

Division of Polynomials

Goal: To long divide polynomials

ex Long Division Review

$$\begin{array}{r}
 687 \div 9 \\
 \hline
 9 \overline{) 687} \\
 \underline{-63} \\
 57 \\
 \underline{-54} \\
 3
 \end{array}$$

(1)6(R)3

Quotient: 76
Remainder: 3

check: $9 \cdot 76 + 3 = 687 \checkmark$
 (divisor)(quotient) + R = dividend

$$\frac{687}{9} = 76 \frac{3}{9} = 76 \frac{1}{3} \rightarrow 76 + \frac{1}{3}$$

ex long divide

a) $(x^2 - 6x + 9) \div (x - 3)$

$$\frac{x^2 - 6x + 9}{x - 3}$$

$$\begin{array}{r}
 \downarrow \quad \downarrow \\
 \overline{) x^2 - 6x + 9} \\
 \underline{-x^2 + 3x} \\
 9
 \end{array}$$

(x-3)

Q: $x - 3$
R: 0

check gives a factorization of the dividend.

$$\begin{array}{r}
 \textcircled{x-3} \overline{) x^2 - 6x + 9} \\
 \underline{-x^2 + 3x} \\
 -3x + 9 \\
 \underline{+3x + 9} \\
 \textcircled{0} \leftarrow \text{remainder}
 \end{array}$$

$$Q \cdot x \rightarrow$$

$$R: 0$$

$$\begin{aligned}
 \text{check: } & (x-3)(x-3) + 0 \\
 & = x^2 - 6x + 9
 \end{aligned}$$

check a factor of the dividend.

$$b) (x^2 + 5x - 9) \div (x - 2)$$

$$\begin{array}{r}
 \textcircled{x+7} \\
 \textcircled{x-2} \overline{) x^2 + 5x - 9} \\
 \underline{-x^2 + 2x} \\
 7x - 9 \\
 \underline{-7x + 14} \\
 \textcircled{5}
 \end{array}$$

check:

$$\begin{aligned}
 & (x-2)(x+7) + 5 = x^2 + 5x - 9 \\
 & \begin{array}{l} \textcircled{-2x} \\ \textcircled{7x} \end{array}
 \end{aligned}$$

$$x^2 + 5x - 14 + 5$$

$$x^2 + 5x - 9 \checkmark$$

$$\frac{x^2 + 5x - 9}{x - 2} = \boxed{x + 7 + \frac{5}{x - 2}}$$

$$c) (2x^2 - x - 1) \div (2x - 1)$$

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

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

$$\textcircled{x - \frac{1}{2x - 1}}$$

$$\overline{-1}$$

check: $(2x-1)x - 1 = 2x^2 - x - 1$
 $2x^2 - x - 1 \checkmark$

$$\overline{x - \frac{2x-1}{2x-1}}$$

d) $(3x^4 + 2x^3 - 11x^2 - 2x + 5) \div (x^2 - 2)$

$$x^2 + 0x - 2 \overline{) \begin{array}{r} 3x^4 + 2x^3 - 11x^2 - 2x + 5 \\ - 3x^4 + 0x^3 + 6x^2 \\ \hline 2x^3 - 5x^2 - 2x \\ - 2x^3 + 0x^2 + 4x \\ \hline -5x^2 + 2x + 5 \\ + 5x^2 + 0x + 10 \\ \hline 2x - 5 \end{array}}$$

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

You Try it!

$$(18x^6 - 27x^5 - 3x^2) \div 9x^3$$

$$18x^6 - 27x^5 - 3x^2$$

$$9x^3$$

$$\frac{18x^3}{9x^2} - \frac{3x^2}{9x^2} - \frac{13x}{3 \cdot 9x^2}$$

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