

## Lesson 1 Long Division

**Note:** When dividing a polynomial by a binomial, the terms are written in descending order. Use 0 as a placeholder if a degree is missing.

**Ex. 1)** Divide  $P(x) = x^3 + 4x^2 + 5x + 2$  by  $x + 2$ ,  
 divide  $x^3$  by  $x$

*good example on pg. 84*

$$\begin{array}{r}
 x^2 + 2x + 1 \\
 x + 2 \overline{) x^3 + 4x^2 + 5x + 2} \\
 \underline{-(x^3 + 2x^2)} \phantom{+ 5x + 2} \\
 2x^2 + 5x \phantom{+ 2} \\
 \underline{-(2x^2 + 4x)} \phantom{+ 2} \\
 x + 2 \\
 \underline{-(x + 2)} \\
 0
 \end{array}$$

*divisor* →  $x + 2$   
*dividend* →  $x^3 + 4x^2 + 5x + 2$   
*Subtract* →  $x^2(x+2)$   
*divide  $x^3$  by  $x$*   
*divide  $2x^2$  by  $x$*   
 $2x(x+2) \rightarrow$   
 $1(x+2) \rightarrow$   
*remainder of 0*

$\therefore (x+2)$  is a factor of  $P(x)$

Resulting functions should be expressed as

$$\frac{P(x)}{x-a} = Q(x) + \frac{R}{x-a}$$

$$\frac{x^3 + 4x^2 + 5x + 2}{x+2} = x^2 + 2x + 1 + \frac{0}{x+2}$$

*not necessary because  $R=0$*

Or

$$P(x) = (x-a) \cdot Q(x) + R$$

**Dividend = Divisor x Quotient + Remainder**

$$x^3 + 4x^2 + 5x + 2 = (x+2)(x^2 + 2x + 1) + 0$$

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Recall

divide  
multiply  
subtract

$$\begin{array}{r} \text{divisor} \swarrow 12 \overline{) 327} \leftarrow \text{dividend} \\ \underline{2(12)} \phantom{0} \\ 87 \\ \underline{7(12)} \phantom{0} \\ 3 \leftarrow \text{remainder} \end{array}$$

$$\frac{327}{12} = 27 + \frac{3}{12}$$

$$327 = 12(27) + 3$$

$$\begin{array}{r} 186 \\ 23 \overline{) 4278} \\ \underline{23} \phantom{0} \\ 197 \\ \underline{184} \phantom{0} \\ 138 \\ \underline{138} \\ 0 \end{array}$$

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$$\begin{array}{r} 217 \\ 19 \overline{) 4133} \\ \underline{38} \phantom{0} \\ 33 \phantom{0} \\ \underline{143} \phantom{0} \\ 133 \\ \underline{133} \\ 10 \end{array}$$

$$\frac{4133}{19} = 217 + \frac{10}{19}$$

$$\times \quad 4133 = 19(217) + 10$$

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Ex. 2) Divide  $2x^3 + 5 - 2x + 3x^2$  by  $(x - 1)$

← must be in descending order

$$\begin{array}{r}
 2x^2 + 5x + 3 \\
 x-1 \overline{) 2x^3 + 3x^2 - 2x + 5} \\
 \underline{2x^3 - 2x^2} \phantom{+ 5} \\
 5x^2 - 2x \phantom{+ 5} \\
 \underline{5x^2 - 5x} \phantom{+ 5} \\
 3x + 5 \\
 \underline{3x - 3} \\
 8
 \end{array}$$

$\frac{2x^3 + 3x^2 - 2x + 5}{x-1} = 2x^2 + 5x + 3 + \frac{8}{x-1}$

$2x^3 + 3x^2 - 2x + 5 = (x-1)(2x^2 + 5x + 3) + 8$

3(-2) → 2  
 3+2  
 -2(-1) → 5  
 -2+5

Ex. 3) Divide  $3x^4 - x^3 + 3x - 20$  by  $x + 2$

$$\begin{array}{r}
 3x^3 - 7x^2 + 14x - 25 \\
 x+2 \overline{) 3x^4 - x^3 + 0x^2 + 3x - 20} \\
 \underline{3x^4 + 6x^3} \phantom{+ 0x^2} \\
 -7x^3 + 0x^2 \phantom{+ 3x} \\
 \underline{-7x^3 - 14x^2} \phantom{+ 3x} \\
 14x^2 + 3x \phantom{- 20} \\
 \underline{14x^2 + 28x} \phantom{- 20} \\
 -25x - 20 \\
 \underline{-25x - 50} \\
 30
 \end{array}$$

placeholder

$\frac{3x^4 - x^3 + 3x - 20}{x+2} = 3x^3 - 7x^2 + 14x - 25 + \frac{30}{x+2}$

Assign pg. 89 #1, d