

If you have questions email me or call/text me at my Google Voice: 785-816-1401.

POLYNOMIAL OPERATIONS

ADDITION AND SUBTRACTION:

Adding and subtracting polynomials is the same as the procedure used in combining like terms. When *adding* polynomials, simply drop the parenthesis and combine like terms. When *subtracting* polynomials, distribute the negative first, then combine like terms.

Examples:

Addition:

$$(2x^2 + 3x - 7) + (3x^2 - 4x - 10) = 2x^2 + 3x^2 + 3x - 4x - 7 - 10 = 5x^2 - x - 17$$

Subtraction:

$$(5x^2 - 12x + 1) - (2x^2 + 3x - 7) = 5x^2 - 12x + 1 - 2x^2 - 3x + 7 = 3x^2 - 15x + 8$$

MULTIPLICATION:

1. Monomial times Monomial: To multiply a monomial times a monomial, just multiply the numbers then multiply the variables using the rules for exponents.

Example:

$$(-2x^2y)(5xy^7) = -2 \cdot 5x^2 \cdot x \cdot y \cdot y^7 = -10x^3y^8$$

2. Monomial times Polynomial: Simply use the distributive property to multiply a monomial times a polynomial.

Examples:

a. $-2x(x^2 + 3x - 8) = -2x(x^2) - 2x(3x) - 2x(-8) = -2x^3 + 6x^2 + 16x$

b. $5x^2(-2x^4 + 3y - 6) = 5x^2(-2x^4) + 5x^2(3y) + 5x^2(-6) = -10x^6 + 15x^2y - 30x^2$

3. Binomial times a Binomial: To multiply two binomials, use the **FOIL** method (**F**irst times first, **O**utside times outside, **I**nside times inside, and **L**ast times last).

Example:

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

Special Products: The following formulas may be used in these special cases as a short cut to the FOIL method.

Difference of Squares:

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

Perfect Squares:

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

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

Example:

$$(3x + 4)(3x - 4) = 9x^2 - 16$$

Example:

$$(x + 4)^2 = x^2 + 2(x)(4) + 4^2 = x^2 + 8x + 16$$

Example:

$$(x - 3)^2 = x^2 - 2(x)(3) + 3^2 = x^2 - 6x + 9$$

4. Polynomial times polynomial: To multiply two polynomials where at least one has more than two terms, distribute each term in the first polynomial to each term in the second.

Examples:

$$\begin{aligned} \text{a. } & (x^2 + 3x - 4)(x^2 - 6x + 5) \\ & = x^2(x^2) + x^2(-6x) + x^2(5) + 3x(x^2) + 3x(-6x) + 3x(5) - 4(x^2) - 4(-6x) - 4(5) \\ & = x^4 - 6x^3 + 5x^2 + 3x^3 - 18x^2 + 15x - 4x^2 + 24x - 20 \\ & = x^4 - 3x^3 - 17x^2 + 39x - 20 \\ \text{b. } & (2x - 3)(4x^2 - 5x + 1) \\ & = 2x(4x^2) + 2x(-5x) + 2x(1) - 3(4x^2) - 3(-5x) - 3(1) \\ & = 8x^3 - 10x^2 + 2x - 12x^2 + 15x - 3 \\ & = 8x^3 + 22x^2 + 17x - 3 \end{aligned}$$

DIVISION:

1. Division by Monomial: Each term of the polynomial is divided by the monomial and it is simplified as individual fractions.

Examples:

$$\begin{aligned} \text{a. } & \frac{3x^2 - 9x + 14}{3x} = \frac{3x^2}{3x} - \frac{9x}{3x} + \frac{14}{3x} = x - 3 + \frac{14}{3x} \\ \text{b. } & \frac{10y^2 - 25y + 20}{-5y} = \frac{10y^2}{-5y} - \frac{25y}{-5y} + \frac{20}{-5y} = -2y + 5 - \frac{4}{y} \end{aligned}$$

2. Division by Binomial or Larger Polynomial:

Use the long division format as follows:

- Both the divisor and the dividend must be written in descending order.
- Any missing powers should be replaced by zero.
- All remainders are in fraction form (remainder/divisor) and are added to the quotient.

Examples:

$$\text{a. } (x^2 - 2x - 15) \div (x + 3) = x - 5$$

$$\text{b. } \frac{9x^3 - x + 3}{3x - 2} = 3x^2 + 2x + 1 + \frac{5}{3x - 2}$$

$$\begin{array}{r} x - 5 \\ x + 3 \overline{) x^2 - 2x - 15} \\ \underline{-(x^2 + 3x)} \\ -5x - 15 \\ \underline{-(-5x - 15)} \\ 0 \end{array}$$

$$\begin{array}{r} 3x^2 + 2x + 1 \\ 3x - 2 \overline{) 9x^3 + 0x^2 - x + 3} \\ \underline{-(9x^3 - 6x^2)} \\ 6x^2 - x \\ \underline{-(6x^2 - 4x)} \\ 3x + 3 \\ \underline{-(3x - 2)} \\ 5 \end{array}$$