FACTORING GUIDE

I. Check for GCF (Greatest Common Factor)

If there is a GCF (other than 1), you must factor it out first. Factoring out the GCF may be all that you can do. But the polynomial might be able to be factored further. For example,

$2x^2-8=2(x^2-4)$ but (x^2-4) can factor further (see below for details). So we get $2(x+2)(x-2)$.

II. Count the number of terms…

Two Terms (Binomials)

1) **Difference of squares**

$$A^2-B^2=(A+B)(A-B)$$

Example:

$4x^2-25y^2=(2x+5y)(2x-5y)$

$A=2x \quad B=5y$

*Note: A^2+B^2 does **NOT** factor!

2) **Sum or difference of cubes**

$$A^3-B^3=(A-B)(A^2+AB+B^2)$$
$$A^3+B^3=(A+B)(A^2-AB+B^2)$$

Examples:

$x^3-8=(x-2)(x^2+2x+4)$

$A=x \quad B=2$

$27y^3+64z^3=(3y+4z)(9y^2-12yz+16z^2)$

$A=3y \quad B=4z$

Three Terms (Trinomials)

1) **Leading Coefficient is 1**

Example: x^2+x-6

(find two numbers that multiply to give you -6 and add to give you 1)

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

Example: $x^2+9x+14$

(find two numbers that multiply to Give you 14 and add to give you 9)

$x^2+9x+14=(x+2)(x+7)$

2) **Leading Coefficient is NOT 1**

a) Use "**Guess and Check"** to factor
(Nail down your first and last terms and try different combinations to get your outer and inner terms to equal your middle term.)

$2x^2-5x-12=(2x+3)(x-4)$

outers $=-8x$, inners $=3x$, their sum is $=-5x$

b) OR, use the "**Trinomial Method**." (See back)

c) OR, turn the trinomial into a 4-term polynomial, and then factor by "Grouping". (See YouTube video #5 on back)

Four Terms

Factor by grouping

1) $2ax+2ay-5x-5y$

Group the first two terms and the last two terms by drawing a line after the second term. Factor a GCF out of each group. Make sure the parentheses match. Factor out the parentheses (write it once at the front) and write everything that's left in its own parentheses.

$$2ax+2ay-5x-5y=2ax+2ay\,|\,-5x-5y$$
$$=2a(x+y)-5(x+y)$$
$$=(x+y)(2a-5)$$

*Note: If the parentheses don't match after you factor a GCF out of each group, then start over by rearranging the terms of the polynomial.

"Trinomial Method" for Factoring Trinomials

Example: $2x^2 - 5x - 12$

Step 1: As always, factor out a GCF first if you can. In this example, the GCF is 1. So, we have nothing to do for Step 1.
Step 2: Draw a plus-sign and fill the top two sections with the squared term, but don't write down the square.*

2x	2x

Step 3: Multiply the coefficient of the first term and the last term together. In this example that means we multiply 2 and -12 together to get -24.
Step 4: Now, find two numbers that multiply to give you -24 (from step 3), but add to give you the middle term, -5. Those numbers would be 3 and -8. So, fill in the other two sections of your plus-sign with 3 and -8.

2x	2x
3	-8

Step 5: Inside the plus-sign, reduce from top to bottom, and then write the answer. In this example, 2 and 3 will not reduce, but 2 and -8 can reduce to 1 and -4 as seen below. The answer is

2x	1x
3	-4

Answer: $(2x+3)(x-4)$ Of course, you can check your answer by using the FOIL Method.

*Note: This method will also work for trinomials of the form $\mathbf{ax^4 + bx^2 + c}$, but you would put $\mathbf{ax^2}$ in the top two sections. Similarly, it would also work for $\mathbf{ax^6 + bx^3 + c}$, but you would put $\mathbf{ax^3}$ in the top two sections. And again, it would work for $\mathbf{ax + bx^{1/2} + c}$, but you would put $\mathbf{ax^{1/2}}$ in the top two sections. In fact this works for any trinomial where the middle term's exponent is half of the first term's exponent.

Helpful YouTube videos: 1) https://www.youtube.com/watch?v=I6TBBzIvgB8
2) https://www.youtube.com/watch?v=tvnOWIoeeaU 3) https://www.youtube.com/watch?v=Touv2APcBRw
4) https://www.youtube.com/watch?v=eF6zYNzlZKQ 5) https://www.youtube.com/watch?v=u1SAo2GiX8A