Long division of polynomials is used when the polynomial in the numerator has a higher degree than the polynomial in the denominator. Checking your answers by multiplying out helps you practice your multiplication of polynomials and see what it is you've accomplished with the long division–so make sure you do it!

Questions

1. Divide $\dfrac{8y^4 - 12y^3 - 4y^2}{4y^2}$.

2. Divide $\dfrac{49x^8 - 35x^6 - 56x^3}{7x^3}$.

3. Divide $\dfrac{12x^2 + 19x + 5}{3x + 1}$.

4. Divide $\dfrac{4x^3 + 4x^2 - 19x - 15}{2x + 5}$.

5. Divide $\dfrac{9y^3 - 30y^2 + 31y - 4}{3y - 5}$.

6. Divide $\dfrac{8y^3 + 3y - 7}{4y - 1}$.

Solutions

1.

$$\begin{array}{r l}
 & \,2y^2-3y-1 \\
4y^2 & \overline{)\,8y^4-12y^3-4y^2} \\
 & \underline{\;8y^4} \\
 & -12y^3-4y^2 \\
 & \underline{-12y^3} \\
 & -4y^2 \\
 & \underline{-4y^2} \\
 & 0 \text{ remainder.}
\end{array}$$

This way works also, but it's more work.

This is easier: $\dfrac{8y^4-12y^3-4y^2}{4y^2} = \dfrac{8y^4}{4y^2} - \dfrac{12y^3}{4y^2} - \dfrac{4y^2}{4y^2}$

$= 2y^2-3y-1$.

2.

$\dfrac{49x^8-35x^6-56x^3}{7x^3} = \dfrac{49x^8}{7x^3} - \dfrac{35x^6}{7x^3} - \dfrac{56x^3}{7x^3} = 7x^5-5x^3-8$

3.

$$\begin{array}{r l}
 & 4x+5 \\
3x+1 & \overline{)\,12x^2+19x+5} \\
 & \underline{\;12x^2+4x} \\
 & 15x+5 \\
 & \underline{15x+5} \\
 & 0 \text{ remainder.}
\end{array}$$

so $\dfrac{12x^2+19x+5}{3x+1} = 4x+5$

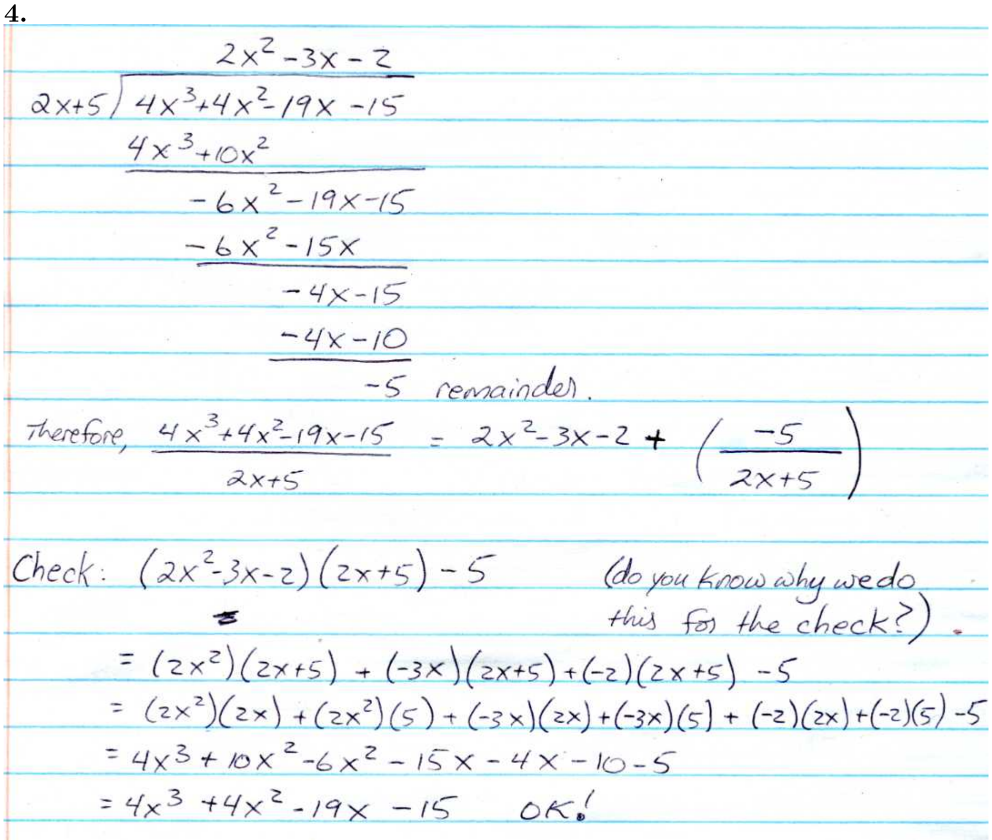
check: $(4x+5)(3x+1) = (4x+5)(3x) + (4x+5)(1)$

$= (4x)(3x) + (5)(3x) + (4x)(1) + (5)(1)$

$= 12x^2 + 15x + 4x + 5$

$= 12x^2 + 19x + 5$ OK!

4.



$2x^2-3x-2$

$2x+5 \,\overline{)\, 4x^3+4x^2-19x-15}$

$\underline{4x^3+10x^2}$

$-6x^2-19x-15$

$\underline{-6x^2-15x}$

$-4x-15$

$\underline{-4x-10}$

-5 remainder.

Therefore, $\dfrac{4x^3+4x^2-19x-15}{2x+5} = 2x^2-3x-2+\left(\dfrac{-5}{2x+5}\right)$

Check: $(2x^2-3x-2)(2x+5)-5$ (do you know why we do this for the check?)

$=$

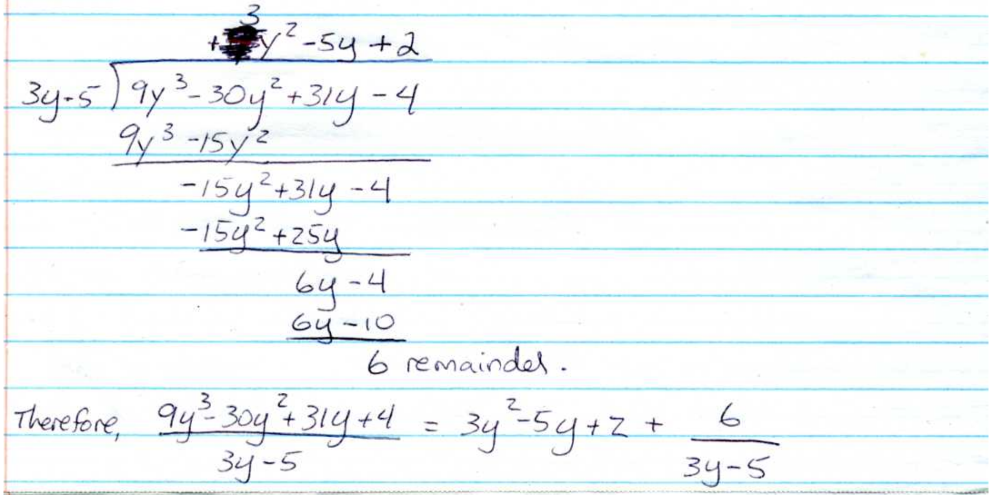
$= (2x^2)(2x+5)+(-3x)(2x+5)+(-2)(2x+5)-5$

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

$= 4x^3+10x^2-6x^2-15x-4x-10-5$

$= 4x^3+4x^2-19x-15$ OK!

5.



$+3y^2-5y+2$

$3y-5 \,\overline{)\, 9y^3-30y^2+31y-4}$

$\underline{9y^3-15y^2}$

$-15y^2+31y-4$

$\underline{-15y^2+25y}$

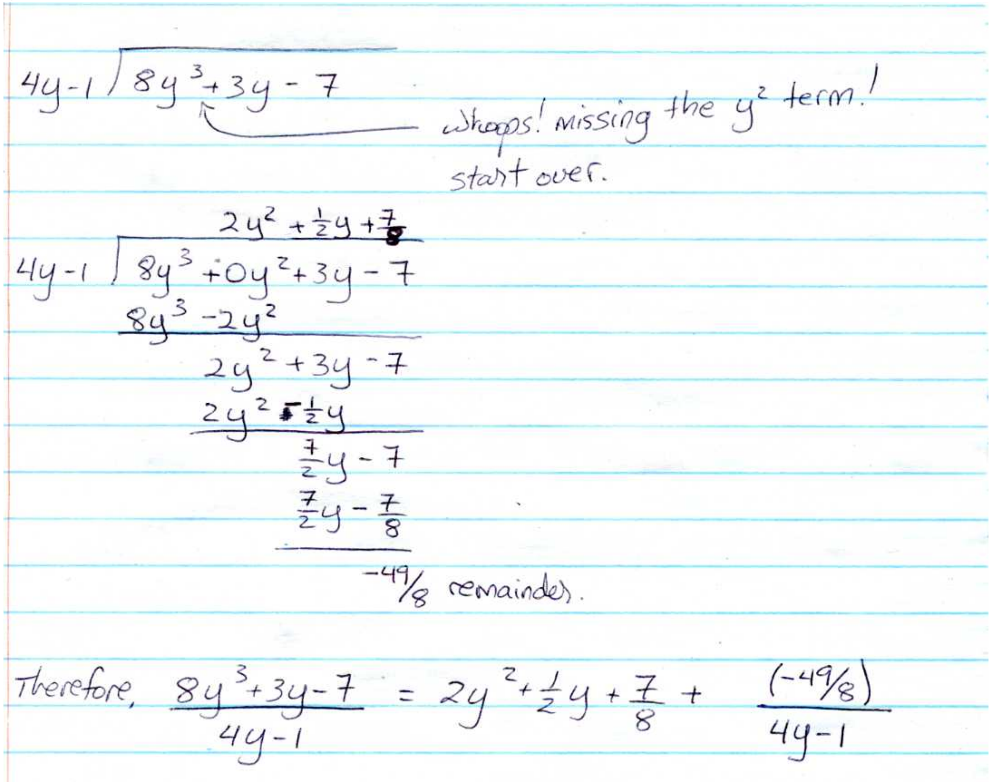
$6y-4$

$\underline{6y-10}$

6 remainder.

Therefore, $\dfrac{9y^3-30y^2+31y+4}{3y-5} = 3y^2-5y+2+\dfrac{6}{3y-5}$

6.



$$4y-1\,\overline{)\,8y^3+3y-7}$$

Whoops! missing the y^2 term! start over.

$$\begin{array}{r}
2y^2+\frac{1}{2}y+\frac{7}{8} \\
4y-1\,\overline{)\,8y^3+0y^2+3y-7} \\
\underline{8y^3-2y^2} \\
2y^2+3y-7 \\
\underline{2y^2-\frac{1}{2}y} \\
\frac{7}{2}y-7 \\
\underline{\frac{7}{2}y-\frac{7}{8}} \\
-49/8
\end{array}$$

remainder.

Therefore, $\dfrac{8y^3+3y-7}{4y-1} = 2y^2+\frac{1}{2}y+\frac{7}{8}+\dfrac{(-49/8)}{4y-1}$