

# Long Division Notes

\* a technique for factoring higher degree polynomials

pre-example

$$\begin{array}{r}
 21 \\
 9 \overline{) 195} \\
 \underline{-18} \phantom{0} \\
 15 \\
 \underline{-9} \\
 6
 \end{array}
 \left. \vphantom{\begin{array}{r} 21 \\ 9 \overline{) 195} \\ \underline{-18} \phantom{0} \\ 15 \\ \underline{-9} \\ 6 \end{array}} \right\} 21 \text{ R6} \rightarrow 21^6/9 = 21^2/3$$

ex 1

$$(6x^3 - 19x^2 + 10x - 4) \div (x - 2)$$

$$\begin{array}{r}
 \phantom{6x^3 - 19x^2 + 10x - 4} + 4x^2 - 7x + 2 \\
 \underline{x - 2 \overline{) 6x^3 - 19x^2 + 10x - 4}} \\
 -6x^3 + 12x^2 \phantom{+ 10x} - 4 \\
 \phantom{-6x^3 +} \underline{-7x^2 + 10x - 4} \\
 \phantom{-6x^3 +} \phantom{-7x^2 +} \underline{-7x^2 + 14x} \\
 \phantom{-6x^3 +} \phantom{-7x^2 +} \phantom{-7x^2 +} \underline{2x - 4} \\
 \phantom{-6x^3 +} \phantom{-7x^2 +} \phantom{-7x^2 +} \phantom{2x - 4} \underline{-2x + 4} \\
 \phantom{-6x^3 +} \phantom{-7x^2 +} \phantom{-7x^2 +} \phantom{2x - 4} \phantom{-2x + 4} 0
 \end{array}$$

always look at front pieces

① what times  $x$  is  $6x^3$

②  $6x^2(x-2)$

③ repeat

this means  $x-2$  is a factor!

$$\boxed{6x^2 - 7x + 2}$$

ex 2

$$(x^2 + 3x + 5) \div (x + 1)$$

$$\begin{array}{r}
 \phantom{x^2 + 3x + 5} + x + 2 \\
 \underline{x + 1 \overline{) x^2 + 3x + 5}} \\
 -x^2 - x \phantom{+ 5} \\
 \phantom{-x^2 -} \underline{2x + 5} \\
 \phantom{-x^2 -} \phantom{2x + 5} \underline{-2x + 2} \\
 \phantom{-x^2 -} \phantom{2x + 5} \phantom{-2x + 2} 3
 \end{array}$$

$$\boxed{x + 2 + \frac{3}{x + 1}}$$

← remainder

↑  
answer

↑  
what you divided by

ex 3

$$(x^3 - 1) \div (x - 1)$$

$$\begin{array}{r}
 x^2 + x + 1 \\
 x-1 \overline{) x^3 + 0x^2 + 0x - 1} \\
 \underline{-x^3 + x^2} \phantom{-1} \\
 x^2 - x - 1 \\
 \underline{-x^2 + x} \phantom{-1} \\
 x - 1 \\
 \underline{-x + 1} \\
 0
 \end{array}$$

\* you have to use placeholders for the inside

$x^2 + x + 1$

ex 4

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

$$\begin{array}{r}
 2x^2 + 1 \\
 x^2 + 2x - 3 \overline{) 2x^4 + 4x^3 - 5x^2 + 3x - 2} \\
 \underline{2x^4 + 4x^3 - 10x^2} \phantom{+ 3x - 2} \\
 x^3 + 3x - 2 \\
 \underline{x^2 + 2x - 3} \\
 x + 1
 \end{array}$$

\* must be in standard form

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

done b/c x is smaller than x<sup>2</sup>