Long Division of Polynomials - Example 2

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Example 2: Simplify $\dfrac{2x^3 - 3x^2 + 5x + 1}{x - 3}$

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Example 2: Simplify $\dfrac{2x^3 - 3x^2 + 5x + 1}{x - 3}$

$$x - 3\overline{)\quad 2x^3 - 3x^2 \;\; + 5x \;\; + 1}$$

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First we divide the lead terms:
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$$x - 3) \quad \begin{array}{r} 2x^2 \\ \hline 2x^3 - 3x^2 + 5x + 1 \end{array}$$

First we divide the lead terms:
$\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

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$$
\begin{array}{r}
\multicolumn{4}{r}{2x^2} \\
\cline{2-4}
x - 3) & 2x^3 - 3x^2 & + 5x & + 1 \\
& \underline{-2x^3 + 6x^2} & & \\
\end{array}
$$

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\underline{-2x^3 + 6x^2} & & \\
3x^2 & + 5x &
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\multicolumn{4}{r}{2x^2} \\
\cline{2-4}
x-3) \quad 2x^3 - 3x^2 & +5x & +1 \\
\underline{-2x^3 + 6x^2} & & \\
3x^2 & +5x &
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

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Now we have a lower degree

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\quad 2x^2 \\
\hline
x - 3 \,\big)\; 2x^3 - 3x^2 + 5x + 1 \\
\underline{-2x^3 + 6x^2} \\
\quad 3x^2 + 5x
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

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\cline{2-4}
x - 3) \quad 2x^3 - 3x^2 & + 5x & + 1 \\
\underline{-2x^3 + 6x^2} & & \\
3x^2 & + 5x &
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

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Example 2: Simplify $\dfrac{2x^3 - 3x^2 + 5x + 1}{x - 3}$

$$
\begin{array}{r}
\multicolumn{4}{r}{2x^2 \;+3x} \\
\cline{2-4}
x-3) \;\; 2x^3 - 3x^2 \;+5x \;+1 \\
\multicolumn{1}{r}{-2x^3 + 6x^2} \\
\cline{1-2}
\multicolumn{1}{r}{3x^2 \;+5x}
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

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\multicolumn{4}{r}{2x^2 \;+3x} \\
\cline{2-4}
x-3) \;\; 2x^3 - 3x^2 \;+5x \;+1 \\
\multicolumn{1}{r}{-2x^3 + 6x^2} \\
\cline{1-2}
\multicolumn{1}{r}{3x^2 \;+5x} \\
\multicolumn{1}{r}{-3x^2 \;+9x} \\
\cline{1-2}
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

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\cline{2-4}
x-3) \;\; 2x^3 - 3x^2 \;+5x \;+1 \\
\multicolumn{1}{r}{-2x^3 + 6x^2} \\
\cline{2-3}
\multicolumn{1}{r}{3x^2 \;+5x} \\
\multicolumn{1}{r}{-3x^2 \;+9x} \\
\cline{2-3}
\multicolumn{1}{r}{14x \;+1}
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

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$$
\begin{array}{r}
 & 2x^2 & +3x & \\
\hline
x-3\,) & 2x^3 & -3x^2 & +5x & +1 \\
 & -2x^3 & +6x^2 & & \\
\hline
 & & 3x^2 & +5x & \\
 & & -3x^2 & +9x & \\
\hline
 & & & 14x & +1
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

Dividing the new lead terms: $\frac{14x}{x} = 14$

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$$
\begin{array}{r}
 & 2x^2 & +3x & +14 \\
\hline
x-3\,) & 2x^3 & -3x^2 & +5x & +1 \\
 & -2x^3 & +6x^2 & & \\
\hline
 & & 3x^2 & +5x & \\
 & & -3x^2 & +9x & \\
\hline
 & & & 14x & +1
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

Dividing the new lead terms: $\frac{14x}{x} = 14$

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$$
\begin{array}{r}
 & 2x^2 & +3x & +14 \\
\hline
x-3) & 2x^3 & -3x^2 & +5x & +1 \\
 & -2x^3 & +6x^2 & & \\
\hline
 & & 3x^2 & +5x & \\
 & & -3x^2 & +9x & \\
\hline
 & & & 14x & +1 \\
 & & & -14x & +42 \\
\hline
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

Dividing the new lead terms: $\frac{14x}{x} = 14$

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 & 2x^2 & +3x & +14 \\
\hline
x-3) & 2x^3 & -3x^2 & +5x & +1 \\
 & -2x^3 & +6x^2 & & \\
\hline
 & & 3x^2 & +5x & \\
 & & -3x^2 & +9x & \\
\hline
 & & & 14x & +1 \\
 & & & -14x & +42 \\
\hline
 & & & & 43
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

Dividing the new lead terms: $\frac{14x}{x} = 14$

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\begin{array}{r}
 & 2x^2 & +3x & +14 \\
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x-3) & 2x^3 & -3x^2 & +5x & +1 \\
 & -2x^3 & +6x^2 & & \\
\hline
 & & 3x^2 & +5x & \\
 & & -3x^2 & +9x & \\
\hline
 & & & 14x & +1 \\
 & & & -14x & +42 \\
\hline
 & & & & 43
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

Dividing the new lead terms: $\frac{14x}{x} = 14$

Once the degree of what is being divided is smaller than the degree we are dividing by, the process is complete:

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x-3) & 2x^3 & -3x^2 & +5x & +1 \\
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\hline
 & & 3x^2 & +5x & \\
 & & -3x^2 & +9x & \\
\hline
 & & & 14x & +1 \\
 & & & -14x & +42 \\
\hline
 & & & & 43
\end{array}
$$

First we divide the lead terms: $\frac{2x^3}{x} = 2x^2$

Next we multiply $2x^2 \cdot (x - 3)$ and subtract

Now we have a lower degree

Now we repeat this process.

Dividing the new lead terms: $\frac{3x^2}{x} = 3x$

Dividing the new lead terms: $\frac{14x}{x} = 14$

Once the degree of what is being divided is smaller than the degree we are dividing by, the process is complete:

Conclusion: $\dfrac{2x^3 - 3x^2 + 5x + 1}{x - 3} = 2x^2 + 3x + 14 + \dfrac{43}{x - 3}$