- a correct statement or reason in the correct place that indicates a contradiction has been reached. For example, 'numbers are ≥ 0 when squared' or 'but $(3a-2b)^2 \geq 0$' o.e.

  If the intermediate form $\frac{(3a-2b)^2}{ab}$ is reached there must be some statement about

  ab being >0 and $(3a-2b)^2 \geq 0$ (Note that stating > 0 would be incorrect)
- a correct conclusion such as 'hence $\frac{9a}{b}+\frac{4b}{a} \geq 12$' 'hence contradiction, so proven' if the inequality is restated you can condone the omission of *a* and *b* being positive

Simply stating $(3a-2b)^2 \geq 0$ without any words like 'but' is insufficient. Stating 'proven' without stating a reason such as there is a 'contradiction' is also insufficient
A minimal acceptable proof would be;

Assume there are positive numbers *a* and *b* such that $\frac{9a}{b}+\frac{4b}{a} < 12$

$9a^2+4b^2 < 12ab \Rightarrow 9a^2-12ab+4b^2 < 0 \Rightarrow (3a-2b)^2 < 0$

As $(3a-2b)^2 \geq 0$, we have a contradiction. Hence proven

Question Number	Scheme	Marks
2	$\int \frac{\ln x}{x^2}\mathrm{d}x = \int x^{-2}\ln x\,\mathrm{d}x = \frac{x^{-1}}{-1}\ln x - \int \frac{x^{-1}}{-1}\times\frac{1}{x}\,\mathrm{d}x$ $= \frac{x^{-1}}{-1}\ln x + \int x^{-2}\,\mathrm{d}x$ $= \frac{x^{-1}}{-1}\ln x + \frac{x^{-1}}{-1}(+c)$ $\int_1^{\mathrm{e}} \frac{\ln x}{x^2}\mathrm{d}x = \left[\frac{-1}{x}\ln x - \frac{1}{x}\right]_1^{\mathrm{e}} = \left(\frac{-1}{\mathrm{e}}\ln \mathrm{e} - \frac{1}{\mathrm{e}}\right) - \left(\frac{-1}{1}\ln 1 - \frac{1}{1}\right)$ $= 1 - \frac{2}{\mathrm{e}}$	M1A1 dM1A1 ddM1 A1 **(6)**

M1: An application of integration by parts the right way around.
If the rule is quoted it must be correct. (A version appears in the formula booklet)

Accept as evidence $\int x^{-2}\ln x\,\mathrm{d}x = \pm Ax^{-1}\ln x \pm B\int x^{-1}\times\frac{1}{x}\,\mathrm{d}x$ o.e.

A1: Accept a correct un-simplified application $= \frac{x^{-1}}{-1}\ln x - \int \frac{x^{-1}}{-1}\times\frac{1}{x}\,\mathrm{d}x$ o.e

dM1: Dependent upon having scored the previous M mark.
It is for reaching a form $\pm Ax^{-1}\ln x \pm Bx^{-1}$ o.e

A1: A completely correct integral.

For students who substitute in limits look for $= \left(\frac{\mathrm{e}^{-1}}{-1}\ln \mathrm{e}\right) - \left(\frac{1^{-1}}{-1}\ln 1\right) + \left[\frac{x^{-1}}{-1}\right]_1^{\mathrm{e}}$

ddM1: Dependent upon both previous M's.
It is awarded for

- achieving an integral of the form $\pm Ax^{-1}\ln x \pm Bx^{-1}$
- substituting in limits and subtracting either way around
- using both $\ln \mathrm{e} = 1$ & ln1 = 0 and achieving an expression of the form $a + \frac{b}{\mathrm{e}}$ which may be un-simplified. Note that an intermediate expression of $-\frac{1}{\mathrm{e}} + 1 + \frac{1}{\mathrm{e}}$ (which may be implied) leading to 1 is fine for this mark

A1 : cso and cao $= 1 - \frac{2}{\mathrm{e}}$ or $-\frac{2}{\mathrm{e}} + 1$ Condone $1 + -\frac{2}{\mathrm{e}}$ but $1 - \frac{2}{\mathrm{e}} + c$ is A0

Note that you may see attempts at the integration via D & I methods. These are essentially the same as via the main method. So still expect to see variations on $-\frac{1}{x}\ln x+\int\frac{1}{x^2}\,\mathrm{d}x$ for the M1, A1.

All stages of working must be seen (bold sentences), so there is an expectation that the intermediate step is seen.

If $\int\frac{\ln x}{x^2}\mathrm{d}x==\frac{-1}{x}\ln x-\frac{1}{x}(+c)$ appears without any justification score this 1,0,1, 0 followed by potentially 1,0