

Algebra 1 - Adding, Subtracting and Multiplying Polynomials - Lesson

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A polynomial is a sum of terms with whole-number exponents, such as $3x^2 - 5x + 7$. To add or subtract, combine like terms. To multiply, distribute each term of one polynomial across the other, using FOIL or an area model. Special products include the square of a binomial and the difference of squares.

Algebra 1 · Common Core State Standards: **A-APR.A.1**

Key facts

- The degree of a polynomial is its greatest exponent.
- Add or subtract by combining like terms; subtracting changes the sign of every term.
- Multiply by distributing each term, then combine like terms.
- $(a + b)^2 = a^2 + 2ab + b^2$ and $(a + b)(a - b) = a^2 - b^2$.
- The sum, difference, and product of polynomials is a polynomial.

What is a polynomial?

Polynomial

A **polynomial** is a sum of terms, each a number times a variable raised to a whole-number power. The **degree** is the greatest exponent. Write a polynomial in **standard form** with the exponents in descending order.

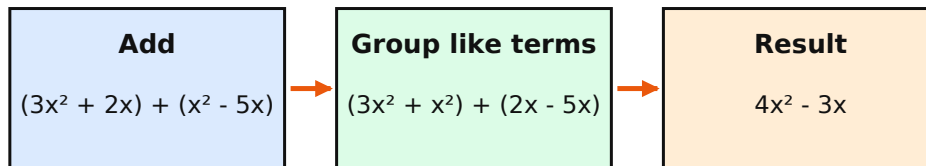
Polynomial	Name	Degree
$7x^2$	monomial	2
$3x - 5$	binomial	1
$x^3 - 4x + 9$	trinomial	3

Name a polynomial by its number of terms and its degree by the largest exponent.

The leading coefficient is the coefficient of the term with the highest degree. In $2x^3 - 7x + 4$, the degree is 3 and the leading coefficient is 2.

How do you add and subtract polynomials?

Combine like terms, which have the same variable and exponent. To subtract, change the sign of every term in the second polynomial first.



Add polynomials by combining like terms.

Example: Subtract $(5x^2 + 3x - 2) - (2x^2 - x + 6)$. Distribute the negative: $5x^2 + 3x - 2 - 2x^2 + x - 6$. Combine: $3x^2 + 4x - 8$.

How do you multiply polynomials?

Multiply every term of one polynomial by every term of the other, then combine like terms. For two binomials, you can use FOIL (First, Outer, Inner, Last) or an area model.

	x	2
x	x^2	$2x$
3	$3x$	6

Area model: $(x+3)(x+2) = x^2 + 2x + 3x + 6 = x^2 + 5x + 6$.

1. Multiply each term in the first factor by each term in the second.
2. Write all the partial products.
3. Combine like terms and write in standard form.

What are the special products?

Two patterns save time. The square of a binomial is $(a+b)^2 = a^2 + 2ab + b^2$. The product of a sum and a difference is $(a+b)(a-b) = a^2 - b^2$.

	x	5
x	x^2	$5x$
5	$5x$	25

A perfect square: $(x+5)^2 = x^2 + 10x + 25$.

The middle term of a square is twice the product of the two terms, so $(x+5)^2 = x^2 + 2(x)(5) + 25$. Note that $(x+5)^2$ is not equal to $x^2 + 25$.

Why are polynomials closed under these operations?

The sum, difference, and product of two polynomials is always another polynomial, just as the sum and product of integers is an integer. Division does not always give a polynomial.

Questions about adding, subtracting and multiplying polynomials

What is the degree of a polynomial?

It is the highest exponent of the variable. The polynomial $2x^3 - 7x + 4$ has degree 3.

What is FOIL?

FOIL is a memory aid for multiplying two binomials: multiply the First terms, Outer terms, Inner terms, and Last terms, then add the products.

How do you subtract polynomials?

Distribute the negative sign to every term in the second polynomial, then combine like terms.

Why is $(x + 5)^2$ not $x^2 + 25$?

Squaring a binomial means multiplying it by itself, which creates the middle term $2(5)x = 10x$. So $(x + 5)^2 = x^2 + 10x + 25$.

What does closed mean for polynomials?

It means adding, subtracting, or multiplying polynomials always gives another polynomial, just as adding integers always gives an integer.