

Dividing Polynomials Synthetic division:

$$\div x+2$$

Can only be used to divide by a linear function

steps:

1. Write the terms of the dividend in descending order. Write the coeff. of the dividend in the first row using zeros for any missing terms not found in the dividend.
2. Write the zero, r, of the divisor (x-r), in the box.
3. Drop the 1st coeff. to the last row.
4. Multiply 1st coeff. by r & put product under the 2nd coeff.
5. Add product from #4 to 2nd coeff. & write the sum in the last row.
6. Repeat #4 & #5 until all coeff. have been used.
7. Write answer by putting variables behind the #'s in the last row. Start with 1 degree less than the dividend polynomial.

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$(4x^3 - 3x^2 + 7x + 2) \div (x - \frac{1}{2})$
divisor
 $x - \frac{1}{2} = 0$
 $x = \frac{1}{2}$

Find a. Then write the coefficients and a in the synthetic division format.

Find a =

$$\begin{array}{r|rrrrr} \frac{1}{2} & 4 & 0 & -3 & 7 & 2 \\ \hline & & & & & \end{array}$$

Bring down the first coefficient. Then multiply and add for each column.

$$\begin{array}{r|rrrrr} \frac{1}{2} & 4 & 0 & -3 & 7 & 2 \\ \hline & 4 & 2 & -2 & 6 & 5 \\ \hline & 4 & 2 & -2 & 6 & 5 \end{array}$$

↓ 2 1 -1 3 → remainder

Write the result.
quotient

(divisor)(quotient) + remainder

$$(4x^3 - 3x^2 + 7x + 2) = (x - \frac{1}{2})(4x^3 + 2x^2 - 2x + 6) + 5$$

Check.

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(A) $(7x^3 - 6x + 9) \div (x + 5)$ Linear

$$\begin{array}{r} -5 \overline{) 7 \ 0 \ -6 \ 9} \\ \underline{\downarrow -35 \ 175 \ -845} \\ 7 \ -35 \ 169 \ \boxed{-836} \text{ R} \\ x^2 \quad x \quad \# \end{array}$$

$$7x^3 - 6x + 9 = (x + 5)(7x^2 - 35x + 169) - 836$$

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Your Turn

Given a polynomial $p(x)$, use synthetic division to divide by $x - a$ and obtain the quotient and the (nonzero) remainder. Write the result in the form $p(x) = (x - a)(\text{quotient}) + p(a)$. You may wish to perform a check.

6. $(2x^3 + 5x^2 - x + 7) \div (x - 2)$

$$\begin{array}{r} 2 \overline{) 2 \ 5 \ -1 \ 7} \\ \underline{\downarrow +4 \ 18 \ 34} \\ 2 \ 9 \ 17 \ \boxed{41} \rightarrow \text{R} \\ x^2 \quad x \quad \# \end{array}$$

$$2x^3 + 5x^2 - x + 7 = (x - 2)(2x^2 + 9x + 17) + 41$$