Factoring Polynomia

Factoring a polynomial is the process of writing it as the product of two or more polynomial factors.

Example: $7x^2 + 35x + 42 = 7(x+2)(x+3)$ — one monomial factor (7) and two binomial factors (x+2) & (x+3)

Set the factors of a polynomial equation (as opposed to an expression) equal to zero in order to solve for a variable: Example: To solve $7x^2 + 35x + 42 = 0 \rightarrow x + 2 = 0$, x = -2; and x + 3 = 0, x = -3

The flowchart below illustrates a sequence of steps for factoring polynomials.

First, always factor out the Greatest Common Factor (GCF), if one exists.



No

Four or more

terms

Factor by Grouping:

grouping.

1. Group the terms with

out the GCF from each

2. Continue factoring—by

looking for Special Cases,

Grouping, etc.—until the

(or all factors are Prime).

equation is in simplest form

common factors and factor

¹ **Prime** polynomials cannot be factored using integers alone. The Sum of

Squares and the quadratic factors of the Sum and Difference of **Squares** are always **Prime**.

Special Cases?

Yes

Binomial (two terms)

1. Difference of Squares:

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

2. Sum of Squares: 1,3 $a^2 + b^2 = Prime$

3. Difference of Cubes: 1, 2

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

4. Sum of Cubes: 1, 2

$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

Trinomial (three terms)

Perfect Square Trinomial:

1.
$$x^2 + 2xy + y^2 = (x + y)^2$$

Is the equation a Binomial or a Trinomial?

2.
$$x^2 - 2xy + y^2 = (x - y)^2$$

³FYI: A Sum of Squares can be factored using **imaginary numbers** if you rewrite it as

a Difference of Squares: $a^2 + b^2 =$

No Special

$$[a^{2}-(-b^{2})] =$$

$$[a-(b\sqrt{-1})][a+(b\sqrt{-1})] =$$

$$(a-bi)(a+bi)$$

²Use **S.O.A.P** to remember the signs for the factors of the Sum and Difference of Cubes:

Same,

Opposite,

Always Positive

Choose:

1. Factor by Grouping

Cases

- 2. Complete the Square
- 3. Use the Quadratic⁴ Formula

⁴Completing the Square and the Quadratic Formula are primarily methods for solving equations rather than simply factoring expressions.

Also, if the GCF doesn't contain a variable, it may not be necessary to factor it out prior to using either of these methods. However, doing so will provide smaller coefficients to work with.

Factoring steps are adapted from Professor Elias Juridini, Lamar State College-Orange.