Question	Scheme	Marks
4(i)	E.g. try [f (2) = −8, f (3) = 8, f (4) = 64] f (5) = ...	**M1**
	So, a counterexample is f (5) = 175	**A1**
	Since $5^3 = 125 < 175 < 216 = 6^3$ so f (5) cannot be a perfect cube.	**A1**
		(3)
(ii)	$(x+1)^2 - 6x + 4 = x^2 + 2x + 1 - 6x + 4$	**M1**
	$x^2 - 4x + 5 = (x-2)^2 - 4 + 5$	**M1**
	$(x-2)^2 + 1 > 0$ since $(x-2)^2 \geqslant 0$ for all x, hence $(x+1)^2 > 6x - 4$ *	**A1***
		(3)
		(6 marks)

(i)

M1: Shows evidence of searching for a counter example, e.g. attempts to use a positive integer greater than 1 in the expression. Note n = 1,2,3,4 all give perfect cubes, but this mark may be scored for the evidence of trying n = 2, 3 or 4 even if they think one is not a cube. Alternatively, attempting any greater integer is fine. If their answer is correct e.g. f (3) = 8, this is sufficient, but if it is incorrect you will need evidence such as sight of the 3 being substituted into f(n) condoning slips

n	f(n)	f(n)^(1/3)
2.00	-8.00	-2.00
3.00	8.00	2.00
4.00	64.00	4.00
5.00	175.00	5.59
6.00	356.00	7.09
7.00	622.00	8.54
8.00	988.00	9.96
9.00	1469.00	11.37
10.00	2080.00	12.77
11.00	2836.00	14.15

A1: For the correct result for a suitable counterexample.

A1: Demonstrates/shows that their example fails. They are likely to do this by taking the cube root of their value and showing it is not an integer. All work should be correct, values to at least 1 d.p. with a minimal conclusion. A brief solution for 3 marks would be f (6) = 356 and $\sqrt[3]{356} \approx 7.1$ so statement is not true

(ii)

M1: Gathers terms on one side and expands the brackets. May be done as part of steps with inequalities (using equivalences or not).

M1: Attempts to complete the square on the gathered quadratic. (See general principles)

A1*: Completes the proof with correct work, reason and conclusion given.

This requires all of

- $x^2 - 4x + 5 \equiv (x-2)^2 + 1$
- A reason for $(x-2)^2 + 1 > 0$ such as $(x-2)^2 \geqslant 0$
- A conclusion that refers back to the given statement

Example I: Scores M1, M1, A0 as it lacks both a reason and a reference back to the given statement

$(x+1)^2 > 6x - 4 \Rightarrow x^2 + 2x + 1 - 6x + 4 > 0 \Rightarrow x^2 - 4x + 5 > 0 \Rightarrow (x-2)^2 + 1 > 0$ which is true.

Example II: Scores M1, M1, A0 as the reason is incorrect. It does refer back due to use of $\Leftrightarrow$

$(x+1)^2 > 6x - 4 \Leftrightarrow x^2 + 2x + 1 - 6x + 4 > 0 \Leftrightarrow x^2 - 4x + 5 > 0 \Leftrightarrow (x-2)^2 + 1 > 0$ which is true as $(x-2)^2 > 0$.

Example III: Scores M1, M1, A1

$(x-2)^2+1>0 \Rightarrow x^2-4x+5>0 \Rightarrow x^2+2x+1-6x+4>0 \Rightarrow x^2+2x+1>6x-4 \Rightarrow (x+1)^2>6x-4$

Other methods are possible once the candidates reach the gathered quadratic.

Alternative I

Using their x^2-4x+5 which must be a 3TQ

M1: Attempts BOTH $b^2-4ac=16-20=...$ AND shape of graph 'U shaped (may be a sketch)'

Alternatively, they could attempt $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}=\dfrac{4\pm\sqrt{-4}}{2}$ AND shape of graph 'U shaped

A1: Concludes that

- $b^2-4ac=16-20=-4<0$ there are no roots
- curve $y=x^2-4x+5$ is always **above** the x-axis (which may be from a sketch)
- $x^2-4x+5>0 \Rightarrow (x+1)^2>6x-4$

Alternative II

Using their x^2-4x+5 which must be a 3TQ

M1: Attempts BOTH $\dfrac{\mathrm{d}y}{\mathrm{d}x}=2x-4=0$ AND shape of graph 'U shaped (may be a sketch)'

A1: Concludes that

- there is a minimum at $(2,1)$
- curve $y=x^2-4x+5$ is always above the x-axis
- $x^2-4x+5>0 \Rightarrow (x+1)^2>6x-4$

Alternative III

M1: Candidates can attempt this part using **BOTH** $x=2n$ and $x=2n+1$ but must make progress

with both aspects as far as the main scheme with the terms on one side of the 'equation'

E.g. with $x=2n$ a correct intermediate stage would be $4n^2-8n+5=4(n-1)^2+1$

with $x=2n+1$ a correct intermediate stage would be $4n^2-4n+2=4\left(n-\dfrac{1}{2}\right)^2+1$

If you see candidates who adopt this approach, make sufficient progress and you are not sure how to award then please send to review

Question	Scheme	Marks
5(a)	$h = 0.6$	**B1**
	$\text{Area} \approx \frac{0.6}{2}\{1.5 + 2(0.48 + 0.30 + 0.26 + 0.26 + 0.30 + 0.48) + 1.5\}$	**M1**
	$0.3 \times 7.16\left(\frac{0.3 \times 179}{25}\right) = 2.15\left(\text{m}^2\right)$	**A1**
		(3)
(b)	Total side area $= 0.9 \times 1.5 \times 2 + \text{'2.148'} = (4.848..)$	**M1**
	$\text{Volume} \approx 2.5 \times \text{'4.848'}$	**dM1**
	$12.1\left(\text{m}^3\right)$	**A1**
		(3)
(c)	Overestimate with valid reason, e.g. area of trapezia are bigger than cross sectional area.	**B1**
		(1)
		(7 marks)

(a)

B1: Correct value for h stated or used. The mark may be implied by $0.3 \times \{\}$ or $\frac{0.6}{2}\{....\}$

M1: Correct attempt at the trapezium rule with their value for h.

Look for $\frac{h}{2}\{1.5 + 1.5 + 2(0.48 + 0.30 + 0.26 + 0.26 + 0.30 + 0.48)\}$ o.e.

Allow the M1 if one of the middle values is missing or miscopied e.g. 0.84 for 0.48 but the overall shape of the formula must be correct. Condone a missing trailing bracket

If they write $\frac{0.6}{2}(1.5 + 1.5) + 2 \times (0.48 + 0.30 + 0.26 + 0.26 + 0.30 + 0.48)$ it is M0 unless followed by the correct answer.

May see $\frac{\text{"0.6"}}{2}\{3 + 4(0.48 + 0.30 + 0.26)\}$ if they realise the symmetry, or calculations involving individual trapezia.

A1: Correct answer, accept awrt 2.15. Units are not required. You may see $\frac{537}{250}$ which is fine