

## Factoring Part 1

Factoring is breaking down a polynomial into its smallest components or terms that when multiplied together give us the original polynomial. Factoring helps us with solving the polynomial. There are a number of different ways to factor problems. The first method is to factor out the Greatest Common Factor.

The greatest common factor is the **largest number each term has in common** and/or the **variable with the lowest exponent**. Each given term must contain the same common number and the same variables. If they do not have the same common number and variable, then you cannot factor any of the terms.

$$5xy \quad 7x \quad 12y$$

In this example, none of the terms have common factors so we say the greatest common factor is 1.

$$15x^5y \quad 25x^2y^3 \quad 30x^7y^4$$

In the second example, each term contains a common 5, a common x and y. The greatest common factor is  $5x^2y$ .

Factoring a polynomial is no different than what is stated above. The only difference is that there will now be addition or subtraction signs in the problem.

$$2x + 18 = 2(x + 9)$$

Each term (2x and 18) have a 2 in common. You divide both terms by 2 and what is left goes inside parentheses. The 2 must be shown outside of the parentheses. When you multiply  $2(x + 9)$ , you must get back to  $2x + 18$ .

If there are 3 terms in the polynomial, we do the exact same thing. Bring out the common factor(s) and divide each term by the common factor which then goes inside the parentheses.

$$8x^3 - 14x^2 + 10x$$

*GCF is 2x*

Identify the GCF and divide each term of the polynomial by 2x. Place 2x on the outside and result of the division goes inside parentheses.

$$\frac{8x^3}{2x} - \frac{14x^2}{2x} + \frac{10x}{2x}$$

$$2x(4x^2 + 7x + 5)$$

Check to make sure your answer is correct by multiplying the factored form back together. You should get the same answer that you started with. If no, something went wrong and you need to check it again.

### **Factor by Grouping**

Factor by grouping works when there are four terms in the polynomial. It is called “**factor by grouping**” because that is exactly what you are going to do...group them.

$$xy + 3y + 5x + 15$$

Group the first two terms together and the last two terms together.

$$(xy + 3y)(5x + 15)$$

Now look at each grouped term separately. Pull out the GCF in the first set of parentheses and then pull out the GCF from the second group of parentheses.

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

Again inspecting what we are left with you will notice that both terms have  $(x + 3)$  as a factored term. This term is now considered to be “in common” between the two terms and we can pull out the common factor and what is left goes into parentheses.

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

Some more examples:

$$3x + 3y + ax + ay$$

$$(3x + 3y)(ax + ay)$$

$$3(x + y) + a(x + y)$$

$$(x + y)(3 + a)$$

$$x^3 + 3x^2 + 6x + 18$$

$$(x^3 + 3x^2)(6x + 18)$$

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

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

Same steps each time:

1. Group the terms
2. Factor out the GCF from each grouping
3. Factor out the GCF again from each term