

Synthetic Division

- Set up the synthetic division. Just like with long division, the divisor (what you are dividing by) goes on the outside of the box. The dividend (what you are dividing into) goes on the inside of the box. However, with synthetic division, you just use numbers (no x 's). Put c for the divisor $x-c$ on the outside of the box – for MTH 122, this value will be a zero from the graph of the dividend. Then write the coefficients of the dividend to the right, across the top. Insert any 0's if there are any missing terms.

For example, if you have the problem $(x^4 - 3x + 5) \div (x - 4)$, the setup would be:

$$\begin{array}{r|rrrrr}
 \text{c of divisor } x - c & & & & & \\
 4 & 1 & 0 & 0 & -3 & 5 \\
 \hline
 & & & & &
 \end{array}$$

- Bring down the leading coefficient to the bottom row.

$$\begin{array}{r|rrrrr}
 4 & 1 & 0 & 0 & -3 & 5 \\
 & \downarrow & & & & \\
 \hline
 & 1 & & & &
 \end{array}$$

- Multiply c by the value written on the bottom row. Place this value beneath the next coefficient in the dividend.

$$\begin{array}{r|rrrrr}
 4 & 1 & 0 & 0 & -3 & 5 \\
 & \swarrow & & & & \\
 & & 4 & & & \\
 \hline
 & 1 & & & &
 \end{array}$$

- Add the column created in the last step. Write the sum in the bottom row.

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

- Repeat until done.

$$\begin{array}{r|rrrrr}
 4 & 1 & 0 & 0 & -3 & 5 \\
 & & 4 & 16 & 64 & 244 \\
 \hline
 & 1 & 4 & 16 & 61 & 249
 \end{array}$$

6. Write out the answer. The numbers in the last row make up the coefficients of the quotient (answer when you divide) as well as the remainder. Working right to left, the last value on the right is the remainder – for MTH 122, the students typically start with a zero from the graph, so this remainder should be 0 if the value you are using is a zero. The number to the left of the remainder is the constant term, the next number to the left is the coefficient for x , the next number to the left is the coefficient for x^2 , etc...

The degree of your answer (the quotient) should be one LESS than the degree. So for our example, the answer is:

$$x^3 + 4x^2 + 16x + 61 + \frac{249}{x - 4}$$