

Synthetic Division

Let's look at how to do this using the example:

$$(5x^4 - 4x^2 + x + 6) \div (x - 2)$$

In order to use synthetic division these two things must happen:

- #1** There must be a coefficient for every possible power of the variable.
- #2** The divisor must have a leading coefficient of 1.

Step #1: Write the terms of the polynomial so the degrees are in descending order.

$$5x^4 + 0x^3 - 4x^2 + x + 6$$

- ✓ Since the dividend does not contain all the powers of x , you must include a 0 for the x^3

Step #2: Write the constant a of the divisor $x - a$ to the left and write down the coefficients.

Since the divisor = $x - 3$, then $a = 3$

$$\begin{array}{rcccccc} & 5x^4 & 0x^3 & -4x^2 & +x & +6 \\ & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ \underline{3} & 5 & 0 & -4 & 1 & 6 \end{array}$$

Step #3: Bring down the first coefficient, 5.

$$\begin{array}{rcccccc} \underline{3} & 5 & 0 & -4 & 1 & 6 \\ & \downarrow & & & & \\ & 5 & & & & \end{array}$$

Step #4: Multiply the first coefficient by a (3×5), so

$$\begin{array}{rcccccc} \underline{3} & 5 & 0 & -4 & 1 & 6 \\ & \downarrow & & & & \\ & 5 & & & & \\ & & \swarrow & & & \\ & & & 15 & & \end{array}$$

Step #5: After multiplying in the diagonals, add the column.

$$\begin{array}{rcccccc} & & \text{Add} \\ & & \text{the} \\ & & \text{column} \\ \underline{3} & 5 & 0 & -4 & 1 & 6 \\ & \downarrow & \downarrow & & & \\ & 5 & 15 & & & \end{array}$$

Step #6: Multiply the sum, 15, by a ; $15 \times 3 = 45$, and place this number under the next coefficient, then add.

$$\begin{array}{r}
 3 \overline{) 5 \quad 0 \quad -4 \quad 1 \quad 6} \\
 \underline{ \quad 15 \quad 45 } \\
 5 \quad 15 \quad 41
 \end{array}$$

Step #7: Repeat the same procedure as step #6.

$$\begin{array}{r}
 3 \overline{) 5 \quad 0 \quad -4 \quad 1 \quad 6} \\
 \underline{ \quad 15 \quad 45 \quad 123 \quad 372} \\
 5 \quad 15 \quad 41 \quad 124 \quad 378
 \end{array}$$

Where did 123 and 372 come from?

Step #8: Write the quotient.

The numbers along the bottom are coefficients of the power of x in descending order, starting with the power that is one less than that of the dividend.

The quotient is:

$$5x^3 + 15x^2 + 41x + 124 + \frac{378}{x - 3}$$



Remember to place the remainder over the divisor.



Try these:

1) $(m^2 - 3m - 7) \div (m + 2)$

2) $(t^3 - 6t^2 + 1) \div (t + 2)$