Long Division of Polynomials

Long division of polynomials is very similar to long division of numbers (most likely you didn’t learn short division of numbers). Anyway, you look at the first term of the divisor and divide it into the first term of the dividend.

\[
\begin{array}{c|ccc}
\text{quotient} & \text{divisor} & \text{dividend} \\
\hline
\end{array}
\]

so in the case of \((y^3 - y^2 - 4y - 7) \div (y + 1)\)
you would divide \(y\) into \(y^3\) resulting in \(y^2\) as shown.

\[
y^2 \\
y + 1) y^3 - y^2 - 4y - 7
\]

then multiply the quotient by the divisor as in number division

and place the result underneath in the appropriate columns.

The next step is where a mistake is often made, you need to **subtract** just as you would in number division.

\[
y^2 \\
y + 1) y^3 - y^2 - 4y - 7 \\
- (y^3 + y^2)
\]

It is helpful here to distribute the minus sign, then add.

\[
y^2 \\
y + 1) y^3 - y^2 - 4y - 7 \\
- y^3 - y^2
\]

So that your result is

\[
y^2 \\
y + 1) y^3 - y^2 - 4y - 7 \\
- y^3 - y^2 \\
- 2y^2
\]

Now bring down the next term (as you would bring down the next digit in number division)
Now divide $y$ into $-2y^2$ to get $-2y$ and multiply the quotient by the divisor as before. Remember again you want to \textbf{subtract}. 

\[
\begin{array}{c}
y^2 \\
\hline
y+1) y^3 - y^2 - 4y - 7 \\
-y^3 - y^2 \\
\hline
-2y^2 - 4y \\
\end{array}
\]

which gives you

\[
\begin{array}{c}
y^2 - 2y \\
\hline
y+1) y^3 - y^2 - 4y - 7 \\
-y^3 - y^2 \\
\hline
-2y^2 - 4y \\
\end{array}
\]

\[
\begin{array}{c}
2y^2 + 2y \\
\hline
-2y - 7 \\
\end{array}
\]

\[
\begin{array}{c}
-2y^2 - 4y \\
\hline
2y + 2 \\
\end{array}
\]

\[
\begin{array}{c}
-5 \\
\hline
\end{array}
\]

So that the quotient (answer) is:

\[
y^2 - 2y - 2 - \frac{5}{y+1}
\]