Question Number	Scheme	Marks
3 (a)	$2\tan\theta + 3\sin\theta = 0$ States or uses $\tan\theta = \dfrac{\sin\theta}{\cos\theta} \rightarrow 2\dfrac{\sin\theta}{\cos\theta} + 3\sin\theta = 0$ $\sin\theta\left(2 + 3\cos\theta\right) = 0$ $2 + 3\cos\theta = 0$ $\cos\theta = -\dfrac{2}{3} \Rightarrow \theta =$ awrt $132°$ or awrt $228°$ $\cos\theta = -\dfrac{2}{3} \Rightarrow \theta =$ awrt $131.8°$ and awrt $228.2°$ $\sin\theta = 0 \Rightarrow \theta = 180°, 360°$	M1 dM1 A1 A1 B1 **(5)**
(b)	Sets $2x + 40° =$ their $131.8° \Rightarrow x = ...$ $x =$ awrt $45.9°$	M1 A1 **(2)** **(7 marks)**

(a) Condone a lack of a degrees symbol throughout.

Condone solutions that drop θ's in parts of the working

M1: States $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$ or attempts to use $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$ in the given equation. Condone slips in coefficients.

dM1: Attempts to use $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$ o.e., cross multiplies and either factorises or cancels to form a linear equation in $\cos\theta$

A1: Achieves $\cos\theta = -\dfrac{2}{3}$ and finds one correct θ value to the nearest degree.

Condone radian solutions for this mark so allow awrt 2.3(0) or awrt 3.98 following $\cos\theta = -\dfrac{2}{3}$

A1: Achieves $\cos\theta = -\dfrac{2}{3}$ and finds both θ values in degrees correct to one dp.

Any extra values in the range (for $\cos\theta = -\dfrac{2}{3}$) is A0

B1: Achieves $\sin\theta = 0$ followed by $\theta = 180°, 360°$ Condone 0 appearing as a solution

(b) Condone a lack of a degrees symbol

M1: Sets $2x + 40° =$ their $131.8°$ and proceeds to a value for x.

Look for correct order of operations so $2x + 40° = "131.8°" \Rightarrow x = \dfrac{"131.8°" \pm 40°}{2}$

There may be multiple attempts, which can be ignored for this mark

Follow through on their smallest value (must be greater than $40°$), from part (a)

A1: $x =$ awrt $45.9°$ following a correct equation. Do not accept multiple solutions here

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Note that there are many parallel solutions in part (a) that can be marked similarly.

Alt I

Using $\sin\theta = \tan\theta\cos\theta$ o.e

$2\tan\theta + 3\tan\theta\cos\theta = 0 \Rightarrow \tan\theta\left(2+3\cos\theta\right) = 0$

In this case the B1 mark is for achieving $\tan\theta = 0 \Rightarrow \theta = 180°, 360°$ Condone 0 appearing as a solution.

Alt II

Multiplying throughout by $\sin\theta$ and using $\sin^2\theta + \cos^2\theta = 1$ eventually leads to a cubic $\cos\theta$ which has roots of $\cos\theta = -\frac{2}{3}$ and $\cos\theta = 1$. Allow use of a calculator to solve cubic equations, etc.

$$2\frac{\sin\theta}{\cos\theta} + 3\sin\theta = 0 \overset{\times\sin\theta}{\rightarrow} 2\frac{\sin^2\theta}{\cos\theta} + 3\sin^2\theta = 0 \rightarrow 2\frac{\left(1-\cos^2\theta\right)}{\cos\theta} + 3\left(1-\cos^2\theta\right) = 0$$

$$\rightarrow 3\cos^3\theta + 2\cos^2\theta - 3\cos\theta - 2 = 0 \rightarrow \cos\theta = -\frac{2}{3}, \cos\theta = \pm 1$$

M1: For $\tan\theta = \frac{\sin\theta}{\cos\theta}$

dM1: for $\cos\theta = k$, $|k| < 1, k \neq 0$

A1: For $\cos\theta = -\frac{2}{3}$ and a solution as in the main scheme

A1: : For $\cos\theta = -\frac{2}{3}$ and both solutions as in the main scheme

B1 Achieves $\cos\theta = \pm 1$ followed by $\theta = 180°, 360°$. Condone 0 appearing as a solution

Alt III

Multiplying throughout by $\cos\theta$ and using $\sin^2\theta + \cos^2\theta = 1$ eventually leads to a quartic in $\sin\theta$ which has roots $\sin\theta = \pm\frac{\sqrt{5}}{3}$ and $\sin\theta = 0$

$$2\sin\theta = -3\sin\theta\cos\theta \overset{SQUARING}{\rightarrow} 4\sin^2\theta = 9\sin^2\theta\cos^2\theta$$

$$\rightarrow 4\sin^2\theta = 9\sin^2\theta\left(1-\sin^2\theta\right) \rightarrow 9\sin^4\theta - 5\sin^2\theta = 0$$

$$\rightarrow \sin^2\theta = \frac{5}{9}, \sin\theta = 0$$

M1: For $\tan\theta = \frac{\sin\theta}{\cos\theta}$

dM1: For $\sin^2\theta = k$ or $\sin\theta = k$, $|k| < 1, k \neq 0$

A1: For $\sin\theta = \frac{\sqrt{5}}{3}$, $\sin\theta = -\frac{\sqrt{5}}{3}$ or $\sin^2\theta = \frac{5}{9}$ and a correct solution as in the main scheme

A1: For $\sin\theta = \frac{\sqrt{5}}{3}$, $\sin\theta = -\frac{\sqrt{5}}{3}$ or $\sin^2\theta = \frac{5}{9}$ and both solutions (only) in the main scheme

B1: Achieves $\sin\theta = 0$ followed by $\theta = 180°, 360°$ Condone 0 appearing as a solution

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The solution must be obtained from correct working.

Calculator solutions like $2\tan\theta + 3\sin\theta = 0 \Rightarrow \theta = 131.8°$ and $228.2°$ score no marks in (a)

Even the solution $\theta = 180°, 360°$ cannot score the B1 mark if it is not preceded by $\sin\theta = 0$ or $\tan\theta = 0$

(b) is hence or otherwise so must follow their solution in (a) or be a restart.

Question Number	Scheme	Marks
	$\mathrm{f}(x)=4x^3+ax^2-29x+b$	
4.(a)	Sets $\mathrm{f}\left(-\frac{1}{2}\right)=0\rightarrow\ 4\times\left(-\frac{1}{2}\right)^3+a\times\left(-\frac{1}{2}\right)^2-29\times\left(-\frac{1}{2}\right)+b=0$	M1
	$\Rightarrow \frac{1}{4}a+b+14=0\Rightarrow\ a+4b=-56$ *	A1*
		(2)
(b)	Sets $\mathrm{f}(2)=-25\rightarrow\ 4\times2^3+a\times2^2-29\times2+b=-25$	M1
	$4a+b=1$	A1
		(2)
(c)	(i) Solves $a+4b=-56$ with their $4a+b=1\Rightarrow a=...,b=...$	M1
	$a=4,b=-15$	A1
	(ii) $4x^3+4x^2-29x-15=(2x+1)\left(2x^2+x-15\right)$	M1, A1
	$=(2x+1)(2x-5)(x+3)$ cso	A1
		(5)
		(9 marks)

(a)

M1: Attempts to set $\mathrm{f}\left(-\frac{1}{2}\right)=0\rightarrow$ equation in a and b Condone slips (e.g. on signs) but $\mathrm{f}\left(\frac{1}{2}\right)=0$ is M0.

Score when you see embedded values within the equation or two correct terms on the lhs of the equation.

A1*: Completes proof with at least one intermediate simplified and correct line such as $\frac{1}{4}a+b+14=0$. Simplifying each term is sufficient $-\frac{1}{2}+\frac{1}{4}a+\frac{29}{2}+b=0$. Any incorrect lines written after the start of their 'proof' should be scored A0*

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Solutions where the = 0 is implied but not stated should be awarded M1 A0*

E.g. $\mathrm{f}\left(-\frac{1}{2}\right)=4\times\left(-\frac{1}{2}\right)^3+a\times\left(-\frac{1}{2}\right)^2-29\times\left(-\frac{1}{2}\right)+b=\frac{1}{4}a+b+14$. So $\frac{1}{4}a+b=-14\Rightarrow a+4b=-56$

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(b)

M1: Attempts to set $\mathrm{f}(2)=-25\rightarrow$ equation in a and b Condone slips, e.g sign slips or setting $\mathrm{f}(2)=25$

Setting $\mathrm{f}(-2)=-25$ is not a slip and should be marked M0.

A1: $4a+b=1$ or other simplified equivalent such as $a+\frac{1}{4}b-\frac{1}{4}=0$. The constant terms must be collected.

Note that this is not a given answer so allow recovery.

(c)(i)

M1: Attempts to solve $a+4b=-56$ (allowing for slips) with their $4a+b=1\Rightarrow a=...,b=...$

Award as long as values appear for both a and b, so allow these just written down (say from a calculator) There is no need their calculations

A1: Both values correct: $a=4,b=-15$. Both just written down without working scores M1 A1 provided (b) is correct