Choosing a Factoring Method

When presented with a polynomial to factor, first determine which method to use. There are several types of polynomials, each requiring its own factoring method.

The following steps will help you make that determination.

Step 1: Always check first for a *Greatest Common Factor* (GCF). If there is a **GCF**, then divide it out of each of the terms in the polynomial.

Examples:

$2x + 6$	$y^2 - 8y$	$3z^3 + 24$
$\mathbf{2}(x + 3)$	$\mathbf{y}\,(y - 8)$	$\mathbf{3}(z^3 + 8)$
$9t^2 + 12t - 18$	$4x^2 - 16$	$a^2b - a^3b^2 + ab^2$
$\mathbf{3}\,(3t^2 + 4t - 6)$	$\mathbf{4}(x^2 - 4)$	$\mathbf{ab}\,(a - a^2\,b + b)$

Step 2: After factoring out the Greatest Common Factor (if one exists), try to factor further. Start by counting the number of terms.

1. If there are two terms:

   - Try factoring as a *Difference of Squares*

     Example: $x^2 - 4 = (x - 2)(x + 2)$

   - Is it a *Sum of Squares*?

     Example: $x^2 + 4$ = prime, cannot be factored

   - Try factoring as a *Sum or Difference of Cubes*

     Sum of Cubes: $z^3 + 8 = (z + 2)(z^2 - 2z + 4)$

     Difference of Cubes: $z^3 - 8 = (z - 2)(z^2 + 2z + 4)$

   - Try using the *Square Root Property*

     (See handout #81 located on our math carousel)

NOTE: The purpose of this handout is to help students determine the most effective method to factor a polynomial. It is a guide. For specific steps using any of these methods, refer to our handouts or ask a tutor or a learning specialist for assistance.

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Step 3: If there are *three* terms:

- Try factoring as a *Perfect Square Trinomial*
  EXAMPLE: $4x^2 + 12x + 9 = (2x + 3)(2x + 3) = (2x + 3)^2$

- Try factoring by *Trial and Error*
  This method is best used for trinomials with a leading coefficient of 1.
  EXAMPLE: $1x^2 + 3x - 10$ or $x^2 + 3x - 10 = (x + 5)(x - 2)$

- Try using the *AC Method*
  This method is especially useful when the leading coefficient is a number larger than 1.

EXAMPLE: $\mathbf{18}x^2 + 5x - 2 = (9x - 2)(2x + 1)$

In MAT1033 and beyond, use the Quadratic Formula, the Completing the Square method, or the Square Root Property to solve prime (unfactorable) quadratic equations. For more information, please refer to ASC handouts #23 and #24.

Step 4: If there are *four* terms:

- Try using *Two by Two Grouping*
  Example:

$a - a^2 b + b - ab^2 \Longrightarrow a^2b - a - ab^2 + b$

$= a(ab - 1) - b(ab - 1)$

$= (ab - 1)(a - b)$

- Try using *Three by One Grouping*
  Example:

$x^2 + 2xy + y^2 - 4 \Longrightarrow x^2 + 2xy + y^2 \mid -4$

$= (x + y)(x + y) - 4$

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

$= [(x + y) + 2][(x + y) - 2]$

$= (x + y + 2)(x + y - 2)$