

## 2-5 The Fundamental Theorem of Algebra

Fundamental Thm. of Alg. — all polynomial functions have at least one zero

Linear Factorization Thm. — all polynomial functions of degree  $n$  have exactly  $n$  factors

$$f(x) = x^3 + 5x^2 - 7x + 10 = (x-1)(x+2)(x+5)$$

Complex Zeros occur in conjugate pairs —

$$5+2i \quad 5-2i$$

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\* Ex. 1 Factor and find all of the zeros:

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

$$\begin{array}{r} 1 \ 1 \ -3 \ 4 \ -2 \\ \underline{-1} \ \underline{-1} \ \underline{2} \\ 1 \ -2 \ 2 \ 0 \end{array}$$

$$x = \{1, 1 \pm i\}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{2 \pm \sqrt{4-8}}{2} = \frac{2 \pm \sqrt{-4}}{2} = \frac{2 \pm 2i}{2} = 1 \pm i$$

Ex. 2 Factor and find all of the zeros:

$$f(x) = x^3 - 6x^2 + 13x - 10 = (x-2)(x^2 - 4x + 5)$$

$$\begin{array}{r} 2 \ 1 \ -6 \ 13 \ -10 \\ \underline{-2} \ \underline{-8} \ \underline{10} \\ 1 \ -4 \ 5 \ 0 \end{array}$$

$$x = \{2, 2 \pm i\}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{4 \pm \sqrt{16-20}}{2} = \frac{4 \pm \sqrt{-4}}{2} = \frac{4 \pm 2i}{2} = 2 \pm i$$

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Ex. 3 Factor and find all of the zeros:

$$f(x) = x^5 + 6x^3 + 2x^2 - 27x + 18 = (x-1)(x^4 + x^3 + 7x^2 + 9x - 18)$$

$$\begin{array}{r} 1 \ 1 \ 0 \ 6 \ 2 \ -27 \ 18 \\ \underline{-1} \ \underline{-1} \ \underline{9} \ \underline{-18} \\ 1 \ 1 \ 7 \ 9 \ -18 \ 0 \end{array}$$

$$(x-1)(x+1)(x^2 + 7x + 9)$$

$$\begin{array}{r} 1 \ 1 \ 1 \ 7 \ 9 \ -18 \\ \underline{-1} \ \underline{-1} \ \underline{9} \ \underline{18} \\ 1 \ 2 \ 9 \ 18 \ 0 \end{array}$$

$$(x-1)(x+1)(x+2)(x-3i)(x+3i)$$

$$\begin{array}{r} -1 \ 1 \ 2 \ 9 \ 18 \\ \underline{-1} \ \underline{2} \ \underline{0} \ \underline{-18} \\ 1 \ 0 \ 9 \ 0 \end{array}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \{1, -2, \pm 3i\}$$

$$\frac{\pm 6i}{2} = \pm 3i$$

Ex. 4 Find a polynomial function with integer coefficients with 1 and  $2-3i$  as zeros.

$$f(x) = (x-1)(x-(2-3i))(x-(2+3i))$$

$$(x-1)(x-2+3i)(x-2-3i)$$

$$x^5 - 2x^4 - 2x^3 + 14x^2 + 13x - 912$$

$$(x-1)(x^2 - 4x + 13)$$

$$f(x) = x^5 - 5x^4 + 17x^3 - 13$$

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Homework:  
p.144  
1-15 odds  
+ #34

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