Question			Answer	Marks	AO		Guidance
11	**(a)**		$\int 1.\ln(x-4)\mathrm{d}x$ so $u = \ln(x-4)$ and $v' = 1$	**M1**	**1.1a**	Attempt integration by parts, with correct parts	u and v' correctly allocated and correct formula used M0 if $v = x-4$ from $v' = 1$
			$x\ln|x-4| - \int \dfrac{x}{x-4}\mathrm{d}x$	**A1**	**1.1**	Correct expression	Allow brackets not modulus Allow $x \times \dfrac{1}{x-4}$, even if subsequently spoilt
			$\int \dfrac{x}{x-4}\mathrm{d}x = \int 1 + \dfrac{4}{x-4}\mathrm{d}x$	**M1**	**3.1a**	Attempt to deal with improper fraction	Allow sign error ie $1 - \dfrac{4}{x-4}$ Could use substitution of $u = x-4$ but must get as far as a proper fraction (ie $1 \pm 4u^{-1}$) Do not need to actually integrate for M1
			$= x + 4\ln|x-4|$	**A1**	**1.1**	Correct integration of fraction	Allow brackets not modulus Using a substitution gives $x - 4 + 4\ln|x-4|$; must be in terms of x and not u for A1
			$\int \ln(x-4)\mathrm{d}x$ $= x\ln|x-4| - x - 4\ln|x-4| + c$ $= (x-4)\ln|x-4| - x + c$ **A.G.**	**A1**	**2.4**	Show given answer with no errors seen	Modulus required in final answer, as well as $+ c$ Can go from penultimate line in MS to given answer with no further detail needed Answer from using substitution will need to justify changing c eg $c + 4$ is a constant hence c' is also a constant
				[5]			**NB** differentiating given answer is 0/5

Question			Answer	Marks	AO		Guidance
							OR
							B1 – use substitution of $v = x - 4$, with $\dfrac{\mathrm{d}v}{\mathrm{d}x} = 1$ seen, to obtain $\int \ln v \, \mathrm{d}v$
							if B0 as it is not explicit then next 4 marks are still available
							M1 – attempt integration by parts on $\int \ln v \, \mathrm{d}v$, using correct parts and correct formula
							A1 – obtain $v \ln|v| - v$ (allow no modulus)
							A1 – obtain $(x-4)\ln|x-4| - (x-4)$
							A1 – obtain given answer, including modulus sign, and with justification for their c becoming c'
	(b)		State $x = 4$	**B1** **[1]**	**2.2a**		Must be an equation
	(c)		$\left\lvert \displaystyle\int_{5}^{7} \ln(x-4)\mathrm{d}x \right\rvert + \left\lvert \displaystyle\int_{4.5}^{5} \ln(x-4)\mathrm{d}x \right\rvert$	**M1**	**3.1a**	Attempt sum of absolute areas	Or integral $\displaystyle\int_{5}^{7} \ln(x-4)\mathrm{d}x - \int_{4.5}^{5} \ln(x-4)\mathrm{d}x$
			$(3\ln 3 - 2) + (\tfrac{1}{2}\ln\tfrac{1}{2} + \tfrac{1}{2})$	**A1**	**1.1**	Correct expression for area	Any unsimplified equiv
			$3\ln3 - 2 - \tfrac{1}{2}\ln 2 + \tfrac{1}{2}$	**M1**	**3.1a**	Attempt to rearrange to required form	Use $\ln\tfrac{1}{2} = -\ln 2$ and gather like terms Could follow M0 Allow M1 (implied) for 3ln3 + 0.5ln2 – 2.5, even if –0.5ln0.5 not seen first
			$3\ln3 - \tfrac{1}{2}\ln 2 - \tfrac{3}{2}$	**A1**	**1.1**	Obtain $3\ln3 - \tfrac{1}{2}\ln 2 - \tfrac{3}{2}$	Or $3\ln3 - 0.5\ln 2 - 1.5$