Question Number	Scheme	Marks
1 (a)	$nax = \pm 4x$ OR $\frac{n(n-1)(ax)^2}{2} = \frac{24}{5}x^2$	M1
	$na = -4$ AND $\frac{n(n-1)a^2}{2} = \frac{24}{5}$	A1
	Sub $a = \frac{-4}{n} \Rightarrow \frac{n(n-1)16}{2n^2} = \frac{24}{5} \Rightarrow 80(n-1) = 48n \Rightarrow n = ...$	dM1, A1, A1
	$a = -\frac{8}{5}, n = \frac{5}{2}$	**(5)**
(b)	$p = \frac{"\frac{5}{2}"\left("\frac{5}{2}"-1\right)\left("\frac{5}{2}"-2\right)\times\left("-\frac{8}{5}"\right)^3}{6} = -\frac{32}{25}$	M1, A1
		(2)
(c)	Allow $\lvert x\rvert < \frac{5}{8}$ OR $\lvert x\rvert$„ $\frac{5}{8}$ or equivalents such as $-\frac{5}{8} < x < \frac{5}{8}$	B1ft
		(1)
		(8 marks)

(a)

M1: For $nax = \pm 4x$ OR $\frac{n(n-1)(ax)^2}{2} = \pm\frac{24}{5}x^2$ which may be implied. Condone missing brackets.

Allow the method mark to be scored for

- non-simplified versions such as $\binom{n}{1}ax = \pm 4x$ or ${}^nC_2(ax)^2 == \frac{24}{5}x^2$
- simplified versions (with x's cancelled) such as $na = -4$ or $\frac{n(n-1)a^2}{2} = \frac{24}{5}$

A1: Correct equations not involving x's (and not in combination notation form)

Scored for both $na = -4$ AND $\frac{n(n-1)a^2}{2} = \frac{24}{5}$ o.e.

dM1: Solves two equations of the correct form and proceeds to find a value for either a or n.

Expect to see the following

- 'simplified' initial equations of the form $na = \pm 4$ and $\frac{n(n-1)a^2}{2} = \pm\frac{24}{5}$
- a simplified intermediate equation in a single variable. Look, for example, for equations of the form $80(n-1) = 48n$ or $-2(-4-a) = \frac{24}{5}$ that are easily solvable. Condone slips
- followed by a value for either a or n.

A1: Either $a = -\frac{8}{5}$ or $n = \frac{5}{2}$ following two correct equations which may be in an un-simplified form

Allow equivalent fractions or decimals

A1: Both $a=-\frac{8}{5}$ and $n=\frac{5}{2}$ following correct equations **AND** following the award of all previous marks. Allow equivalent fractions or decimals

(b) The M1 can be awarded from a made up $n \notin \mathrm{N}$ and a. For example, they may say let $n=\frac{1}{2}, a=6$

M1: Attempts $\frac{n(n-1)(n-2)}{3!}\times a^3\left(x^3\right)$ with their values for a and n with or without the x^3

Condone ${}^nC_3(ax)^3=...x^3$ provided the value produced implies correct processing

A1: $-\frac{32}{25}$ o.e which must be seen without the x^3

(c)

B1ft: $|x|<\frac{5}{8}$, $|x|$,, $\frac{5}{8}$ or equivalents such as $-\frac{5}{8}<x<\frac{5}{8}$ but follow through on their a. E.g. $|x|<\frac{1}{a}$

If they haven't got a value for a they can score this for $|x|<\frac{1}{a}$. If they have a value for a it must be used.

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Note the demand is to show working and not rely on calculator technology

Solutions that don't show an intermediate equation in a single variable score as follows. If unsure please use review

Scenario I: Writes down two correct simplified initial equations and then correct values for a and n, but no simplified intermediate equation

E.g.I $na=-4$ AND $\frac{n(n-1)a^2}{2}=\frac{24}{5}\Rightarrow a=-\frac{8}{5}, n=\frac{5}{2}$

Score 1,1,0,1,0. All marks in (b) and (c) are available

E.g.II $na=-4$ AND $\frac{n(n-1)a^2}{2}=\frac{24}{5}\Rightarrow \frac{-\frac{4}{a}\left(-\frac{4}{a}-1\right)a^2}{2}=\frac{24}{5}\Rightarrow a=-\frac{8}{5}, n=\frac{5}{2}$

Score 1,1,0,1,0. All marks in (b) and (c) are available

Scenario II: Writes down one or two correct un-simplified initial equations and then correct values for a and n

E.g. $na=-4$ AND ${}^nC_2(ax)^2==\frac{24}{5}x^2\Rightarrow a=-\frac{8}{5}, n=\frac{5}{2}$

Score 1,0,0,1,0. All marks in (b) and (c) are available

Scenario III: Writes down one or two correct un-simplified initial equations and then a correct value for just n

E.g. $na=4$ AND ${}^nC_2(ax)^2==\frac{24}{5}x^2\Rightarrow a=\frac{8}{5}, n=\frac{5}{2}$

Score 1,0,0,1,0. As the value of a is incorrect, then only the M mark in (b) is available

Scenario IV: Only writes down one correct equation and then uses trial and improvement methods to find/show correct values for a and n

E.g. $na=-4$ and then follows with trials including $a=-\frac{8}{5}, n=\frac{5}{2}$ and shows $\frac{\frac{5}{2}\times\frac{3}{2}}{2}\times\left(-\frac{8}{5}\right)^2=\frac{24}{5}$

Score 1,0,0,1,0. All marks in (b) and (c) are available

Question Number	Scheme	Marks
2	$\int x^3 \ln\left(\frac{1}{2}x\right) \mathrm{d}x = \frac{1}{4}x^4 \ln\left(\frac{1}{2}x\right) - \int \frac{1}{4}x^4 \times \frac{1}{x} \mathrm{d}x$ $= \frac{1}{4}x^4 \ln\left(\frac{1}{2}x\right) - \frac{1}{16}x^4 (+c)$ $\left[\frac{1}{4}x^4 \ln\left(\frac{1}{2}x\right) - \frac{1}{16}x^4\right]_2^{2\mathrm{e}^2} = \left(\frac{16\mathrm{e}^8}{4}\ln \mathrm{e}^2 - \frac{16\mathrm{e}^8}{16}\right) - \left(\frac{16}{4}\ln 1 - \frac{16}{16}\right)$ $= 7\mathrm{e}^8 + 1$	M1 dM1 A1 ddM1 A1 **(5 marks)**

Condone missing dx's throughout

M1: Attempts to integrate by parts the correct way around.

Look for $\int x^3 \ln\left(\frac{1}{2}x\right) \mathrm{d}x = ax^4 \ln\left(\frac{1}{2}x\right) \pm \int bx^4 \times \frac{1}{x} \mathrm{d}x$ o.e. such as $ax^4 \ln\left(\frac{1}{2}x\right) \pm \int bx^3 \mathrm{d}x$ with $a > 0$

dM1: And then integrates again to a form $px^4 \ln\left(\frac{1}{2}x\right) - qx^4$ where p and q are **positive constants**.

A1: Correct simplified or un-simplified integration. $\frac{1}{4}x^4 \ln\left(\frac{1}{2}x\right) - \frac{1}{16}x^4$ with or without the bracket

ddM1: Attempts to substitute in both limits and subtract either way around, condoning slips. It is dependent upon having an integral of the correct form. To score this mark

- Look for integration that leads to the form $px^4 \ln\left(\frac{1}{2}x\right) \pm qx^4$ where p and q are **positive constants**
- Substitution of both limits and an attempt to subtract either way around
- Correct calculation of both $\ln\left(\frac{1}{2} \times 2\mathrm{e}^2\right) = 2$ and $\ln\left(\frac{1}{2} \times 2\right) = 0$ which may be implied

A1: $7\mathrm{e}^8 + 1$ which must be in simplest form

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Note: You may see D and I methods attempted. For the first three marks score M1, dM1 for integration to the form $px^4 \ln\left(\frac{1}{2}x\right) - qx^4$ where p and q are **positive constants.**

You may see something like this;

D	I
$\ln\left(\frac{1}{2}x\right)$	x^3
$\frac{1}{x}$	$\frac{x^4}{4}$

You could also see methods involving substitution in which the marks are scored as in the main scheme.

E.g. Let $u = \frac{x}{2}$ then $\int_2^{2\mathrm{e}^2} x^3 \ln\left(\frac{1}{2}x\right) \mathrm{d}x = \int_1^{\mathrm{e}^2} 16x^3 \ln u \, \mathrm{d}u = \left[4u^4 \ln u - u^4\right]_1^{\mathrm{e}^2} = 7\mathrm{e}^8 + 1$

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