Dividing Polynomials Using Long Division

Model Problems:

Example 1: Divide $\dfrac{2x^3-8x^2+9x-2}{x-2}$ using long division.

$$x-2\overline{\smash{\big)}\,2x^3-8x^2+9x-2}$$

$x-2$ is called the divisor and $2x^3-8x^2+9x-2$ is called the dividend. The first step is to find what we need to multiply the first term of the divisor *(x)* by to obtain the first term of the dividend ($2x^3$). This is $2x^2$. We then multiply $x-2$ by $2x^2$ and put this expression underneath the dividend. The term $2x^2$ is part of the quotient, and is put on top of the horizontal line (above the $8x^2$). We then *subtract* $2x^3 - 4x^2$ from $2x^3-8x^2+9x-2$.

$$\begin{array}{r l}
 & 2x^2 \\
x-2 & \overline{\smash{\big)}\,2x^3-8x^2+9x-2} \\
 & \underline{-(2x^3-4x^2)} \\
 & \qquad -4x^2+9x-2
\end{array}$$

The same procedure is continued until an expression of lower degree than the divisor is obtained. This is called the remainder.

$$\begin{array}{r l}
 & 2x^2-4x+1 \\
x-2 & \overline{\smash{\big)}\,2x^3-8x^2+9x-2} \\
 & \underline{-(2x^3-4x^2)} \\
 & \qquad -4x^2+9x-2 \\
 & \qquad \underline{-(-4x^2+8x)} \\
 & \qquad\qquad\quad x-2 \\
 & \qquad\qquad\quad \underline{-(x-2)} \\
 & \qquad\qquad\qquad 0
\end{array}$$

We've found that $\dfrac{2x^3-8x^2+9x-2}{x-2}=2x^2-4x+1$

Example 2: $\dfrac{8t^3+14t+8}{2t+1}$

Since the dividend (the numerator) doesn't have a second-degree term, it is useful to use placeholders so that we do our subtraction correctly. The problem works out as follows:

$$2t + 12t + 1)\overline{8t^3 + 0t^2 + 14t + 8}$$

Dividing we get:

$$\begin{array}{rl} & \underline{\quad 4t^2 \quad -2t \quad +8 \quad} \\ 2t+1) & 8t^3 + 0t^2 + 14t + 8 \\ & \underline{-(8t^3 \ + 4t^2)} \\ & \quad -4t^2 + 14t \\ & \quad \underline{-(-4t^2 - \ 2t)} \\ & \qquad +16t + 8 \\ & \qquad \underline{-(+16t + 8)} \\ & \qquad\qquad 0 \end{array}$$

PRACTICE:

1. $\dfrac{3x^3 + 5x^2 - 11x + 3}{x+3}$ **2.** $\dfrac{4x^3 + 6x^2 - 10x + 4}{2x-1}$ **3.** $\dfrac{x^3 + 1}{x-1}$

ANSWERS:

1. $3x^2 - 4x + 1$ **2.** $2x^2 + 4x - 3 + \dfrac{1}{2x-1}$ **3.** $x^2 + x + 1 + \dfrac{2}{x-1}$