Algebra II
5.4 Factoring

Obj: To factor polynomials and solve higher degree equations.

Factoring

✓Take out common terms first.
✓Factor more than once if necessary.

Examples, Factor each:

$2x^2-5x-12$ $\qquad (2x+3)(x-4)$

$6x^2+15x$ $\qquad 3x(2x+5)$

x^3+2x^2-15x

$\qquad x(x^2+2x-15)$

$\qquad x(x+5)(x-3)$

Examples, Factor each:
Perfect Square Trin.

$x^2-10x+25$

$(x-5)^2$

$4w^4-16w^3+16w^2$

$4w^2(w^2-4w+4)$

$4w^2(w-2)^2$

Difference of 2 Squares

$4x^2-49$

$(2x-7)(2x+7)$

$2y^5-18y^3$

$2y^3(y^2-9)$

Sum & Difference of 2 Cubes

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

x^3+8 $(x+8)(x^2-2x+4)$

$8x^3-27$ $(2x-3)(4x^2+2x+9)$

$1-125x^3$ $(1-5x)(1+5x+25x^2)$

$64w^4-27w$ $w(64w^3-27)$

$w(4w-3)(16w^2+12w+9)$

2

Factoring by Grouping:

When you have 4 terms, group the first 2 and the last 2.

$(x^3+2x^2+9x+18)$

$x^2(x+2) \quad 9(x+2)$

$[(x^2+9)(x+2)]$

$(x^3-2x^2-9x+18)$

$x^2(x-2) \quad -9(x-2)$

$[(x^2-9)(x-2)]$

$(x^2y^2-3x^2-4y^2+12)$

$x^2(y^2-3) -4(y^2-3)$

$(x^2-4)(y^2-3)$

Misc. Examples:

$81x^4-16$

$(9x^2-4)(9x^2+4)$

$3y^5-75y^3 \quad 3y^3(y^2-25)$

$3y^3(y+5)(y-5)$

$4x^6-20x^4+24x^2$

$2x^3-54$

x^4-2x^2-63

Solving Polynomial Equations by Factoring

$$4x(x-3)(3x+2)(x^2-5)(x^2+5)=0$$

To solve a poly. equation:

1. Set equal to zero
2. Factor
3. Set each factor equal to zero
4. (The degree is the *most* # of solutions possible.)

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$$x^2 - 5x - 6 = 0$$

$$(x-6)(x+1) = 0$$

$$x - 6 = 0 \qquad x + 1 = 0$$

$$\boxed{x = 6 \qquad x = -1}$$

$$2y^5 - 18y = 0$$

$$2y(y^4 - 9) = 0$$

$$2y(y^2 + 3)(y^2 - 3) = 0$$

$$2y = 0 \qquad y^2 + 3 = 0$$

$$\boxed{y = 0} \qquad \boxed{y = \pm\sqrt{-3}}$$

$$y^2 - 3 = 0$$

$$\boxed{y = \pm\sqrt{3}}$$

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$$2x^5 + 24x = 14x^3$$

$$2x^5 - 14x^3 + 24x = 0$$

$$2x(x^4 - 7x^2 + 12) = 0$$

$$2x(x^2 - 3)(x^2 - 4) = 0$$

$$2x(x^2 - 3)(x + 2)(x - 2) = 0$$

$$2x = 0 \quad x^2 - 3 = 0 \quad x + 2 = 0 \quad x - 2 = 0$$

$$\boxed{x = 0} \quad \boxed{x = \pm\sqrt{3}} \quad \boxed{x = -2} \quad \boxed{x = +2}$$

$$x^3 - 27 = 0$$

$$(x - 3)(x^2 + 3x + 9)$$

$$x - 3 = 0 \qquad x^2 + 3x + 9 = 0$$

$$\boxed{x = 3}$$

5

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$$3x^3 + 7x^2 - 12x = 28$$

$$3x^3 + 7x^2 - 12x - 28 = 0$$

$$x^2(3x+7) - 4(3x+7) = 0$$

$$(x^2-4)(3x+7) = 0$$

$$(x-2)(x+2)(3x+7) = 0$$

$$3x+7 = 0$$

$$\boxed{x=2} \quad \boxed{x=-2} \quad \boxed{x = \frac{-7}{3}}$$

$$54y^3 = -2$$

$$54y^3 + 2 = 0$$

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$$9x^4 - 12x^2 + 4 = 0$$

6

1. Set equal to zero
2. Factor
3. Set each factor equal to zero
4. (The degree is the *most* # of solutions possible.)

$$16x^8 = 81$$