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1. Evaluate $27 x^{4}-36 x^{3}-9 x^{2}-33 x+3 \div 3 x-4$

| First I have to set up the division problem, filling in any missing terms with placeholders. | $3 x - 4 \longdiv { 2 7 x ^ { 4 } - 3 6 x ^ { 3 } - 9 x ^ { 2 } - 3 3 x + 3 }$ |
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| 1) Divide: To begin any long division problem, I must divide the first term in the dividend (27x4) by the first term in the divisor (3x). $27 x^{4} / 3 x=9 x^{3}$ <br> $9 x^{3}$ goes on the top as the first term of the quotient. | $3 x - 4 \longdiv { 2 7 x ^ { 4 } - 3 6 x ^ { 3 } - 9 x ^ { 2 } - 3 3 x + 3 }$ |
| 2) Multiply: 1 must multiply $9 x^{3}$ by $3 x-4$, making sure 1 distribute. $9 x^{3}(3 x-4)=27 x^{4}-36 x^{3}$. This goes under the first two terms of the dividend. | $\begin{gathered} 9 x - 4 \longdiv { 2 7 x ^ { 4 } - 3 6 x ^ { 3 } - 9 x ^ { 2 } - 3 3 x + 3 } \\ 27 x^{4}-36 x^{3} \end{gathered}$ |
| 3) Subtract: I must subtract the binomial $27 x^{4}-36 x^{3}$ from the first two terms of the dividend to get $0 x^{3}$ and 1 bring down the next term $\left(-9 x^{2}\right)$. | $\begin{gathered} 9 x^{3} \\ 3 x - 4 \longdiv { 2 7 x ^ { 4 } - 3 6 x ^ { 3 } - 9 x ^ { 2 } - 3 3 + 3 } \\ -\left(27 x^{4}-36 x^{3}\right) \\ 0 x^{3}-9 x^{2} \end{gathered}$ |
| Now I just repeat steps 1, 2, and 3 until I get to the last term: <br> The remainder (-57) becomes the numerator of the fraction with the divisor $(3 x-4)$ as the denominator. | $\begin{gathered} 9 x - 4 \longdiv { 2 7 x ^ { 4 } + 3 x ^ { 2 } - 3 x - 1 5 - \frac { 5 7 } { 3 x - 4 } } \\ \frac{-\left(27 x^{4}-36 x^{3}\right)}{0 x^{3}-9 x^{2}} \\ \frac{-\left(0 x^{3}+0 x^{2}\right)}{-9 x^{2}-33 x+3} \\ \frac{-\left(-9 x^{2}+12 x\right)}{-45 x+3} \\ \frac{-(-45 x+60)}{-57} \end{gathered}$ |

2. Is $3 x-4$ a factor of $27 x^{4}-36 x^{3}-9 x^{2}-33 x+3$ ? How do you know?

No, because whenever the remainder is something other than 0 , it means that the dividend is not divisible by the divisor. When the division leaves me with a remainder of 0,1 know that I have found one of the factors of the polynomíal.

## Additional Practice

1. Evaluate $4 x^{3}-11 x-35 \div 2 x-5$ following the steps below.
a) Before you set up the problem, check to see if you are missing any terms in the dividend. Write the dividend with a placeholder for the missing term(s).
b) On the top of the back of this sheet, set up the long division problem with the $2 x-5$ on the outside and the altered dividend with the placeholder on the inside.
c) Which two terms should you use to begin the division process? $\qquad$ and $\qquad$ Divide these two terms. What did you get? $\qquad$ Write your answer on the top of the division bar.
d) Now multiply the term you just wrote above the long division bar with the divisor: $2 x-5$. What did you get?
$\qquad$ Place the result under the first two terms of the dividend.
e) Now subtract those two terms from the ones above. REMEMBER to subtract BOTH terms. What did you get?
$\qquad$
f) Bring down the next term.
g) Repeat steps c) through f) as many times as necessary.
h) Is there a remainder? What does that mean?
2) Divide $27 x^{3}+1$ by $3 x+1$ using long division.
