

Modified Long Division

$$\frac{x^2 + 2x + 2}{x + 1} = ax + b + \frac{c}{x + 1} \quad \text{(trial solution)}$$

same denominator

solve for a, b & c

$$\cancel{(x+1)} \left(\frac{x^2 + 2x + 2}{\cancel{x+1}} \right) = \left(ax + b + \frac{c}{x+1} \right) (x+1)$$

$$x^2 + 2x + 2 = ax(x+1) + b(x+1) + c$$

$$\underline{x^2} + \underline{2x} + \underline{2} = \underline{ax^2} + \underline{ax} + \underline{bx} + \underline{b} + \underline{c}$$

$$\underline{x^2}: \quad \cancel{x^2} = a\cancel{x^2} \quad \Rightarrow \quad 1 = a \quad \Rightarrow \quad a = 1$$

$$\underline{x^1}: \quad \cancel{2x} = a\cancel{x} + b\cancel{x} \quad \Rightarrow \quad 2 = a + b \quad \Rightarrow \quad b = 1$$

$$\underline{x^0}: \quad 2 = b + c \quad \Rightarrow \quad 2 = b + c \quad \Rightarrow \quad c = 1$$

↑
use
substitution

so

$$\boxed{\frac{x^2 + 2x + 2}{x + 1} = x + 1 + \frac{1}{x + 1}}$$