Question	Scheme	Marks	AOs
4	$\int_0^3 \frac{kx}{x^2+6}\,dx + \int_3^{\infty} \frac{k}{x^2-4}\,dx = \frac{1}{4} \Rightarrow k\left([\ldots]_0^3 + [\ldots]_3^{\infty}\right) = \frac{1}{4} \Rightarrow k = \ldots$	M1	3.1a
	$(k)\int_0^3 \frac{x}{x^2+6}\,dx = (k)\left[\frac{1}{2}\ln\left(x^2+6\right)\right]_0^3 = (k)\left(\frac{1}{2}\ln(15) - \frac{1}{2}\ln(6)\right)$	M1 A1	1.1b 1.1b
	$(k)\int \frac{1}{x^2-4}\,dx = (k)\frac{1}{4}\ln\left(\frac{x-2}{x+2}\right)$	M1	1.1b
	$\int_3^{\infty} \frac{1}{x^2-4}\,dx = \lim_{t\to\infty}\left[\frac{1}{4}\ln\left(\frac{x-2}{x+2}\right)\right]_3^t$ $= \frac{1}{4}\left(\lim_{t\to\infty}\ln\left(\frac{t-2}{t+2}\right) - \ln\left(\frac{1}{5}\right)\right) = \frac{1}{4}\ln 5$	M1 A1	3.1a 1.1b
	So $\frac{k}{2}\ln\left(\frac{15}{6}\right) + \frac{k}{4}\ln 5 = \frac{1}{4} \Rightarrow k\ln\left(\frac{5}{2}\right)^2 + k\ln(5) = 1$ so $k = \frac{1}{\ln\left(\frac{125}{4}\right)}$.	M1 A1	2.1 1.1b
		(8)	
			(8 marks)

Notes:

M1: For a complete overall method. Correct expression for the total area formed, a sum of two areas with an attempt made for both areas in terms of k and with area set equal to $\frac{1}{4}$.

M1: Correct form for integral of left hand part (with or without k) and attempts to apply the limits. Accept $a\ln\left(x^2+6\right)$.

A1: Integral correct, with limits applied correctly. No need to combine lns at this stage.

M1: Correct form integral for the right hand part (with or without k), quoted directly or uses partial fractions. Accept $A\ln\left(\frac{x-2}{x+2}\right)$ or $A\ln(x-2) - B\ln(x+2)$ from an attempt at partial fractions.

M1: Applies the limits on the improper integral, 3 as lower limit and t as upper with $t \to \infty$ to obtain a value for the integral. If partial fractions used, the log terms will need combining first.

A1: Fully correct integral for right hand section, as in scheme or equivalent, with or without k.

M1: Adds the results of both the integrals and equates to $\frac{1}{4}$, including k, and uses correct log laws to combine their log terms to find k.

A1: Correct answer. Accept any equivalents in the correct form, e.g. $\frac{1}{\ln(31.25)}$ or statement that $a = \frac{125}{4}$ etc.