How to Perform Polynomial Long Division in just TEN STEPS:

A step-by-step guide

Example #1:

Find the quotient of:

$$\frac{x^2 - 9x - 10}{x + 1}$$

Step #1

- Set up the division in this format:

$$x+1\overline{)x^2 \ -9x-10}$$

Step #2

- First divide the first term of the dividend (x^2) by the first term of the divisor (x), and write the answer on the top line:

$$\begin{array}{r} x \\ x+1\overline{)x^2 \ -9x-10} \end{array}$$

Step #3

- Now take that x, and multiply it by the divisor (x + 1) and write is directly underneath making sure to line it up with the "like" terms above it :

$$\begin{array}{r} x \\ x+1\overline{)x^2 \ -9x-10} \\ x^2 \ +1x \end{array}$$

Step #4

- Now we must subtract the lined up polynomials:
  - (I have added the changed signs in red so now we can just add the terms)

$$\begin{array}{r} x \\ x+1\overline{)x^2 \ -9x-10} \\ \underline{-x^2 \ \overset{-}{+}1x } \end{array}$$

Step #5

- When the terms are added the x^2 will cancel out and leave you with -10x:

$$
\begin{array}{r|l}
 & x \\ \hline
x+1 & x^2 \;\; -9x-10 \\
 & -x^2 \;\; \overset{-}{+}1x \\ \hline
 & \qquad -10x
\end{array}
$$

Step #6

- Now we must carry down the -10 from the dividend to the same line as the -10x:

$$
\begin{array}{r|l}
 & x \\ \hline
x+1 & x^2 \;\; -9x-10 \\
 & -x^2 \;\; \overset{-}{+}1x \\ \hline
 & \qquad -10x-10
\end{array}
$$

Step #7

- Now we must divide the NEW first term of the dividend (-10x) by x and write it up top of the divisor sign:

$$
\begin{array}{r|l}
 & x \;-10 \\ \hline
x+1 & x^2 \;\; -9x-10 \\
 & -x^2 \;\; \overset{-}{+}1x \\ \hline
 & \qquad -10x-10
\end{array}
$$

Step #8

- Now I'll multiply the –10 (on top) by the divisor (x+1) and line the product up with the like terms as shown below (refer to step #3):

$$
\begin{array}{r|l}
 & x \;-10 \\ \hline
x+1 & x^2 \;\; -9x-10 \\
 & -x^2 \;\; \overset{-}{+}1x \\ \hline
 & \qquad -10x-10 \\
 & \qquad -10x-10
\end{array}
$$

Step #9

- Now we must subtract the lined up polynomials:
  - (I have added the changed signs in red so now we can just add the terms) (refer to step #4)

$$\begin{array}{r} x - 10 \\ x+1\overline{)\,x^2 - 9x - 10} \\ -x^2 - 1x \\ \hline -10x - 10 \\ +10x + 10 \\ \hline \end{array}$$

Step #10

- The solution:
  - Once you have no more terms to bring down from the dividend the process is complete
  - The quotient (the answer to the division) is found on top of the dividing sign:

$$\begin{array}{r} x - 10 \\ x+1\overline{)\,x^2 - 9x - 10} \\ -x^2 - 1x \\ \hline -10x - 10 \\ +10x + 10 \\ \hline 0 \end{array}$$

- In this example the quotient(solution) is ***x -10***
  - The number written at the very bottom of the long division (in this case zero) is the **remainder**
    - Therefore the remainder for this example is zero

And we can write this as:

$$\frac{x^2 - 9x - 10}{x + 1} = x - 10$$

<u>How to rewrite the quotient with a remainder</u>

Some examples of polynomial division give a remainder, just as in this example below:

$$
\begin{array}{r}
x^2 \quad - 2x \quad + 4 \\
3x + 1 \overline{\big) 3x^3 - 5x^2 + 10x - 3} \\
-3x^3 - 1x^2 \qquad\qquad\quad \\
\hline
-6x^2 + 10x - 3 \\
+6x^2 + \ \ 2x \qquad \\
\hline
12x - 3 \\
-12x - 4 \\
\hline
-7
\end{array}
$$

In this case we would write this quotient as:

$$x^2 - 2x + 4 + \frac{-7}{3x-1}$$

- where the remainder is added to the solution and ***written as a fraction over the divisor***

<u>Check your work</u>

- you can check your work by multiplying the divisor by the quotient and then adding the remainder (if there is one)
  - this should give you the dividend
    - if not…try again!