MATH SKILL INFORMATION PAGE

Algebra	**For use with 10-9**

LONG DIVISION WITH POLYNOMIALS

Problem: $(2x^3 - 9x^2 + 11x - 3) \div (2x - 3)$

↑ Dividend ↑ Divisor

Step 1: Use the normal long division bar:

$$\begin{array}{r|l} \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \end{array}$$

Step 2: Divide the first term of the dividend ($2x^3$) by the first term of the divisor ($2x$). What you get is part of the quotient, and it goes above the division bar.

$$\begin{array}{r|l} & x^2 \\ \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \end{array}$$

$$\frac{2x^3}{2x} = x^2$$

Step 3: Multiply the divisor $(2x - 3)$ by that x^2. x^2 times $(2x - 3)$ equals $2x^2 - 3x$. Put the result $(2x^2 - 3x)$ under the first two terms of the dividend. MAKE SURE that the first term of the result goes directly under the first term of the dividend.

$$\begin{array}{r|l} & x^2 \\ \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \\ & 2x^3 - 3x^2 \end{array}$$

Step 4: Subtract the $(2x^2 - 3x^2)$ from the two terms above it in the dividend.

$$\begin{array}{r|l} & x^2 \\ \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \\ & -(2x^3 - 3x^2) \\ \cline{2-2} & \quad\;\; -6x^2 \end{array}$$

Notice what happens here: when the $(2x^3 - 3x^2)$ is subtracted, you're really adding the opposite, which means that you change the signs for each term in $(2x^3 - 3x^2)$. So, you do $2x^3$ minus $2x^3$, and $-9x^2$ plus $3x^2$. The $-3x^2$ became $+3x^2$ because you are subtracting a negative, and adding that $+3x^2$ to the $-9x^2$ then gives you $-6x^2$ on the next line.

Step 5: As you do in regular numerical division, bring the next term from the dividend (+11x) straight down two rows, so that it is next to the result of the subtraction. Now you have the expression "$- 6x^2 +11x$ " which you will use in the next step.

$$\begin{array}{r|l} & x^2 \\ \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \\ & -(2x^3 - 3x^2) \\ \cline{2-2} & \quad\;\; -6x^2 + 11x \end{array}$$

Step 6: This is a repeat of step 2, this time using the $- 6x^2$ as the new first term of the dividend. When you divide $- 6x^2$ by $2x$, you get $-3x$, so that's the number that goes above the division bar as part of the quotient.

$$\begin{array}{r|l} & x^2 - 3x \\ \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \\ & -(2x^3 - 3x^2) \\ \cline{2-2} & \quad\;\; -6x^2 + 11x \end{array}$$

$$\frac{-6x^2}{2x} = -3x$$

Step 7: This is a repeat of step 3, multiplying the divisor $(2x - 3)$ by $-3x$. That results in $-6x^2 + 9x$, which is what you put underneath the $- 6x^2 + 11x$.

$$\begin{array}{r|l} & x^2 - 3x \\ \cline{2-2} 2x - 3 & 2x^3 - 9x^2 + 11x - 3 \\ & -(2x^3 - 3x^2) \\ \cline{2-2} & \quad\;\; -6x^2 + 11x \\ & \quad\;\; -6x^2 + 9x \end{array}$$

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Step 8: This is a repeat of step 4, subtracting the $-6x^2 + 9x$ from the $-6x^2 + 11x$. Just like in step 4, since you're subtracting each term in the expression $-6x^2 + 9x$, you're really adding the opposite, so you add a positive $6x^2$ to the negative $6x^2$ and then you add a negative 9x to the positive 11x. Your answer, positive 2x, you put underneath the 9x.

$$\begin{array}{rl} & x^2 - 3x \\ 2x - 3 \; \big) & \overline{2x^3 - 9x^2 + 11x - 3} \\ & \underline{-(2x^3 - 3x^2)} \\ & \quad -6x^2 + 11x \\ & \;\; \underline{-(-6x^2 + 9x)} \\ & \qquad\qquad 2x \end{array}$$

which you subtract like this: $- \; -6x^2$ and $- \; {}^{+}9x$, which is the same as adding $6x^2$ and ${}^{-}9x$

Step 9: This is a repeat of step 5, bringing the next term of the dividend (– 3) straight down.

$$\begin{array}{rl} & x^2 - 3x \\ 2x - 3 \; \big) & \overline{2x^3 - 9x^2 + 11x - 3} \\ & \underline{-(2x^3 - 3x^2)} \\ & \quad -6x^2 + 11x \\ & \;\; \underline{-(-6x^2 + 9x)\quad} \\ & \qquad\qquad 2x - 3 \end{array}$$

NOTICE at this point that you have just repeated steps 2 through 5. You'll repeat them again, and if this was a longer problem, you could repeat them numerous times. Those four steps are the things you have to understand, memorize, and practice in order to do long division with polynomials anytime, whether it be on the chapter test, the state-mandated standardized test, the end-of-course exam, or if someone just stops you walking on the street and asks you how to do long division with polynomials.

Step 10: Repeat step 2.

$$\begin{array}{rl} & x^2 - 3x + 1 \\ 2x - 3 \; \big) & \overline{2x^3 - 9x^2 + 11x - 3} \\ & \underline{-(2x^3 - 3x^2)} \\ & \quad -6x^2 + 11x \\ & \;\; \underline{-(-6x^2 + 9x)\quad} \\ & \qquad\qquad 2x - 3 \end{array} \qquad \boxed{\frac{2x}{2x} = 1}$$

Step 11: Repeat step 3.

$$\begin{array}{rl} & x^2 - 3x + 1 \\ 2x - 3 \; \big) & \overline{2x^3 - 9x^2 + 11x - 3} \\ & \underline{-(2x^3 - 3x^2)} \\ & \quad -6x^2 + 11x \\ & \;\; \underline{-(-6x^2 + 9x)\quad} \\ & \qquad\qquad 2x - 3 \\ & \qquad\qquad 2x - 3 \end{array}$$

Step 12: Repeat step 4.

$$\begin{array}{rl} & x^2 - 3x + 1 \\ 2x - 3 \; \big) & \overline{2x^3 - 9x^2 + 11x - 3} \\ & \underline{-(2x^3 - 3x^2)} \\ & \quad -6x^2 + 11x \\ & \;\; \underline{-(-6x^2 + 9x)\quad} \\ & \qquad\qquad 2x - 3 \\ & \qquad\quad \underline{-(2x - 3)} \\ & \qquad\qquad\qquad 0 \end{array}$$

Since there is no remainder, you don't have to continue or put the remainder over the divisor (see page 466, example 4, for how to show an answer that has a remainder).

The final answer: $\mathbf{(2x^3 - 9x^2 + 11x - 3) \;\div\; (2x - 3) \;=\; \boxed{x^2 - 3x + 1}}$

Note: you can check it by multiplying the divisor and the quotient, and see if you get the dividend.
$(2x - 3)(x^2 - 3x + 1) = (2x^3 - 9x^2 + 11x - 3)$