Algebra Connections

Mr. Breitsprecher's Edition   February 22, 2005   Web: www.clubtnt.org/my_algebra

Multiplying Polynomials

Multiplying polynomials is just another application of the commutative and associative properties of multiplication. Combined with the multiplication rules for exponents, we have all the tools necessary to practice and master this algebraic skill.

The key will be to apply these procedures in an organized, simplified fashion. Understanding this process is important – time spent becoming familiar with these procedures of multiplying polynomials will repay itself.

Like many things – it is probably best to look at and practice simpler examples before we move to those that require a greater understanding. Recall that a polynomial is an expression with one or more terms added to or subtracted from each other. For example, $x^3 + 5x^2 - 8$ is a polynomial.

The simplest form of a polynomial only has 1 term – it is called a monomial. Let's start by looking at multiplying monomials by monomials.

Example 1: Multiplying Monomials:

$(4x^3)(3x^4)$

- Group coefficients and like bases:

  $(4*3)*(x^2 x^4)$

- Add exponents and simplify:

  $12x^7$

Example 2: Multiplying Monomials:

$(-3c^4d)(2c^2d^3e)$

- Group coefficients and like bases:

  $(-3*2)(c^4c^2)(dd^3)(e)$

- Simplify:

  $-6c^6d^4e$

Multiplying a Polynomial by a Monomial

This isn't new; we looked at this earlier without using these terms. Recall that distributive property: a(b+c) = ab + bc. Do you see that this is really multiplying a polynomial by a monomial?

Example 1: Multiplying a Binomial by a Monomial:

$4t(2t-3)$

- Multiply each term of the binomial by 4t:

  $4t(2t-3)$

- Apply the distributive property:

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

- Simplify each term:

  $8t^2-6t$

Special Case Product Formulas

There are patterns in numbers and in algebra – it is important to see these relationships. In some cases – multiplying 2 binomials takes on a special pattern. We will not discuss why they work or "prove" them; you can apply foil to see for yourself. Please practice these patterns so that you can recognize and apply them – they are extremely important when factoring polynomials.

- Difference Of Squares: $(a+b)(a-b) = a^2-b^2$
- Perfect Square Trinomials:
  - $(a+b)^2 = a^2+2ab+b2$
  - $(a-b)^2 = a^2 – 2ab + b^2$

More Links for Polynomial Expressions
http://www.ifigure.com/math/algebra/algebra.htm

Solve Your Math Problem (you supply the problem, it provides the solution)
http://www.webmath.com/polymult.html

How to Add, Subtract, Multiply, and Divide Polynomials
http://faculty.ed.umuc.edu/~swalsh/Math%20Articles/Polynomial.html

Interactive Exponents and Polynomial Review (requires plug-in, available at site)
http://www.mathnotes.com/Intro/aw_introchap3.html

Practice Test: Polynomial Concepts and Operations (interactive)
http://www.mccc.edu/~kelld/polynomials/polynomials.htm

Example 2: Multiplying a Trinomial by a Monomial:

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

- Multiply each term of the trinomial by $-4a^2$:

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

- Apply the distributive property:

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

- Simplify:

$$12a^4 - 8a^3 + 16a^2$$

So we have seen how to multiply polynomials by monomials – this was just an application of the distributive property. Apply the same principles when multiplying polynomials with more than 1 term (i.e. binomial, trinomials, etc.).

THE KEY IS TO REMEMBER TO MULTIPLY EACH TERM OF THE FIRST POLYNOMIAL BY EACH TERM OF THE SECOND POLYNOMIAL. We can draw arrows to help us keep track – this is especially useful when multiplying polynomials that contain many terms.

Example: Multiplying Polynomials With More Than 1 Term:

$$(x+5)(x+3)$$

- Multiply each term in the second polynomial by each term in the first:

$$(x+5)(x+3)$$

- Apply the distribution property:

$$(x*x)+(x*3)+(5*x)+(5*3)$$

- Simplify:

$$x^2+3x+5x+15)$$

- Combine like terms:

$$x^2+8x+15$$

Note how the product of two binomials (example above) equals the sum of the products of the first terms, the outer terms, the inner terms and the last terms.

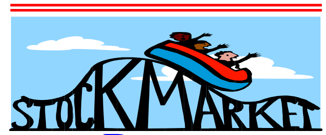
The acronym **FOIL** (**F**irst **O**uter **I**nner **L**ast) can be used to help memorize how to multiply 2 binomials. In this author's opinion – that is just an extra rule to memorize; we don't need it. Please use it if you find it helpful and be aware that you will probably see it in another math class.

We can accomplish the same thing be remembering to multiply each term of the first polynomial by each term of the second polynomial.

We can easily keep track of this if we draw arrows for each product while we work out the solution. This approach works when multiplying any polynomial with more than one term by any other polynomial

Using **FOIL** will **ONLY** work when multiplying two binomials. It **WILL NOT** work when multiplying a binomial by a trinomial or with any other type of polynomial. If you have been successful accurately using **FOIL** in the past – please continue to use it.

Sometimes, new approaches are helpful – drawing arrows to keep track of each term as you multiply polynomials, can be a convenient method. This author recommends keeping memorization to a minimum when learning algebra.



Report

- Helium was up, feathers were down.
- Paper was stationery.
- Fluorescent tubing was dimmed in light trading.
- Knives were up sharply.
- Pencils lost a few points.
- Hiking equipment was trailing.
- Elevators rose, while escalators continued their slow decline.
- Light switches were off.
- Mining equipment hit rock bottom.
- Diapers remain unchanged.
- Shipping lines stayed at an even keel.
- The market for raisins dried up.
- Caterpillar stock inched up a bit.
- Sun peaked at midday.
- Balloon prices were inflated.
- Kleenex nosed up.

Quick Review Polynomials

Definitions

Monomial has one term: $5y$ or $-8x^2$ or 3.

Binomial has two terms: $-3x^2 + 2$, or $9y - 2y^2$

Trinomial has 3 terms: $-3x^2 + 2 + 3x$, or $9y - 2y^2 + y$

Degree Of The Term is the exponent of the variable: $3x^2$ has a degree of 2.

Degree of a Polynomial is the highest degree of any of its terms.

When the variable does not have an exponent -understand that there's a '1' .

One thing you will do when solving polynomials is combine like terms. Understanding this is the key to accurately working with polynomials. Let's look at some examples:

- Like terms: $6x + 3x - 3x$
- **NOT** like terms: $6xy + 2x - 4$

The first two terms are like and they can be combined:

$$5x^2 + 2x^2 - 3$$

Combining like terms, we get:

$$7x^2 - 3$$