

5.6 Long & Synthetic Division of Polynomials

Long division of real numbers is a method of determining how many times one number goes into another number and what the remainder would be. For example, we could say that 5 goes into 17 three times with a remainder of 2. That is, $17 = 3 \cdot 5 + 2$.

Example 5.6.1

Find $3983 \div 26$ using long division. Do not give a decimal as an answer.

As we saw in the last section, we can divide polynomials as well. This process works fine when we divide by a *monomial*, but what if we want to divide by any another polynomial instead? We accomplish this using either *polynomial long division* or *polynomial synthetic division*.

Example 5.6.2

Find $\frac{6x + 8x^2 - 12}{2x + 3}$ using long division. Check your work

Example 5.6.3

Find $\frac{x^3 - 1}{x - 1}$ using long division. Check your work.

Example 5.6.4

Find $(2x^4 + 3x^3 - 7x - 10) \div (x^2 - 2x)$ using long division. Check your work.

Synthetic Division

Synthetic division is a method that allows us to divide two polynomials using a less verbose method. It works in a similar manner to long division, but is written out differently. One primary issue with synthetic division is that the divisor **must be written as $x - c$** – it must be linear and the leading coefficient must be one. If your divisor is any other polynomial, you must use the long division method - so practice both!

Example 5.6.5

Find $(x^3 - 7x - 6) \div (x + 2)$ using synthetic division. Check your work.

Example 5.6.6

Find $(x^5 + x^3 - 2) \div (x - 1)$ using synthetic division. Check your work.

Example 5.6.7

Find $\frac{5x^3 - 6x^2 + 3x + 11}{x - 2}$ using synthetic division. Check your work.