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

(c)(ii)

M1: Attempt to divide or factorise out $(2x+1)$ from their $4x^3+4x^2-29x-15$ or multiple thereof

For factorisation look for correct first and last terms E.g. $4x^3+"a"x^2-29x+"b"=(2x+1)\left(2x^2+kx\pm"b"\right)$

For division look for a quadratic quotient of the form $2x^2+px+q$ with some "correct" work to find the term in x for example. Condone sign slip when attempting to find p

A1: Correct quadratic factor $2x^2+x-15$

A1: cso $(2x+1)(2x-5)(x+3)$. Note that M1, A1 must have been awarded and the full product must be seen. It is not acceptable to see just the factors

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The question states "Hence" so there is an expectation that they use the factor of $(2x+1)$ which is given.

Solutions that just state $4x^3+4x^2-29x-15=(2x+1)(2x-5)(x+3)$ score M0 and therefore A0 A0

If they wish to start with another factor they must prove it is a factor first.

E.g. $f(-3)=4\times-27+4\times9-29\times-3-15=0\Rightarrow(x+3)$ is a factor followed by division by $(x+3)$

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Tabular or methods of division may be seen in (a) and (b). The question does not demand use of the factor or remainder theorem so these methods should be rewarded.

The M1 would be scored for a full attempt and A1 for a correct answer or proof.

If you cannot see what they are doing and find it hard to award, then put in review please

Example of a tabular version for (a):

$(2x+1)$ is a factor of $f(x)=4x^3+ax^2-29x+b$

	$2x^2$	$(-29-2b)x$	b
$2x$	$4x^3$	$2(-29-2b)x^2$	$2bx$
1	$2x^2$	$(-29-2b)x$	b

Then states that $2(-29-2b)+2=a\Rightarrow$

Example of a long division method for (b).

When $f(x)=4x^3+ax^2-29x+b$ is divided by $(x-2)$ the remainder is -25

$$
\begin{array}{r}
4x^2+(a+8)x+(2a-13) \\
x-2\overline{)\,4x^3+ax^2-29x+b} \\
\underline{4x^3-8x^2} \\
(a+8)x^2-29x \\
\underline{(a+8)x^2-(2a+16)x} \\
(2a-13)x+b \\
\underline{(2a-13)x+(-4a+26)} \\
b+4a-26
\end{array}
$$

Remainder is -25 so $b+4a-26=-25\Rightarrow b+4a=1$

Question Number	Scheme	Marks
5. (i)	$3^a = 70 \Rightarrow a\log 3 = \log 70$	M1
	$\Rightarrow a = \dfrac{\log 70}{\log 3} = 3.867$	A1
		(2)
(ii)	$4 = \log_3 81$ or $3\log_3 b = \log_3 b^3$ or $\log_3 5b = \log_3 5 + \log_3 b$	B1
	$4 + 3\log_3 b = \log_3 5b \Rightarrow \log_3 81b^3 = \log_3 5b$	M1
	$\Rightarrow 81b^3 = 5b \Rightarrow b = ...$	dM1
	$\Rightarrow b = \sqrt{\dfrac{5}{81}}$	A1
		(4)
		(6 marks)

This question demands working from the candidates so answers cannot appear without appropriate methods

(i)

M1: Takes (the same) log of both sides and uses the power law.

Alternatively writes $a = \log_3 70$ with the correct base. But $a = \log 70$ is M0

A1: CSO. 3.867 following a suitable intermediate line. This is not awrt but isw after sight of 3.867

Cannot be achieved via Trial and Improvement

(ii) Note that this was marked **M1 A1 dM1 A1**. It is now being marked **B1 M1 dM1 A1**

B1: One correct log law used on a term **of the initial equation**.

Can be achieved without the bases being present

Look for $4 = \log_3 81$ or $3\log_3 b = \log_3 b^3$ or $\log_3 5b = \log_3 5 + \log_3 b$

M1: Correctly combines two terms **of the initial equation** to form a log equation of the correct form

$\log_3 ... = \log_3 ...$ or $\log_3 ... = \pm 4$.

Possible answers are; $\log_3 81b^3 = \log_3 5b$, $\log_3 81b^2 = \log_3 5$, $\log_3\left(\dfrac{b^3}{5b}\right) = -4$

For this mark you can condone a slip on the sign of the 4.

E.g. $4 + 3\log_3 b = \log_3 5b \Rightarrow \log_3 b^3 - \log_3 5b = 4 \Rightarrow \log_3 \dfrac{b^3}{5b} = 4$

dM1: Removes the logs correctly and proceeds to a value for b using a correct method.

Must follow M1 and an equation of the form $\log_3 ... = \log_3 ...$ or $\log_3 ... = \pm 4$

A1: $b = \sqrt{\dfrac{5}{81}}$ or exact equivalent such as $b = \dfrac{1}{9}\sqrt{5}$. The negative (and 0) solution, if found, must be discarded.

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Correct answer from incorrect working: Watch for solutions like the following

$$4 + 3\log_3 b = \log_3 5b \Rightarrow 4 = \log_3 5b - \log_3 b^3 \Rightarrow 4 = \frac{\log_3 5b}{\log_b b^3} \Rightarrow 81 = \frac{5b}{b^3} \Rightarrow b = \sqrt{\frac{5}{81}}$$

Score B1 M0 dM0 A0

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