

## 1.9.1 Dividing Polynomials

Dividing a polynomial by another polynomial is similar to performing a division of numbers using long division. For example, divide the polynomial  $x^3 + 13x^2 + 39x + 46$  by  $x + 9$

**Solution:**

$$1) \begin{array}{r} x^2 \\ x+9 \overline{) x^3 + 13x^2 + 39x + 46} \end{array} \quad \text{first divide } x \text{ into } x^3 \text{ to get } x^2$$


---

$$2) \begin{array}{r} x^2 \\ x+9 \overline{) x^3 + 13x^2 + 39x + 46} \\ \underline{x^3 + 9x^2} \phantom{+ 39x + 46} \\ 4x^2 \phantom{+ 39x + 46} \end{array} \quad \begin{array}{l} \text{now multiply } x^2 \text{ by } x + 9 \text{ to get } x^3 + 9x^2 \\ \text{then subtract } x^3 + 9x^2 \text{ from } x^3 + 13x^2 \text{ to get } 4x^2 \end{array}$$


---

$$3) \begin{array}{r} x^2 + 4x \\ x+9 \overline{) x^3 + 13x^2 + 39x + 46} \\ \underline{x^3 + 9x^2} \phantom{+ 39x + 46} \phantom{\downarrow} \\ 4x^2 + 39x \phantom{+ 46} \end{array} \quad \begin{array}{l} \text{bring down the } + 39x \\ \\ \text{divide } 4x^2 \text{ by } x \text{ to get } 4x \end{array}$$


---

$$4) \begin{array}{r} x^2 + 4x \\ x+9 \overline{) x^3 + 13x^2 + 39x + 46} \\ \underline{x^3 + 9x^2} \phantom{+ 39x + 46} \phantom{\downarrow} \\ 4x^2 + 39x \phantom{+ 46} \\ \underline{4x^2 + 36x} \phantom{+ 46} \\ 3x \phantom{+ 46} \end{array} \quad \begin{array}{l} \text{now multiply } 4x \text{ by } x + 9 \text{ to get } 4x^2 + 36x \\ \text{then subtract } 4x^2 + 36x \text{ from } 4x^2 + 39x \text{ to get } 3x \end{array}$$


---

$$5) \begin{array}{r} x^2 + 4x + 3 \\ x+9 \overline{) x^3 + 13x^2 + 39x + 46} \\ \underline{x^3 + 9x^2} \phantom{+ 39x + 46} \phantom{\downarrow} \phantom{\downarrow} \\ 4x^2 + 39x \phantom{+ 46} \phantom{\downarrow} \\ \underline{4x^2 + 36x} \phantom{+ 46} \phantom{\downarrow} \\ 3x + 46 \phantom{\downarrow} \\ \underline{3x + 27} \\ 19 \end{array} \quad \begin{array}{l} \text{bring down the } + 46 \\ \\ \text{divide } 3x \text{ by } x \text{ to get } 3 \\ \\ \text{multiply } 3 \text{ by } x + 9 \text{ to get } 3x + 27 \end{array}$$

Since the remainder has a lower degree than the divisor, the division is now complete. The result can be written as:

$$x^3 + 13x^2 + 39x + 46 = (x + 9)(x^2 + 4x + 3) + 19$$

**(NOTE: You could check your answer by multiplying out the result.)**

## 1.9.1 Dividing Polynomials (Continued)

Using the previous example, complete the polynomial division questions below:

1.  $x^3 - 5x^2 - x - 10$  by  $x - 2$

2.  $2y^3 + y^2 - 27y - 36$  by  $y + 3$

3.  $y^3 - 28y - 41$  by  $y + 4$

4.  $2x^3 - 3x^2 - 8x - 3$  by  $2x + 1$

[\*note:  $y^3 - 28y - 41 = y^3 + 0y^2 - 28y - 41$ ]

5.  $-6x^3 + 29x^2 + 7x - 13$  by  $2x - 1$

6.  $y^3 + 4y^2 - 3y - 12$  by  $y + 4$