

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 $u = \ln 2x \quad v' = x^3$ $u' = \frac{P}{x} \quad v = Qx^4$ PI by $Qx^4 \ln 2x - \int \frac{P}{x} \times Qx^4 \, dx$ Or $u = x^3 \quad v' = \ln 2x$ $u' = Rx^2 \quad v = f(x) \neq \ln 2x$	3.1a	M1	$u = \ln 2x \quad v' = x^3$ $u' = \frac{1}{x} \quad v = \frac{x^4}{4}$ $\left[\frac{x^4}{4} \ln 2x \right]_{\frac{1}{2}}^2 - \int_{\frac{1}{2}}^2 \frac{1}{x} \frac{x^4}{4} \, dx$ $= \left[\frac{x^4}{4} \ln 2x - \frac{x^4}{16} \right]_{\frac{1}{2}}^2$ $= \left(\frac{2^4}{4} \ln 4 - 1 \right) - \left(\frac{\left(\frac{1}{2} \right)^4}{4} \ln 1 - \frac{\left(\frac{1}{2} \right)^4}{16} \right)$ $= (4 \ln 2^2 - 1) - \left(-\frac{1}{256} \right)$ $= 8 \ln 2 - \frac{255}{256}$
	Substitutes their u, u', v, v' of either of the above forms into the integration by parts formula eg $Qx^4 \ln 2x - \int \frac{P}{x} \times Qx^4 \, dx$ $x^3 f(x) - \int Rx^2 f(x) \, dx$ PI by $\frac{x^4}{4} \ln 2x - \frac{x^4}{16} \text{ OE}$	1.1a	M1	
	Obtains $\frac{x^4}{4} \ln 2x - \int \frac{1}{x} \frac{x^4}{4} \, dx$ Condone missing dx PI by $\frac{x^4}{4} \ln 2x - \frac{x^4}{16}$	1.1b	A1	
	Completes integration by parts to obtain $\frac{x^4}{4} \ln 2x - \frac{PQx^4}{4}$	1.1a	M1	
	Substitutes correct limits into $\frac{x^4}{4} \ln 2x - Kx^4$ and subtracts condone poor bracketing.	1.1a	M1	
	Completes reasoned argument to obtain $8 \ln 2 - \frac{255}{256}$ With at least one line of substituted values before final answer.	2.1	R1	
	Question 14 Total		6	