 - 56x^6 - 24x^5 - 4x^6 - 3x^4 + 7x^2 + 3x$$

$$32x^{10} + 24x^8 - 60x^6 - 24x^5 - 3x^4 + 7x^2 + 3x$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

1. $(5x^3 - 2x)(2x^3 + 6x^2 + x) =$

$$5x^3(2x^3) + 5x^3(6x^2) + 5x^3(x) + -2x(2x^3) + -2x(6x^2) + -2x(x)$$

$$10x^6 + 30x^5 + 5x^4 - 4x^4 - 12x^3 - 2x^2$$

$$10x^6 + 30x^5 + x^4 - 12x^3 - 2x^2$$

2. $(3x^4 - x)(3x^4 - 5x^3 + 3x - 5) =$

$$3x^4(3x^4) + 3x^4(-5x^3) + 3x^4(3x) + 3x^4(-5) + -x(3x^4) + -x(-5x^3) + -x(3x) + -x(-5)$$

$$9x^8 - 15x^7 + 9x^5 - 15x^4 - 3x^5 + 5x^4 - 3x^2 + 5x$$

$$9x^8 - 15x^7 + 6x^5 - 10x^4 - 3x^2 + 5x$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

$$3. \quad (5x^2 + 3)(4x^2 + 5x - 3) =$$

$$5x^2(4x^2) + 5x^2(5x) + 5x^2(-3) + 3(4x^2) + 3(5x) + 3(-3)$$

$$20x^4 + 25x^3 - 15x^2 + 12x^2 + 15x - 9$$

$$20x^4 + 25x^3 - 3x^2 + 15x - 9$$

$$4. \quad (2x^3 - 3x)(x^3 + 6x^2 - 3x + 2) =$$

$$2x^3(x^3) + 2x^3(6x^2) + 2x^3(-3x) + 2x^3(2) - 3x(x^3) - 3x(6x^2) - 3x(-3x) - 3x(2)$$

$$2x^6 + 12x^5 - 6x^4 + 4x^3 - 3x^4 - 18x^3 + 9x^2 - 6x$$

$$2x^6 + 12x^5 - 9x^4 - 14x^3 + 9x^2 - 6x$$

To **multiply polynomials**, use the **distributive property** then **combine like terms**.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

$$1. \quad (3x^5 - 4)(3x^4 - 5x^3 + 3x^3) =$$

$$3x^5(3x^4) + 3x^5(-5x^3) + 3x^5(3x^3) + -4(3x^4) + -4(-5x^3) + -4(3x^3)$$

$$9x^9 - 15x^8 + 9x^8 - 12x^4 + 20x^3 - 12x^3$$

$$9x^9 - 6x^8 - 12x^4 + 8x^3$$

$$2. \quad (a^3 + 7a)(2a^3 - 3a^2 + 2a^3) =$$

$$a^3(2a^3) + a^3(-3a^2) + a^3(2a^3) + 7a(2a^3) + 7a(-3a^2) + 7a(2a^3)$$

$$2a^6 - 3a^5 + 2a^6 + 14a^4 - 21a^3 + 14a^4$$

$$4a^6 - 3a^5 + 28a^4 - 21a^3$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

$$3. \quad (2y^2 - y)(6y^2 + 3y + 6) =$$

$$2y^2(6y^2) + 2y^2(3y) + 2y^2(6) + -y(6y^2) + -y(3y) + -y(6)$$

$$12y^4 + 6y^3 + 12y^2 - 6y^3 - 3y^2 - 6y$$

$$12y^4 + 9y^2 - 6y$$

$$4. \quad (8y^4 + 6)(5y^2 + 3y^3 + 5y - 4) =$$

$$8y^4(5y^2) + 8y^4(3y^3) + 8y^4(5y) + 8y^4(-4) + 6(5y^2) + 6(3y^3) + 6(5y) + 6(-4)$$

$$40y^6 + 24y^7 + 40y^5 - 32y^4 + 30y^2 + 18y^3 + 30y - 24$$

$$24y^7 + 40y^6 + 40y^5 - 32y^4 + 18y^3 + 30y^2 + 30y - 24$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

$$1. \quad (5t^2 - 2t)(-3t^4 + 3t^2 + 5t - 3) =$$

$$5t^2(-3t^4) + 5t^2(3t^2) + 5t^2(5t) + 5t^2(-3) + -2t(-3t^4) + -2t(3t^2) + -2t(5t) + -2t(-3)$$

$$-15t^6 + 15t^4 + 25t^3 - 15t^2 + 6t^5 - 6t^3 - 10t^2 + 6t$$

$$-15t^6 + 6t^5 + 15t^4 + 19t^3 - 25t^2 + 6t$$

$$2. \quad (7y^5 - 6y)(6y^4 - 4y^3 + 6y^2 + 5) =$$

$$7y^5(6y^4) + 7y^5(-4y^3) + 7y^5(6y^2) + 7y^5(5) + -6y(6y^4) + -6y(-4y^3) + -6y(6y^2) + -6y(5)$$

$$42y^9 - 28y^8 + 42y^7 + 35y^5 - 36y^5 + 24y^4 - 36y^3 - 30y$$

$$42y^9 - 28y^8 + 42y^7 - y^5 + 24y^4 - 36y^3 - 30y$$

To multiply polynomials, use the distributive property then combine like terms.

Multiply polynomials.

- 1 Multiply the polynomials using the distributive property.
 - a For each term of the first polynomial, distribute into the second
- 2 polynomial.
- 3 Combine the like terms.

Write the product ordering exponents from greatest to least.

$$3. \quad (6x^3 - 3)(2x^3 - 5x^2 + 6) =$$

$$6x^3(2x^3) + 6x^3(-5x^2) + 6x^3(6) + -3(2x^3) + -3(-5x^2) + -3(6)$$

$$12x^6 - 30x^5 + 36x^3 - 6x^3 + 15x^2 - 18$$

$$12x^6 - 30x^5 + 30x^3 + 15x^2 - 18$$

$$4. \quad (4a^2 + 3a)(a^2 + 2a^2 - 6) =$$

$$4a^2(a^2) + 4a^2(2a^2) + 4a^2(-6) + 3a(a^2) + 3a(2a^2) + 3a(-6)$$

$$4a^4 + 8a^4 - 24a^2 + 3a^3 + 6a^3 - 18a$$

$$12a^4 + 9a^3 - 24a^2 - 18a$$