Question			Answer	Marks	AOs		Guidance
10			Curve crosses the x-axis when $y=0$ $y=(k-x)\ln x=0$ Either $k-x=0$ or $\ln x=0$ $x=k$ or 1	**M1** **A1**	**3.1a** **1.1b**	Attempt to solve $y=0$ Both roots required	
			EITHER Area = $\int_1^k (k-x)\ln x \, \mathrm{d}x$ Let $u=\ln x$, $\frac{\mathrm{d}v}{\mathrm{d}x}=k-x$, $\frac{\mathrm{d}u}{\mathrm{d}x}=\frac{1}{x}$, $v=kx-\frac{1}{2}x^2$	**M1**	**2.1**	Using integration by parts with $u=\ln x$, $\frac{\mathrm{d}v}{\mathrm{d}x}=k-x$ clearly argued	
			Area = $\left[\left(kx-\frac{1}{2}x^2\right)\ln x\right]_1^k-\int_1^k \frac{1}{x}\left(kx-\frac{1}{2}x^2\right)\mathrm{d}x$	**A1**	**1.1b**	Allow without limits	
			$\left[\left(kx-\frac{1}{2}x^2\right)\ln x\right]_1^k-\int_1^k \left(k-\frac{1}{2}x\right)\mathrm{d}x$	**M1**	**3.1a**	Simplifying the integrand	
			$\left[\left(kx-\frac{1}{2}x^2\right)\ln x-\left(kx-\frac{1}{4}x^2\right)\right]_1^k$	**A1**	**1.1b**	Second part correct	
			$\left(\left(k^2-\frac{1}{2}k^2\right)\ln k-\left(k^2-\frac{1}{4}k^2\right)\right)-\left(\left(k-\frac{1}{2}\right)\ln 1-\left(k-\frac{1}{4}\right)\right)$	**M1dep**	**1.1a**	Using limits. Dependendent on M mark for integration by parts	
			$=\frac{1}{2}k^2\ln k-\frac{3}{4}k^2+k-\frac{1}{4}$	**A1** **[8]**	**1.1b**	Cao	

Question			Answer	Marks	AOs		Guidance
10			OR Integral split into two separate integrals $\int_1^k k\ln x \, dx$				
			Let $u = \ln x, \quad \frac{dv}{dx} = k, \quad \frac{du}{dx} = \frac{1}{x}, \quad v = kx$	**M1**		Using integration by parts with $u = \ln x, \quad \frac{dv}{dx} = k$ or $u = \ln x, \quad \frac{dv}{dx} = \pm x$ clearly argued	
			$= \left[kx\ln x\right]_1^k - \int_1^k \frac{1}{x} kx \, dx$	**M1**		Simplifying the integrand	
			$\left[kx\ln x\right]_1^k - \int_1^k k \, dx = \left[kx\ln x - kx\right]_1^k$ $\left(k^2\ln k - k^2\right) - \left(k\ln 1 - k\right) = k^2\ln k - k^2 + k$ And Area = $\int_1^k x\ln x \, dx$ Let $u = \ln x, \quad \frac{dv}{dx} = x, \quad \frac{du}{dx} = \frac{1}{x}, \quad v = \frac{1}{2}x^2$	**M1dep**		Substituition of limits seen in at least one integral. Dependendent on M mark for integration by parts	
			$= \left[\frac{1}{2}x^2\ln x\right]_1^k - \int_1^k \frac{1}{x} \times \frac{1}{2}x^2 dx$ $\left[\frac{1}{2}x^2\ln x\right]_1^k - \int_1^k \frac{1}{2}x \, dx$	**A1**		Both integrals correct at this stage Allow without limits	
			$\left[\frac{1}{2}x^2\ln x - \frac{1}{4}x^2\right]_1^k$ $\left(\frac{1}{2}k^2\ln k - \frac{1}{4}k^2\right) - \left(\frac{1}{2}\ln 1 - \frac{1}{4}\right) = \frac{1}{2}k^2\ln k - \frac{1}{4}k^2 + \frac{1}{4}$ Area $= \left(k^2\ln k - k^2 + k\right) - \left(\frac{1}{2}k^2\ln k - \frac{1}{4}k^2 + \frac{1}{4}\right)$	**A1**		Both integrals fully correct Allow without limits	
			$= \frac{1}{2}k^2\ln k - \frac{3}{4}k^2 + k - \frac{1}{4}$	**A1**		Cao	