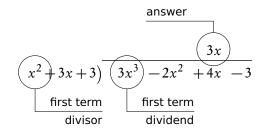## 2.2.4 Polynomial long division

When we need to divide one polynomial by another we use *polynomial long division*. The number to be divided is called the 'dividend'. The number which divides it is called 'divisor'.

Polynomial long division

Divide $3x^3 - 2x^2 + 4x - 3$ by $x^2 + 3x + 3$:

$$\boxed{x^2 + 3x + 3}\overline{\big)\,\boxed{3x^3 \quad -2x^2 \quad +4x \quad -3}}$$

       divisor   dividend

1. Divide the first term of the dividend by the first term of the divisor

answer

$$\overset{\displaystyle \boxed{3x}}{x^2 + 3x + 3 \big)\, 3x^3 \quad -2x^2 \quad +4x \quad -3}$$

first term divisor   first term dividend

2. Multiply the divisor by this answer and subtract this from our dividend

$$\boxed{(x^2 + 3x + 3)} \times \boxed{3x} = 3x^3 + 9x^2 + 9x$$

$$\overset{\displaystyle \boxed{3x}}{x^2 + 3x + 3 \big)\, \begin{array}{llll} 3x^3 & -2x^2 & +4x & -3 \\ -3x^3 & -9x^2 & -9x & \\ \hline & -11x^2 & -5x & -3 \end{array}}$$

3. Divide the result of the substituition by the first term of the divisor. Repeat the process until this is no longer possibile

result $\boxed{3x - 11}$

$$x^2 + 3x + 3 \big)\, \begin{array}{llll} 3x^3 & -2x^2 & +4x & -3 \\ -3x^3 & -9x^2 & -9x & \\ \hline & -11x^2 & -5x & -3 \\ & 11x^2 & +33x & +33 \\ \hline \end{array}$$

remainder $\boxed{28x + 30}$

4. Write the answer:

result $+ \dfrac{\text{remainder}}{\text{divisor}}$

$$3x - 11 + \frac{28x + 30}{x^2 + 3x + 3}$$

B.
ACADEMY