Factoring Polynomials of Degree 3 or More:

A polynomial's degree is determined from the highest exponent. For example,

$$f(x) = 16x^4 + 8x^3 + 2x^2 + 1$$

is a polynomial of degree 4 because the highest exponent is 4.

1. First, check whether a GCF (Greatest Common Factor) can be factored out. If the lead coefficient is negative, it is easier to make it positive to factor by factoring -1 out of the polynomial. Don't forget to include these results in your final expression!

2. What is the form of the polynomial after checking for a GCF?

Name:	Form:	Approach:
Sum of Cubes	$a^3 + b^3$	$= (a + b)(a^2 - ab + b^2)$
Difference of Cubes	$a^3 - b^3$	$= (a - b)(a^2 + ab + b^2)$
Four Term Polynomial	4-terms or more	Use grouping to factor and rewrite the expressions as the product of two binomials.

(See the Synthetic Division handout for more factoring methods)

3. Has the factoring produced another polynomial which can be further factored, such as

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

If so, refer to the Solving Quadratics Handout.

4. Polynomials that cannot be factored are called **prime**.

Strategies for Factoring Special Polynomials:

Finding Pairs of Factors:

Given $ax^2 + bx + c$, find m and n so that $mn = ac$ and $m + n = b$.

For example, given $12x^2 - x - 6$, find m and n so that $mn = 12 \cdot -6 = -72$ and $m + n = -1$

Make a t-table and list all possible pairs of factors of ac on one side and check if their sum is b on the other side:

Product: $ac = -72 = mn$	Sum: $b = -1 = m + n$
$1 \cdot -72$	$1 + (-72) = -71$
$2 \cdot -36$	$2 + (-36) = -34$
$3 \cdot -24$	$3 + (-24) = -21$
$4 \cdot -18$	$4 + (-18) = -14$
(5 is not a factor of -72)	
$6 \cdot -12$	$6 + (-12) = -6$
(7 is not a factor of -72)	
$8 \cdot -9$	$8 + (-9) = -1$

Factoring Four Term Polynomials Using Grouping

$$3x^2 - 5x - 6x + 10$$

1. Group pairs of terms with common factors. Be sure to keep that second minus sign *inside* the parentheses and put a plus sign in the middle.

$$= (3x^2 - 5x) + (-6x + 10)$$

2. Factor out the GCF from each grouping. When the first term in the group is negative, factor out a negative.

$$= x(3x - 5) - 2(3x - 5)$$

3. Factor out the new GCF which will be the binomial in parentheses and rewrite as the product of two binomials.

$$= (3x - 5)(x - 2)$$

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