Question Number	Scheme	Marks
3. (a)	$\left(1+\frac{x}{4}\right)^{12} = 1+12\left(\frac{x}{4}\right)^{1}+\frac{12\times11}{2}\left(\frac{x}{4}\right)^{2}+\frac{12\times11\times10}{3!}\left(\frac{x}{4}\right)^{3}+\ldots$	M1
	$=1+3x,+\frac{33}{8}x^{2}+\frac{55}{16}x^{3}$	B1, A1
		(3)
(b)	$\left(\frac{x^2+8}{x^5}\right)\left(1+\frac{x}{4}\right)^{12} =$	
	Sight of a term independent of x = "$\frac{55}{16}$" or $8\times{}^{12}C_5\left(\frac{1}{4}\right)^5\left(=\frac{99}{16}\right)$	B1ft,
	"$\frac{55}{16}$" $+8\times{}^{12}C_5\left(\frac{1}{4}\right)^5 = \frac{55}{16}+\frac{99}{16}=\frac{77}{8}$	M1 A1
		(3) **(6 marks)**

(a)

M1 For an attempt at the binomial expansion. Score for a correct attempt at term 3 or 4.

Accept sight of ${}^{12}C_2\left(\frac{x}{4}\right)^2$ or ${}^{12}C_3\left(\frac{x}{4}\right)^3$ condoning the omission of brackets. Accept any relevant coefficient appearing from Pascal's triangle. FYI ${}^{12}C_2 = 66$, ${}^{12}C_3 = 220$

B1 For $1+3x$ Must be simplified. Also allow $1,3x$ if written as a list.

A1 For $+\frac{33}{8}x^2+\frac{55}{16}x^3$ Accept $+4.125x^2+3.4375x^3$

(All four terms do not need to be written as a summation and may be written as a list).

(b)

B1ft Sight of "$\frac{55}{16}$" or $8\times{}^{12}C_5\left(\frac{1}{4}\right)^5\left(=\frac{99}{16}\right)$ which must be independent of x

Most candidates do not find the additional term in the expansion of $\left(1+\frac{x}{4}\right)^{12}$ so typically would only score a maximum of 100 in (b)

M1 For attempting to add their "$\frac{55}{16}$" to $8\times{}^{12}C_5\left(\frac{1}{4}\right)^5$ or $8\times792\left(\frac{1}{4}\right)^5$

A1 For $\frac{77}{8}$ oe eg 9.625

Question Number	Scheme	Marks
4 (a)	-35	B1 **(1)**
(b)	Attempts $f\left(\pm\frac{2}{3}\right)=0 \rightarrow \left(\frac{2}{3}-3\right)\left(3\left(\frac{2}{3}\right)^2+\left(\frac{2}{3}\right)+a\right)-35=0$	M1
	$-\frac{7}{3}(2+a)=35 \Rightarrow a=-17$ *	A1* **(2)**
(c)	$f(x)=(x-3)(3x^2+x-17)-35=3x^3-8x^2-20x+16$	B1
	$=(3x-2)(x^2-2x-8)$	M1 A1
	$=(3x-2)(x+2)(x-4)$	M1 A1 **(5)** **(8 marks)**

(a)

B1 -35 stated

(b)

M1 Attempts to set $f\left(\pm\frac{2}{3}\right)=0$. Must see $\pm\frac{2}{3}$ substituted into the expression and set equal to zero.
Condone bracket errors for this mark. They may multiply out the expression before substituting so allow errors in the manipulation for this mark. (FYI $3x^3+x^2+ax-9x^2-3x-3a$)
"=0" may be implied by their working.

A1* Achieves the given answer with no incorrect work (including brackets) and at least one correct intermediate line before proceeding to $a=-17$. "=0" must be seen somewhere for this mark.
Eg. $-\frac{7}{3}(2+a)=35 \Rightarrow a=-17$

……

Alt (b)

M1 Assumes $a=-17$ and attempts $f\left(\pm\frac{2}{3}\right)=0$ where $f(x)=(x-3)(3x^2+x-17)-35$

A1* Achieves $f\left(\frac{2}{3}\right)=0$ with no incorrect work, at least one correct intermediate line and states hence proven or some other acknowledgement of the "proof".

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