Using the Conjugate Root Theorem

EX #3: A cubic polynomial has real coefficients. If two of the roots are $x = 4$ and $x = \sqrt{5}$, what is the other root?

$x = -\sqrt{5}$

EX #4: If a quintic polynomial has real coefficients, and three of the zeros are $x = 2i$, $x = -3 + \sqrt{5}$, and $x = 1$, name the other zeros.

$x = -2i$

$x = -3 - \sqrt{5}$

Finding Roots of Polynomials

Use Conjugates to Find Polynomials

EX #5: Find a cubic polynomial equation with roots at $-2i$ and -5.

$x = -2i,\ 2i,\ -5$

$\underbrace{(x+2i)(x-2i)}(x+5)$

	x	$-2i$
x	x^2	$\cancel{-2ix}$
$2i$	$\cancel{+2ix}$	$-4i^2$

$x^2 - 4i^2 = x^2 - 4(-1) = x^2 + 4$

$(x^2+4)(x+5)$

	x	$+5$
x^2	x^3	$+5x^2$
$+4$	$+4x$	$+20$

$= x^3 + 5x^2 + 4x + 20$

Lesson 4: Complex Roots

- Quadratic Formula still:
  - Always comes in pairs, conjugate pairs!

Remember the Quadratic Formula – (record below)

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

- You will end up with a negative discriminant! (value UNDER the radical)
- To eliminate the negative, take out an i.

Conjugate Pairs

- If a + bi is a zero
- Then a-bi is a zero

Remember: imaginary zeros don't cross the x-axis.

Examples:

$f(x) = x^3 + 9x$ GCF

$x(x^2+9) = 0$

$x = 0 \quad x^2+9=0$

$\quad -9 \quad -9$

$\sqrt{x^2} = \sqrt{-9}$

$x = \pm 3i$

$\boxed{x = 0, 3i, -3i}$

$f(x) = x^4 - 5x^3 + 7x^2 + 3x - 10$

$x = -1, 2$

$$\begin{array}{r|rrrrr} -1 & 1 & -5 & 7 & 3 & -10 \\ & \downarrow & -1 & 6 & -13 & 10 \\ \hline & 1 & -6 & 13 & -10 & 0 \checkmark \end{array}$$

$$\begin{array}{r|rrrr} 2 & 1 & -6 & 13 & -10 \\ & \downarrow & 2 & -8 & 10 \\ \hline & 1 & -4 & 5 & 0 \checkmark \end{array}$$

use Quad Formula

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(5)}}{2(1)}$$

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