Process for Factoring

<u>Step 0</u>: Arrange the terms in standard form, descending from the leading (highest-degree) term first. (If there is more than one variable, choose a variable and arrange in descending order by that variable.)

<u>Step 1</u>: Factor out the greatest common factor from all terms.

<u>Step 2</u>: Count the terms.

(Terms are separated by add or subtract symbols, except when the addition or subtraction symbol is already inside parentheses.)

<u>Step 3</u>: If you have 2 terms, factor it by its pattern:

3a: Sum of squares: $a^2 + b^2$ is prime.

3b: Difference of squares: $a^2 - b^2 = (a - b)(a + b)$

3c: Sum of cubes: $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

3d: Difference of cubes: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

[In 3c and 3d the acronym SOAP can be used to remember the three signs in the factors:

 $\underline{S}ame - \underline{O}pposite - \underline{A}lways \underline{P}ositive]$

<u>Step 4</u>: If you have 3 terms, determine which of the following applies:

4a: Perfect Square Trinomial (sum): $a^2 + 2ab + b^2 = (a+b)^2$

4b: Perfect Square Trinomial (difference): $a^2 - 2ab + b^2 = (a - b)^2$

4c: Leading coefficient 1: $x^2 + bx + c$; Find two numbers that multiply to *c* and add to *b* using guess-and-check or magic X.

4d: Leading coefficient not 1: $ax^2 + bx + c$;

Use guess-and-check by finding numbers for the first terms that multiply to *a* and numbers for the second terms that multiply to *c*, or

Use the "double magic X" by finding two numbers that multiply to the product *ac* and add to *b*, then use these to rewrite the middle term and factor by grouping.

4e: If the expression is quadratic in form, $a(garbage)^2 + b(garbage) + c$,

Substitute u=garbage to get a true quadratic, factor using u and one of the methods 4a-4d, then replace u by *garbage*, simplify inside parentheses. Check for greatest common factor.

<u>Step 5</u>: If you have 4 terms, factor by grouping.

4a: Two groups of two terms results in two binomial factors.

4b: [Less common]: group three terms to make a perfect square trinomial minus a constant, then factor as a difference of squares.

<u>Step 6</u>: Check each factor to see if it can be factored. Continue factoring until every factor is prime. (When you are done, you should have one term with all add and subtract signs inside parentheses.)

<u>Step 7</u>: When in doubt, multiply your result. You should get your original expression (or a simplified version of it). Factoring is the opposite of multiplying.