

Long Division Steps:

1. Divide the first term of the dividend by the first term of the divisor.
2. Write the result from step 1 in the quotient and use it to multiply the divisor.
3. Subtract the product from the dividend.
4. Repeat steps 1-3 using the difference from step 3 as the new dividend.

Example: Find the quotient. $(x^3 + 3x^2 + 3x + 2) \div (x^2 + x + 1)$

Dividend = $(x^3 + 3x^2 + 3x + 2)$

Divisor = $(x^2 + x + 1)$

$$\begin{array}{r}
 \overline{) x^3 + 3x^2 + 3x + 2} \\
 \underline{-(x^3 + x^2 + x)} \\
 2x^2 + 2x + 2 \\
 \underline{-(2x^2 + 2x + 2)} \\
 0 \leftarrow \text{remainder}
 \end{array}$$

Use long division.

<p>1. $(x^2 + 5x - 14) \div (x - 2)$</p> $ \begin{array}{r} \overline{) x^2 + 5x - 14} \\ \underline{-(x^2 - 2x)} \\ 7x - 14 \\ \underline{-(7x - 14)} \\ 0 \end{array} $	<p>2. $(2x^2 - 17x - 38) \div (2x + 3)$</p> $ \begin{array}{r} \overline{) 2x^2 - 17x - 38} \\ \underline{-(2x^2 + 3x)} \\ -20x - 38 \\ \underline{+(20x + 30)} \\ -8 \end{array} $ <p style="text-align: center;"> $X - 10 \text{ R: } -8$ or $X - 10 - \frac{8}{2x + 3}$ </p>
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$$3. (x^4 - 7x^2 + 9x - 10) \div (x - 2)$$

$$\begin{array}{r}
 x^3 + 2x^2 - 3x + 3 \\
 x-2 \overline{) (x^4 + 0x^3 - 7x^2 + 9x - 10} \\
 \underline{+(x^4 + 2x^3)} \\
 2x^3 - 7x^2 \\
 \underline{+ (-2x^3 + 4x^2)} \\
 -3x^2 + 9x \\
 \underline{+ (+3x^2 - 6x)} \\
 3x - 10 \\
 \underline{+ (-3x + 6)} \\
 -4
 \end{array}$$

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

$$4. (x^3 - x^2 - 21x + 45) \div (x^2 + 2x - 15)$$

$$\begin{array}{r}
 x-3 \\
 x^2+2x-15 \overline{) (x^3 - x^2 - 21x + 45} \\
 \underline{+(x^3 + 2x^2 + 15x)} \\
 -3x^2 - 6x + 45 \\
 \underline{+ (+3x^2 + 6x - 45)} \\
 0
 \end{array}$$

$$x-3$$

no remainder

$$5. (8x^3 + 5x^2 + 12x + 10) \div (x^2 + 3)$$

$$\begin{array}{r}
 8x + 5 \\
 x^2+0x+3 \overline{) (8x^3 + 5x^2 + 12x + 10} \\
 \underline{+(8x^3 + 0x^2 + 24x)} \\
 5x^2 - 12x + 10 \\
 \underline{+ (5x^2 + 0x + 15)} \\
 -12x - 5
 \end{array}$$

$$8x + 5 + \frac{-12x - 5}{x^2 + 3}$$

$$6. (4x^4 + 2x^3 - 9x + 12) \div (x^2 - 2x)$$

$$\begin{array}{r}
 4x^2 + 10x + 20 \\
 x^2-2x+0 \overline{) (4x^4 + 2x^3 + 0x^2 - 9x + 12} \\
 \underline{+(4x^4 + 8x^3 + 0x^2)} \\
 10x^3 + 0x^2 - 9x \\
 \underline{+ (-10x^3 + 20x^2 + 0)} \\
 20x^2 - 9x + 12 \\
 \underline{+ (-20x^2 + 40x + 0)} \\
 31x + 2
 \end{array}$$

$$4x^2 + 10x + 20 + \frac{31x + 2}{x^2 - 2x}$$

Synthetic Division Steps:

1. Write the coefficients of the polynomial and then write the value of r on the left. Write the first coefficient below the line.
2. Multiply the r -value by the number below the line, and write the product below the next coefficient.
3. Write the sum (not the difference) below the line. Multiply r by the number below the line and write the product below the next coefficient.
4. Write the sum (not the difference) below the line. Repeat steps 1-3 as needed.

Note: Synthetic Division can only be used on linear divisors (i.e. in the form $x - r$). If the divisor is in any other form, Long Division must be used.

Use synthetic division.

7. $(x^2 + 5x - 6) \div (x - 1)$

$$\begin{array}{r|rrr} 1 & 1 & 5 & -6 \\ & \downarrow & & \\ \hline & 1 & 6 & 0 \end{array}$$

$$\boxed{x+6}$$

8. $(x^3 + x + 30) \div (x + 3)$

$$\begin{array}{r|rrrr} -3 & 1 & 0 & 1 & 30 \\ & \downarrow & -3 & 9 & -30 \\ \hline & 1 & -3 & 10 & 0 \end{array}$$

$$\boxed{x^2 - 3x + 10}$$

$$9. (2x^4 - 11x^3 + 15x^2 + 6x - 18) \div (x - 3)$$

$$\begin{array}{r} \underline{3} \mid 2 \quad -11 \quad 15 \quad 6 \quad -18 \\ \quad \downarrow \quad 6 \quad -15 \quad 0 \quad 18 \\ \hline 2 \quad -5 \quad 0 \quad 6 \quad \underline{0} \\ \text{R.} \end{array}$$

$$\boxed{2x^3 - 5x^2 + 6}$$

$$10. (x^2 - 2x - 48) \div (x + 5)$$

$$\begin{array}{r} \underline{-5} \mid 1 \quad -2 \quad -48 \\ \quad \downarrow \quad -5 \quad 35 \\ \hline 1 \quad -7 \quad -13 \end{array}$$

~~$x - 9$~~

$$\boxed{x - 7 + \frac{-13}{x+5}}$$

$$11. (x^4 - 7x^2 + 9x - 10) \div (x - 2)$$

$$\begin{array}{r} \underline{2} \mid 1 \quad 0 \quad -7 \quad 9 \quad -10 \\ \quad \downarrow \quad 2 \quad 2 \quad -10 \quad -2 \\ \hline 1 \quad 2 \quad -5 \quad -1 \quad \underline{-12} \end{array}$$

$$\boxed{x^3 + 2x^2 - 5x - 1 + \frac{-12}{x-2}}$$

$$12. (3x^3 - 16x^2 - 103x + 36) \div (x + 4)$$

$$\begin{array}{r} \underline{-4} \mid 3 \quad -16 \quad -103 \quad 36 \\ \quad \downarrow \quad -12 \quad 112 \quad -36 \\ \hline 3 \quad -28 \quad 9 \quad \underline{0} \end{array}$$

$$\boxed{3x^2 - 28x + 9}$$