

Exercise 23

For the following exercises, use synthetic division to find the quotient.

$$(4x^3 - 5x^2 + 13) \div (x + 4)$$

Solution

Solving $x + 4 = 0$ gives $x = -4$; this is the number that goes on the top left. Write out all the coefficients of the dividend to the right.

$$\begin{array}{r|rrrr} -4 & 4 & -5 & 0 & 13 \\ \hline & & & & \end{array}$$

Bring down the leading coefficient.

$$\begin{array}{r|rrrr} -4 & 4 & -5 & 0 & 13 \\ \hline & 4 & & & \end{array}$$

Multiply the top left number by the number brought down and put the result under the second coefficient of the dividend.

$$\begin{array}{r|rrrr} -4 & 4 & -5 & 0 & 13 \\ \hline & 4 & -16 & & \end{array}$$

Add the numbers in the second column.

$$\begin{array}{r|rrrr} -4 & 4 & -5 & 0 & 13 \\ \hline & & -16 & & \\ \hline & 4 & -21 & & \end{array}$$

Multiply this sum of the second column by the top left number and put it in the next column.

$$\begin{array}{r|rrrr} -4 & 4 & -5 & 0 & 13 \\ \hline & & -16 & 84 & \\ \hline & 4 & -21 & & \end{array}$$

Add the numbers in the third column.

$$\begin{array}{r|rrrr} -4 & 4 & -5 & 0 & 13 \\ \hline & & -16 & 84 & \\ \hline & 4 & -21 & 84 & \end{array}$$

Multiply this sum of the third column by the top left number and put it in the next column.

$$\begin{array}{r|rrrr}
 -4 & 4 & -5 & 0 & 13 \\
 & & -16 & 84 & -336 \\
 \hline
 & 4 & -21 & 84 &
 \end{array}$$

Add the numbers in the fourth column.

$$\begin{array}{r|rrrr|r}
 -4 & 4 & -5 & 0 & 13 \\
 & & -16 & 84 & -336 \\
 \hline
 & 4 & -21 & 84 & -323
 \end{array}$$

This final result is the remainder, and the numbers to the left are the coefficients of the quotient, which is $4x^2 - 21x + 84$.

$$(4x^3 - 5x^2 + 13) \div (x + 4) = 4x^2 - 21x + 84 + \frac{-323}{x + 4}$$