Warm-up:

Factor, then solve:

1. $3x^2 - 14x + 8 = 0$

24
1 24
2 12
3 8
4 6

$3x^2-12x-2x+8$
$3x(x-4)-2(x-4)$
$(3x-2)(x-4)=0$
$x=\frac{2}{3}$ $x=4$

2. $25x^2 - 1 = 0$

$(5x+1)(5x-1)=0$
$x=-\frac{1}{5}$ $x=\frac{1}{5}$

Given the zeros, write a polynomial function of least degree that has real coefficients and a leading coefficient of 1.

3. $x = 3, x = -6$

$(x-3)(x+6)$
$x^2-3x+6x-18$
$x^2+3x-18$

4. $x = -1 + 7i$

$(x+1)^2=(7i)^2$
$(x+1)(x+1)=49i^2$
$x^2+2x+1=-49$
$x^2+2x+50=0$

Divide using long division or tabular division:

$$x+4\overline{)3x^3+4x^2-30x+8}$$

$3x^2-8x+2$
$-3x^3+12x^2$
$-8x^2-30x$
$-(-8x^2-32x)$
$2x+8$
$2x+8$
0

$3x^2-8x+2$

Why do we do polynomial division?

to find all roots

Synthetic Division – another method (quicker) for dividing, BUT it has it's limitations

Limitations: dividing by a binomial, degree 1, LC 1

Ex: (from the warm-up):

$$x+4\overline{)3x^3+4x^2-30x+8}$$

$$\begin{array}{r|cccc} -4 & 3 & 4 & -30 & 8 \\ & & -12 & 32 & -8 \\ \hline & 3 & -8 & 2 & 0 \end{array}$$

$$3x^2-8x+2$$

Use synthetic, long, or tabular division to find the roots.

Examples:

1. $\dfrac{2x^3-10x^2+9x+15}{x-3}$

$$\begin{array}{r|cccc} 3 & 2 & -10 & 9 & 15 \\ & & 6 & -12 & -9 \\ \hline & 2 & -4 & -3 & 6 \end{array}$$

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

2. $\dfrac{x^3-3x^2-7x+6}{x+2}$

$$\begin{array}{r|cccc} -2 & 1 & -3 & -7 & 6 \\ & & -2 & 10 & -6 \\ \hline & 1 & -5 & 3 & 0 \end{array}$$

$$x^2-5x+3$$

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

$$\begin{array}{c|ccccc} 2 & 2 & -1 & -4 & 0 & -8 \\ & & 4 & 6 & 4 & 8 \\ \hline & 2 & 3 & 2 & 4 & 0 \end{array}$$

$2x^3+3x^2+2x+4$

4. $\frac{3x^3 - 81x + 30}{x-5}$

$$\begin{array}{c|cccc} 5 & 3 & 0 & -81 & 30 \\ & & 15 & 75 & -30 \\ \hline & 3 & 15 & -6 & 0 \end{array}$$

$3x^2+15x-6$

5. $\frac{6x^3 + 7x^2 + x + 1}{2x+3}$

$$\begin{array}{c|cccc} -\frac{3}{2} & 6 & 7 & 1 & 1 \\ & & -9 & 3 & -6 \\ \hline & 6 & -2 & 4 & -5 \end{array}$$

$$2x+3 \overline{)\,6x^3+7x^2+x+1} \quad 3x^2-x+2+\frac{-5}{2x+3}$$

$-6x^3+9x^2$

$-2x^2+x$

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

$4x+1$

$-(4x+6)$

-5

6. $\frac{x^3 + 2x^2 - 4x + 1}{x^2+x-2}$

$$x^2+x-2 \overline{)\,x^3+2x^2-4x+1} \quad x+1+\frac{-3x+3}{x^2+x-2}$$

$-x^3+x^2-2x$

x^2-2x+1

$-x^2+x-2$

$-3x+3$

When is it best to use:	
Long Division	Synthetic Division