Q	Marking instructions	AO	Marks	Typical solution
14	If log rule applied to start with, give first two marks for integration by parts applied to $x^3 \ln x$ and ignore $x^3 \ln 2$ term. Begins integration by parts by writing $u = \ln 2x \qquad v' = x^3$ $u' = \dfrac{P}{x} \qquad v = Qx^4$ PI by $Qx^4 \ln 2x - \int \dfrac{P}{x} \times Qx^4 \, \mathrm{d}x$ Or $u = x^3 \qquad v' = \ln 2x$ $u' = Rx^2 \qquad v = \mathrm{f}(x) \neq \ln 2x$	3.1a	M1	$u = \ln 2x \qquad v' = x^3$ $u' = \dfrac{1}{x} \qquad v = \dfrac{x^4}{4}$ $\left[\dfrac{x^4}{4}\ln 2x\right]_{\frac{1}{2}}^{2} - \int_{\frac{1}{2}}^{2} \dfrac{1}{x}\dfrac{x^4}{4}\mathrm{d}x$ $= \left[\dfrac{x^4}{4}\ln 2x - \dfrac{x^4}{16}\right]_{\frac{1}{2}}^{2}$ $= \left(\dfrac{2^4}{4}\ln 4 - 1\right) - \left(\dfrac{\left(\frac{1}{2}\right)^4}{4}\ln 1 - \dfrac{\left(\frac{1}{2}\right)^4}{16}\right)$ $= \left(4\ln 2^2 - 1\right) - \left(-\dfrac{1}{256}\right)$ $= 8\ln 2 - \dfrac{255}{256}$
	Substitutes their u, u', v, v' of either of the above forms into the integration by parts formula eg $Qx^4 \ln 2x - \int \dfrac{P}{x} \times Qx^4 \, \mathrm{d}x$ $x^3 \mathrm{f}(x) - \int Rx^2 \mathrm{f}(x) \, \mathrm{d}x$ PI by $\dfrac{x^4}{4} \ln 2x - \dfrac{x^4}{16}$ OE	1.1a	M1	
	Obtains $\dfrac{x^4}{4} \ln 2x - \int \dfrac{1}{x}\dfrac{x^4}{4} \, \mathrm{d}x$ Condone missing $\mathrm{d}x$ PI by $\dfrac{x^4}{4} \ln 2x - \dfrac{x^4}{16}$	1.1b	A1	
	Completes integration by parts to obtain $\dfrac{x^4}{4} \ln 2x - \dfrac{PQx^4}{4}$	1.1a	M1	
	Substitutes correct limits into $\dfrac{x^4}{4} \ln 2x - Kx^4$ and subtracts condone poor bracketing.	1.1a	M1	
	Completes reasoned argument to obtain $8\ln 2 - \dfrac{255}{256}$ With at least one line of substituted values before final answer.	2.1	R1	
	Question 14 Total		**6**	