4.

$$f(x) = \begin{cases} \dfrac{kx}{x^2 + 6} & \text{for } 0 \leqslant x < 3 \\ \dfrac{k}{x^2 - 4} & \text{for } 3 \leqslant x \end{cases}$$

where k is a positive constant.

The area between the curve $y = f(x)$ and the positive x-axis is $\dfrac{1}{4}$

Show that

$$k = \frac{1}{\ln a}$$

where a is a constant to be determined.

(8)