* **Divide *x*2 – 9*x* – 10 by *x* + 1**

Think back to when you were doing long division with plain old numbers. You would be given one number that you had to divide into another number. You set up the division symbol, inserted the two numbers where they belonged, and then started making guesses. And you didn't guess the whole answer right away; instead, you started working on the "front" part (the larger place values) of the number you were dividing.   Copyright © Elizabeth Stapel 2000-2011 All Rights Reserved

Long division for polynomials works in much the same way:

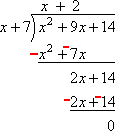
|  |  |
| --- | --- |
| First, I set up the division:  For the moment, I'll ignore the other terms and look just at the leading *x* of the divisor and the leading *x*2 of the dividend. | Set up the division |
| If I divide the leading *x*2 inside by the leading *x* in front, what would I get? I'd get an *x*. So I'll put an *x* on top: | Put the 'x' up top |
| Now I'll take that *x*, and multiply it through the divisor, *x* + 1. First, I multiply the *x* (on top) by the *x* (on the "side"), and carry the *x*2 underneath: | Carry the 'x^2' down |
| Then I'll multiply the *x* (on top) by the 1 (on the "side"), and carry the 1*x* underneath: | Carry the '1x |
| Then I'll draw the "equals" bar, so I can do the subtraction.  To [subtract](http://www.purplemath.com/modules/polyadd2.htm) the polynomials, I *change all the signs* in the second line... | Change signs |
| ...and then I add down. The first term (the *x*2) will cancel out: | Subtract |
| I need to remember to carry down that last term, the "subtract ten", from the dividend: | Carry down the '–10' |
| Now I look at the *x* from the divisor and the new leading term, the –10*x*, in the bottom line of the division. If I divide the –10*x* by the *x*, I would end up with a –10, so I'll put that on top: | Put '–10' up top |
| Now I'll multiply the –10 (on top) by the leading *x* (on the "side"), and carry the –10*x* to the bottom: | Carry the '–10x' down |
| ...and I'll multiply the –10 (on top) by the 1 (on the "side"), and carry the –10 to the bottom: | Carry the '–10' down |
| I draw the equals bar, and *change the signs* on all the terms in the bottom row: | Change the signs |
| Then I add down: | Subtract |

* **Simplify  (x^2 + 9x + 1)/(x + 7)**

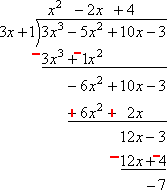
This can be done in either of two ways: I can [factor the quadratic](http://www.purplemath.com/modules/factquad.htm) and then cancel the common factor, like this:

(x + 2)(x + 7)/(x + 7) = x + 2

But what if I didn't know how to factor? I can always use long division:



 **Divide 3*x*3 – 5*x*2 + 10*x* – 3  by  3*x* + 1**

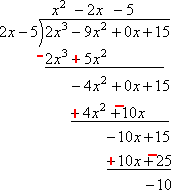


Then my answer is:

* **Divide 2*x*3 – 9*x*2 + 15  by  2*x* – 5**

First off, I note that there is a gap in the degrees of the terms of the dividend: the polynomial   
2*x*3 – 9*x*2 + 15 has no *x* term. My work could get very messy inside the division symbol, so it is important that I leave space for a *x*-term column, just in case. I can create this space by turning the dividend into 2*x*3 – 9*x*2 + 0*x* + 15. This is a legitimate mathematical step: since I've only added zero, I haven't actually changed the value of anything.

Now that I have all the "room" I might need for my work, I'll do the division:

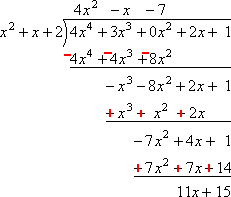


I need to remember to *add* the remainder to the polynomial part of the answer:

x^2 - 2x - 5 + (-10)/(2x - 5)

* **Divide 4*x*4 + 3*x*3 + 2*x* + 1  by *x*2 + *x* + 2**

I'll add a 0*x*2 term to the dividend (inside the division symbol) to make space for my work, and then I'll do the division in the usual manner:



Then my answer is:

4x^2 - x - 7 + (11x + 15)/(x^2 + x + 2)