

2.4 Factor and Solve Polynomial Equations

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Polynomial is **factored completely** if it is written as a product of unfactorable polynomials with integer coefficients.

Common Monomial Factor

Example A)	$x^3 + 2x^2 - 15x = x(x^2 + 2x - 15)$	Factor common monomial
	$= x(x + 5)(x - 3)$	Factor Trinomial

Example B)	$2x^5 - 18x^3 = 2x^3(x^2 - 9)$	Factor common monomial
	$= 2x^3(x + 3)(x - 3)$	Difference of two squares

Example C)	$4x^4 - 16x^3 + 16x^2 = 4x^2(x^2 - 4x + 4)$	Factor common monomial
	$= 4x^2(x - 2)(x - 2)$ $= 4x^2(x - 2)^2$	Perfect Square Trinomial

Special Factoring Patterns

Sum of Two Cubes

$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$	$8x^3 + 27 = (2x + 3)(4x^2 - 6x + 9)$
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Difference of Two Cubes

$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$	$64x^3 - 1 = (4x - 1)(16x^2 + 4x + 1)$
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List of Cubes:

$1^3 = 1$	$6^3 = 216$
$2^3 = 8$	$7^3 = 343$
$3^3 = 27$	$8^3 = 512$
$4^3 = 64$	$9^3 = 729$
$5^3 = 125$	$10^3 = 1000$

Factor by Grouping

$$x^3 - 3x^2 - 16x + 48$$

$(x^3 - 3x^2)(-16x + 48)$	Make two groups
$x^2(x - 3) - 16(x - 3)$	Factor each group separately
$(x - 3)(x^2 - 16)$	Factor again
$(x - 3)(x + 4)(x - 4)$	Difference of two squares

Factor polynomials in quadratic form

Example A)

$16x^4 - 81$	Difference of two Squares
$(4x^2 + 9)(4x^2 - 9)$	Difference of two Squares
$(4x^2 + 9)(2x + 3)(2x - 3)$	

Example B)

$2x^8 + 10x^5 + 12x^2$	Factor out common monomial
$2x^2(x^6 + 5x^3 + 6)$	Factor trinomial in quadratic form
$2x^2(x^3 + 3)(x^3 + 2)$	