

**Dr Oliver Mathematics**  
**Worked Examples**  
**A Function 1**

**From:** AQA Further Mathematics Level 2 (Non-Calculator)

1.

(6)

$$f(x) = \frac{x - 3}{2x}.$$

Solve

$$f(x + 1) - f(2x) = 0.5.$$

You **must** show your working.

**Solution**

Now,

$$\begin{aligned} f(x + 1) &= \frac{(x + 1) - 3}{2(x + 1)} \\ &= \frac{x - 2}{2(x + 1)} \end{aligned}$$

and

$$\begin{aligned} f(2x) &= \frac{(2x) - 3}{2(2x)} \\ &= \frac{2x - 3}{4x}. \end{aligned}$$

Next,

$$f(x + 1) - f(2x) = 0.5 \Rightarrow \frac{x - 2}{2(x + 1)} - \frac{2x - 3}{4x} = \frac{1}{2}$$

$$\text{LCM}[2(x + 1), 4x] = 4x(x + 1)$$

$$\Rightarrow \frac{2x(x - 2) - (2x - 3)(x + 1)}{4x(x + 1)} = \frac{1}{2}$$

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$$\begin{array}{r|rr} \times & 2x & -3 \\ \hline x & 2x^2 & -3x \\ +1 & +2x & -3 \\ \hline \end{array}$$

$$\Rightarrow \frac{(2x^2 - 4x) - (2x^2 - x - 3)}{4x(x + 1)} = \frac{1}{2}$$

$$\Rightarrow \frac{2x^2 - 4x - 2x^2 + x + 3}{4x(x + 1)} = \frac{1}{2}$$

$$\Rightarrow \frac{-3x + 3}{4x(x + 1)} = \frac{1}{2}$$

$$\Rightarrow 2(-3x + 3) = 4x(x + 1)$$

$$\Rightarrow -6x + 6 = 4x^2 + 4x$$

$$\Rightarrow 4x^2 + 10x - 6 = 0$$

$$\Rightarrow 2(2x^2 + 5x - 3) = 0$$

$$\left. \begin{array}{l} \text{add to:} \\ \text{multiply to: } (+2) \times (-3) = -6 \end{array} \right\} \begin{array}{l} +5 \\ -1, +6 \end{array}$$

$$\Rightarrow 2[2x^2 + 6x - x - 3] = 0$$

$$\Rightarrow 2[2x(x + 3) - 1(x + 3)] = 0$$

$$\Rightarrow 2(2x - 1)(x + 3) = 0$$

$$\Rightarrow \underline{\underline{x = \frac{1}{2} \text{ or } x = -3.}}$$

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