Dividing Polynomials

Order in which Division should be worked:

1) Divide
2) Multiply
3) Subtract
4) Bring down
5) Repeat

Example 1:

DIVIDE THIS POLYNOMIAL	$\frac{6x^3+7x^2-4x-4}{3x+2}$	
1) Divide	$\begin{array}{r} \mathbf{2x^2} \\ \hline \mathbf{3x}+2 \;)\; \mathbf{6x^3}+7x^2-4x-4 \end{array}$	$\mathbf{6x^3 \div 3x = 2x^2}$
2) Multiply	$\begin{array}{r} \mathbf{2x^2} \\ \hline \mathbf{3x+2} \;)\; 6x^3+7x^2-4x-4 \\ \mathbf{6x^3+4x^2} \end{array}$	$\mathbf{2x^2\,(3x+2) = 6x^3+4x^2}$
3) Subtract	$\begin{array}{r} 2x^2 \\ \hline 3x+2 \;)\; \mathbf{6x^3+7x^2}-4x-4 \\ \underline{\mathbf{-(6x^3+4x^2)}} \\ \mathbf{3x^2} \end{array}$	$\mathbf{(6x^3+7x^2)-(6x^3+4x^2) = 3x^2}$
4) Bring down	$\begin{array}{r} 2x^2 \\ \hline 3x+2 \;)\; 6x^3+7x^2\mathbf{-4x}-4 \\ \underline{6x^3+4x^2} \\ 3x^2\mathbf{-4x} \end{array}$	
1) Divide	$\begin{array}{r} 2x^2+\mathbf{x} \\ \hline \mathbf{3x}+2 \;)\; 6x^3+7x^2-4x-4 \\ \underline{6x^3+4x^2} \\ \mathbf{3x^2}-4x \end{array}$	$\mathbf{3x^2 \div 3x = x}$
2) Multiply	$\begin{array}{r} 2x^2+\mathbf{x} \\ \hline \mathbf{3x+2} \;)\; 6x^3+7x^2-4x-4 \\ \underline{6x^3+4x^2} \\ 3x^2-4x \\ \mathbf{3x^2+2x} \end{array}$	$\mathbf{x\,(3x+2) = 3x^2+2x}$
3) Subtract	$\begin{array}{r} 2x^2+x \\ \hline 3x+2 \;)\; 6x^3+7x^2-4x-4 \\ 6x^3+4x^2 \\ \mathbf{3x^2-4x} \\ \underline{\mathbf{-(3x^2+2x)}} \\ \mathbf{-\ 6x} \end{array}$	$\mathbf{(3x^2-4x)-(3x^2+2x) = -6x}$
4) Bring down	$\begin{array}{r} 2x^2+x \\ \hline 3x+2 \;)\; 6x^3+7x^2-4x\mathbf{-4} \\ \underline{6x^3+4x^2} \\ 3x^2-4x \\ \underline{3x^2+2x} \\ -\ 6x\ \mathbf{-4} \end{array}$	
1) Divide	$\begin{array}{r} 2x^2+x\ \mathbf{-2} \\ \hline \mathbf{3x}+2 \;)\; 6x^3+7x^2-4x-4 \\ 6x^3+4x^2 \\ 3x^2-4x \\ \underline{3x^2+2x} \\ \mathbf{-6x}\ -4 \end{array}$	$\mathbf{-6x \div 3x = -2}$
2) Multiply	$\begin{array}{r} 2x^2+x\ -\ 2 \\ \hline \mathbf{3x+2} \;)\; 6x^3+7x^2-4x-4 \\ 6x^3+4x^2 \\ 3x^2-4x \\ \underline{3x^2+2x} \\ -\ 6x\ -4 \\ \mathbf{-6x\ -4} \end{array}$	$\mathbf{-2(3x+2) = -6x-4}$

3) Subtract	$2x^2 + x - 2$ $3x+2\ )\ 6x^3 + 7x^2 - 4x - 4$ $6x^3 + 4x^2$ $3x^2 - 4x$ $3x^2 + 2x$ **- 6x - 4** **-(- 6x - 4)** **0**	$(-6x-4) - (-6x-4) = 0$

Example 2 (Remainder):

DIVIDE THIS POLYNOMIAL	$\frac{6x^2 - 2x + 8}{3x+5}$	
1) Divide	$2x$ $3x + 5\ )\ 6x^2 - 2x + 8$	$6x^2 \div 3x = 2x$
2) Multiply	$2x$ $3x + 5\ )\ 6x^2 - 2x + 8$ $6x^2 + 10x$	$2x\,(3x+5) = 6x^2 + 10x$
3) Subtract	$2x$ $3x + 5\ )\ 6x^2 - 2x + 8$ $-(6x^2 + 10x)$ **-12x**	$(6x^2 - 2x) - (6x^2 + 10x) = -12x$
4) Bring down	$2x$ $3x + 5\ )\ 6x^2 - 2x + 8$ $6x^2 + 10x$ $-12x + 8$	
1) Divide	$2x - 4$ $3x + 5\ )\ 6x^2 - 2x + 8$ $6x^2 + 10x$ **-12x** + 8	$-12x \div 3x = -4$
2) Multiply	$2x - 4$ $3x + 5\ )\ 6x^2 - 2x + 8$ $6x^2 + 10x$ $-12x + 8$ **-12x -20**	$-4\,(3x+5) = -12x - 20$
3) Subtract	$2x - 4$ $3x + 5\ )\ 6x^2 - 2x + 8$ $6x^2 + 10x$ **-12x + 8** **-(-12x –20)** **28**	**(-12x + 8) – (-12x – 20) = 28**
Write remainder as a fraction	$2x - 4 + \frac{28}{3x+5}$ $3x + 5\ )\ 6x^2 - 2x + 8$ $6x^2 + 10x$ $-12x + 8$ $-(-12x - 20)$ 28	**Remainder 28 =** $\frac{28}{3x+5}$

Example 3 (Missing terms):

DIVIDE THIS POLYNOMIAL	$\frac{5x^3 - 2x^2 - 6}{x - 1}$	
Insert Missing Terms	$x - 1 \overline{)\ 5x^3 - 2x^2 + \mathbf{0x} - 6}$	$\mathbf{0x}$
1) Divide	$\mathbf{5x^2}$ $x - 1 \overline{)\ \mathbf{5x^3} - 2x^2 + 0x - 6}$	$\mathbf{5x^3 \div x = 5x^2}$
2) Multiply	$\mathbf{5x^2}$ $\mathbf{x - 1}\ )\ 5x^3 - 2x^2 + 0x - 6$ $\mathbf{5x^3 - 5x^2}$	$\mathbf{5x^2\,(x - 1) = 5x^3 - 5x^2}$
3) Subtract	$5x^2$ $x - 1 \overline{)\ \mathbf{5x^3} - \mathbf{2x^2} + 0x - 6}$ $\underline{-(\mathbf{5x^3} - \mathbf{5x^2})}$ $\mathbf{3x^2}$	$\mathbf{(5x^3 - 2x^2) - (5x^3 - 5x^2) = 3x^2}$
4) Bring down	$5x^2$ $x - 1\ )\ 5x^3 - 2x^2 + \mathbf{0x} - 6$ $\underline{5x^3 - 5x^2}$ $3x^2 + \mathbf{0x}$	
1) Divide	$\underline{5x^2 + \mathbf{3x}}$ $\mathbf{x} - 1)\ 5x^3 - 2x^2 + 0x - 6$ $\underline{5x^3 - 5x^2}$ $\mathbf{3x^2} + 0x$	$\mathbf{3x^2 \div x = 3x}$
2) Multiply	$\underline{5x^2 + \mathbf{3x}}$ $\mathbf{x} - 1)\ 5x^3 - 2x^2 + 0x - 6$ $\underline{5x^3 - 5x^2}$ $3x^2 + 0x$ $\mathbf{3x^2 - 3x}$	$\mathbf{3x\,(x - 1) = 3x^2 - 3x}$
3) Subtract	$\underline{5x^2 + 3x}$ $x - 1\ )\ 5x^3 - 2x^2 + 0x - 6$ $\underline{5x^3 - 5x^2}$ $\mathbf{3x^2} + \mathbf{0x}$ $\underline{-(\mathbf{3x^2} - \mathbf{3x})}$ $\mathbf{3x}$	$\mathbf{(3x^2 + 0x) - (3x^2 - 3x) = 3x}$
4) Bring down	$\underline{5x^2 + 3x}$ $x - 1\ )\ 5x^3 - 2x^2 + 0x - \mathbf{6}$ $\underline{5x^3 - 5x^2}$ $3x^2 + 0x$ $\underline{3x^2 - 3x}$ $3x$ **- 6**	
1) Divide	$\underline{5x^2 + 3x + \mathbf{3}}$ $\mathbf{x} - 1)\ 5x^3 - 2x^2 + 0x - 6$ $\underline{5x^3 - 5x^2}$ $3x^2 + 0x$ $\underline{3x^2 - 3x}$ $\mathbf{3x}$ - 6	$\mathbf{3x \div x = 3}$
2) Multiply	$\underline{5x^2 + 3x + \mathbf{3}}$ $\mathbf{x - 1}\ )\ 5x^3 - 2x^2 + 0x - 6$ $\underline{5x^3 - 5x^2}$ $3x^2 + 0x$ $\underline{3x^2 - 3x}$ $3x$ - 6 $\mathbf{3x}$ **- 3**	$\mathbf{3(x - 1) = 3x - 3}$

3) Subtract	$5x^2 + 3x + 3$ $x - 1\,)\,5x^3 - 2x^2 + 0x - 6$ $5x^3 - 5x^2$ $3x^2 + 0x$ $3x^2 - 3x$ **$3x$ - 6** **-($3x$ - 3)** **-3**	**(3x - 6) – (3x – 3) = -3**
Write remainder as a fraction	$5x^2 + 3x + 3 + \frac{-3}{x-1}$ $x - 1\,)\,5x^3 - 2x^2 + 0x - 6$ $5x^3 - 5x^2$ $3x^2 + 0x$ $3x^2 - 3x$ $3x$ - 6 -($3x$ - 3) -3	**Remainder -3 = $\frac{-3}{x-1}$**

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