



# Polynomial Long Division

## Polynomial Long Division

Polynomial long division, or algebraic division, is a method of dividing large polynomials by smaller polynomials. It is very similar to traditional long division for regular integers.

Recall these terms:

**dividend**, **divisor** and **quotient**

$$\begin{array}{r} 75 \\ 2 \overline{) 150} \end{array}$$

EXAMPLE: Divide  $(x^3 + 6x^2 + 12 + 13x)$  by  $(x + 3)$

**STEP ONE:** Arrange the terms in the dividend and divisor in descending order.

Replace the missing term(s) with 0.

E.g. If  $x^3 + 3x \rightarrow x^3 + 0 + 3x$

$$\begin{array}{l} x^3 + 6x^2 + 12 + 13x \\ \rightarrow x^3 + 6x^2 + 13x + 12 \end{array}$$

**STEP TWO:** Divide the first term of the dividend by the first term of the divisor

$$\begin{array}{r} x^2 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \end{array}$$

**STEP THREE:** Multiply the divisor by the first term of the quotient

$$\begin{array}{r} x^2 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \\ \underline{x^3 + 3x^2} \phantom{+ 13x + 12} \end{array}$$

**STEP FOUR:** Subtract and bring down the next term (as per normal long division)

$$\begin{array}{r} x^2 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \\ \underline{-x^3 + 3x^2} \phantom{+ 13x + 12} \phantom{+ 12} \\ 0 + 3x^2 + 13x \phantom{+ 12} \end{array}$$

**STEP FIVE:** Repeat steps 2 to 4 until you reach a remainder. If the remainder is not zero, it is a fraction over the divisor and is added to the quotient.

$$\begin{array}{r} x^2 + 3x + 4 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \\ \underline{-x^3 + 3x^2} \phantom{+ 13x + 12} \phantom{+ 12} \\ 0 + 3x^2 + 13x \phantom{+ 12} \\ \underline{-3x^2 + 9x} \phantom{+ 12} \\ 0 + 4x + 12 \\ \underline{-4x + 12} \\ 0 \end{array}$$



**Instructions:** Divide the polynomials below.

1

Divide  $x^2 + 3x - 10$  by  $x - 2$



2

Divide  $x^2 - 7x - 18$  by  $x + 2$





3

Divide  $3x^2 - 2x - 1$  by  $x - 1$



4

Divide  $x^3 - 2x^2 - 3x + 10$  by  $x + 2$





5

Divide  $x^3 + 3x^2 - 34x + 24$  by  $x - 4$



6

Divide  $2x^3 + 7x^2 - 5x - 4$  by  $2x + 1$





7

Divide  $3x^3 + 81x - 32x^2 - 28$  by  $x - 7$



8

Divide  $4x^3 + 33 + 10x^2 - 46x$  by  $2x - 3$





9

Divide  $2x^4 - 20 - 6x^2 - 25x + 5x^3$  by  $x^2 - 5$



10

Divide  $12x^3 - 18x + 8x^4 + 15 - 22x^2$  by  $2x^2 - 3$





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**STEP TWO:** Divide the first term of the dividend by the first term of the divisor

$$\begin{array}{r} x^2 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \end{array}$$

**STEP THREE:** Multiply the divisor by the first term of the quotient

$$\begin{array}{r} x^2 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \\ \underline{x^3 + 3x^2} \end{array}$$

**STEP FOUR:** Subtract and bring down the next term (as per normal long division)

$$\begin{array}{r} x^2 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \\ \underline{-x^3 + 3x^2} \quad \downarrow \\ 0 + 3x^2 + 13x \end{array}$$

**STEP FIVE:** Repeat steps 2 to 4 until you reach a remainder. If the remainder is not zero, it is a fraction over the divisor and is added to the quotient.

$$\begin{array}{r} x^2 + 3x + 4 \\ x+3 \overline{) x^3 + 6x^2 + 13x + 12} \\ \underline{-x^3 + 3x^2} \quad \downarrow \\ 0 + 3x^2 + 13x \\ \underline{-3x^2 + 9x} \quad \downarrow \\ 0 + 4x + 12 \\ \underline{-4x + 12} \\ 0 \end{array}$$



**Instructions:** Divide the polynomials below.

1

Divide  $2x^2 + 3x - 35$  by  $x + 5$



2

Divide  $3x^3 - 17x + 4 + 6x$  by  $3x + 1$





3

Divide  $8x^3 + 33x - 18 - 26x^2$  by  $2x - 3$



4

Divide  $37x^2 + 18x^4 + 18 - 32x^3 + 91x$  by  $9x + 2$





5

Divide  $8x^5 + 24x^3 - 18 - 51x^2 - 15x^4$  by  $x^2 + 3$



6

Divide  $40 + 27x^5 + 44x - 18x^4 + 81x^3$  by  $3x^2 - 2x + 5$





7

Divide  $47x^2 + 20 - 60x^3 + 25x^4 - 16x$  by  $5x^2 + x + 2$



8

Divide  $30x^7 + 3x^2 + 18x^3 - 37x^6 - 7x^5$  by  $6x^3 + x^2$





9

Divide  $3x^2 + 17x^5 - 16x^4 + 36x^6 - 6x + 8x^3$  by  $4x^3 + x^2 - 2x$



10

Divide  $8 + 26x^6 + 21x^7 - 14x^4 - 15x^5 - 20x^2 - 6x^3$  by  $7x^4 - 3x^3 - 4$

