Q	Marking instructions	AO	Marks	Typical solution
11	Equates $\left(x^2-8x\right)\ln x$ to zero **PI** by 1 or 8 or $\pm 108.(2\ldots)$ May be seen on diagram or integral	3.1a	M1	$\left(x^2-8x\right)\ln x=0$ $x\left(x-8\right)\ln x=0$ $x=8, \ln x=0 \Rightarrow x=1$ $\int_1^8 \left(x^2-8x\right)\ln x \, \mathrm{d}x$
	Obtains at least one of $x=1$ or $x=8$ **PI** by $\pm 108.(2\ldots)$ May be seen on diagram or integral	1.1b	A1	$u=\ln x \qquad u'=\dfrac{1}{x}$ $v'=x^2-8x \qquad v=\dfrac{x^3}{3}-4x^2$
	Deduces the limits are 1 **and** 8 **PI** by $\pm 108.(2\ldots)$ May be seen on integral or substituted into their integrated expression	2.2a	R1	$\left(\dfrac{x^3}{3}-4x^2\right)\ln x-\int\left(\dfrac{x^3}{3}-4x^2\right)\dfrac{1}{x}\mathrm{d}x$ $=\left(\dfrac{x^3}{3}-4x^2\right)\ln x-\left(\dfrac{x^3}{9}-2x^2\right)$
	States $u=\ln x$ and $v'=x^2-8x$ Condone $v=\ln x$ and $u'=x^2-8x$	3.1a	M1	$\int_1^8 \left(x^2-8x\right)\ln x \, \mathrm{d}x$
	Finds $u'=\dfrac{1}{x}$ and $v=\dfrac{x^3}{3}-4x^2$	3.1a	A1	$=\left[\left(\dfrac{8^3}{3}-4\times 8^2\right)\ln 8-\left(\dfrac{8^3}{9}-2\times 8^2\right)\right]$
	Applies integration by parts formula correctly by substituting their u, u' *and* v **PI** by $\left(\dfrac{x^3}{3}-4x^2\right)\ln x-\left(\dfrac{x^3}{9}-2x^2\right)$ or $-\left(\dfrac{x^3}{3}+4x^2\right)\ln x+\left(\dfrac{x^3}{9}-2x^2\right)$ Condone missing brackets	1.1a	M1	$-\left[\left(\dfrac{1^3}{3}-4\times 1^2\right)\ln 1-\left(\dfrac{1^3}{9}-2\times 1^2\right)\right]$ $=-\dfrac{256}{3}\ln 8+\dfrac{640}{9}-\dfrac{17}{9}$ $=\dfrac{623}{9}-256\ln 2$
	Obtains $\left(\dfrac{x^3}{3}-4x^2\right)\ln x-\left(\dfrac{x^3}{9}-2x^2\right)$ **OE** or $-\left(\dfrac{x^3}{3}+4x^2\right)\ln x+\left(\dfrac{x^3}{9}-2x^2\right)$ **OE**	1.1b	A1	$\therefore$ Area $=-\dfrac{623}{9}+256\ln 2$

	Substitutes their non-zero limits correctly into their integrated expression (the subtraction does not need to be seen) or obtains exact values for their integrated expression using their non-zero limits eg $-\frac{256}{3}\ln 8+\frac{640}{9}$ and $\frac{17}{9}$	1.1a	M1	
	Obtains $\frac{623}{9}-256\ln 2$ or $\frac{623}{9}-\frac{256}{3}\ln 8$ **ACF** must be exact form with two terms **PI** $-\frac{623}{9}+256\ln 2$	1.1b	A1	
	Completes a reasoned argument to obtain $-\frac{623}{9}+256\ln 2$ To be awarded R1, all marks must be scored	2.1	R1	
	Question 11 Total		**10**	