Polynomial Division

Remember that multiplication & division are inverses. If you understand multiplication, you can work backwards to divide.

Multiplying: Distributive Property

$$(x^3+2x^2+3x-7)(x^2+x+1)$$

$$x^5+x^4+x^3+2x^4+2x^3+2x^2+3x^3+3x^2+3x-7x^2-7x-7$$

$$x^5+3x^4+6x^3+-2x^2-4x-7$$

Generic Rectangle

	x^3	$+2x^2$	$+3x$	-7
x^2	x^5	$2x^4$	$3x^3$	$-7x^2$
$+x$	x^4	$2x^3$	$3x^2$	$-7x$
$+1$	x^3	$2x^2$	$3x$	-7

The like terms are on each diagonal

$$x^5+3x^4+6x^3-2x^2-4x-7$$

Use whichever method you like. The generic rectangle is easier to use for division, in my opinion.

Dividing: Generic Rectangle

$$\frac{x^3+2x^2-5x+12}{x+4}$$

	x^2	$-2x$	$+3$
x	x^3	$-2x^2$	$3x$
$+4$	$4x^2$	$-8x$	12

$$x^3+2x^2-5x+12$$

So, $x^2-2x+3=\dfrac{x^3+2x^2-5x+12}{x+4}$

Polynomial Division

Long Division: Match biggest terms, multiply, then subtract.

$$
\begin{array}{r}
x^2-2x+3 \\
x+4\,\big)\overline{\,x^3+2x^2-5x+12} \\
-(x^3+4x^2) \\
\hline
-2x^2-5x \\
-(-2x^2-8x) \\
\hline
3x+12 \\
-(3x+12) \\
\hline
0
\end{array}
$$

Sometimes polynomials don't divide evenly. Just use a remainder.

$$
\begin{array}{r}
x^2+7x+38 \\
x-5\,\big)\overline{\,x^3+2x^2+3x+4} \\
-(x^3-5x^2) \\
\hline
7x^2+3x \\
-(7x^2-35x) \\
\hline
38x+4 \\
-(38x+190) \\
\hline
-186
\end{array}
$$

So, $\dfrac{x^3+2x^2+3x+4}{x-5} = x^2+7x+38$ R -186

OR

$x^2+7x+38+\dfrac{-186}{x-5}$

$$
\begin{array}{c|c|c|c|}
 & x^2 & +7x & +38 \\
\hline
x & x^3 & 7x^2 & 38x \\
\hline
-5 & -5x^2 & -35x & -190 \\
\hline
\end{array}
$$

x^3+2x^2+3x+4

4 should go in here.

But $4-190=-186$.

So $\dfrac{x^3+2x^2+3x+4}{x-5} = x^2+7x+38+\dfrac{-186}{x-5}$