

POLYNOMIAL DIVISION

Check for missing terms!

Long

$$\begin{array}{r}
 x^2 - 4x - 16 \\
 x-2 \overline{) x^3 - 6x^2 - 8x + 4} \\
 \underline{-x^3 + 2x^2} \\
 -4x^2 - 8x + 4 \\
 \underline{+4x^2 + 8x} \\
 -16x + 4 \\
 \underline{+16x + 32} \\
 -28
 \end{array}$$

$$x^2 - 4x - 16 - \frac{28}{x-2}$$

$$(x-2)(x^2 - 4x - 16) - 28$$

$$\frac{x^3 - 6x^2 - 8x + 4}{x-2}$$

$$x-2$$

change sign

Synthetic

only works if dividing by $x \pm \#$

$$\begin{array}{r|rrrr}
 2 & 1 & -6 & -8 & 4 \\
 & & 2 & -8 & -32 \\
 \hline
 & 1 & -4 & -16 & -28
 \end{array}$$

$$x^2 - 4x - 16 - \frac{28}{x-2}$$

$$\begin{array}{r}
 2x^6 + 4x^4 - 2x^3 + 7x - 5 \\
 \hline
 x + 3
 \end{array}$$

$$\begin{array}{r}
 \begin{array}{c} \downarrow \\ -3 \end{array} \Big| \begin{array}{ccccccc} 2 & 0 & 4 & -2 & 0 & 7 & -5 \end{array} \\
 + \begin{array}{ccccccc} & -6 & 18 & -66 & 204 & -612 & 1815 \end{array} \\
 \hline
 \begin{array}{ccccccc} 2 & -6 & 22 & -68 & 204 & -605 & 1810 \end{array}
 \end{array}$$

$$2x^5 - 6x^4 + 22x^3 - 68x^2 + 204x - 605 + \frac{1810}{x+3}$$

Rational Root Theorem

$$2x^2 - 7x - 15 = 0$$

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

$$x = -3/2, 5$$

$$\frac{\text{Factors of Last Term}}{\text{Factors of First Term}} = \frac{\begin{matrix} \pm 1 & \pm 3 & \pm 5 & \pm 15 \\ \hline \pm 1 & \pm 2 \end{matrix}}$$

$$1, 3, 5, 15, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{15}{2}$$

$$|x^3 + x - 10 = 0 \quad \begin{array}{c} \pm 1 \pm 2 \pm 5 \pm 10 \\ \hline \pm 1 \\ -8 \\ 0 \end{array}$$

$$x^3 + x - 10 \mid x=1$$

ctrl =

$$|x=2$$

$x-2$ is a factor

$$\begin{array}{r|rrrr} 2 & 1 & 0 & 1 & -10 \\ & & 2 & 4 & 10 \\ \hline & 1 & 2 & 5 & 0 \end{array} \leftarrow \text{must get}$$

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

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

$$= -2 \pm \sqrt{-16}$$

$$\leftarrow -2 \pm \frac{4i}{2}$$

$$-1 \pm 2i$$

Solving by Synth Div.

1) Find a # that makes $f(x)=0$ factors of last
factors of first

2) Use that # to perform Synthetic division.

3) Solve the resulting factors
(May need to repeat the process)

Solve $2x^5 + 3x^4 - x^3 + 9x^2 - 55x - 30 = 0$

$$\frac{\pm 1 \pm 2 \pm 3 \pm 5 \pm 6 \pm 10 \pm 15 \pm 30}{\pm 1 \pm 2}$$

$$\begin{array}{l} \text{---} | x = 1 \neq 0 \\ | x = -1 \neq 0 \end{array}$$

$$| x = 2 = 0$$

$$\begin{array}{r} 2 \overline{) 2 \ 3 \ -1 \ 9 \ -55 \ -30} \\ + \quad \quad 4 \ 14 \ 26 \ 70 \ 30 \\ \hline 2 \ 7 \ 13 \ 35 \ 15 \ 0 \end{array}$$

$$(x-2)(2x^4 + 7x^3 + 13x^2 + 35x + 15) \quad \frac{\pm 1 \pm 3 \pm 5 \pm 15}{\pm 1 \pm 2}$$

$$\text{---} | x = -3 = 0$$

$$\begin{array}{r} -3 \overline{) 2 \ 7 \ 13 \ 35 \ 15} \\ + \quad \quad -6 \ -3 \ -30 \ -15 \\ \hline 2 \ 1 \ 10 \ 5 \ 0 \end{array}$$

$$\rightarrow (x-2)(x+3)(2x^3 + x^2 + 10x + 5) = 0$$

$$x^2(2x+1) + 5(2x+1)$$

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

$$\boxed{x=2 \quad x=-3 \quad x=-\frac{1}{2} \quad \sqrt{x^2+5} = \sqrt{-5} \quad x=\pm i\sqrt{5}}$$