Question Number	Scheme	Marks
1(a)	$h = 1.25$	B1
	$A \approx \frac{1}{2} \times 1.25\left\{3.479 + 5.182 + 2\left(6.101 + 7.448 + 6.823\right)\right\}$	M1
	= 30.9	A1
		(3)
(b)	$\int_{0.5}^{5.5} \left(\mathrm{f}\left(x\right) + 4x\right) \mathrm{d}x = 30.9 + \left[2x^2\right]_{0.5}^{5.5} = 30.9 + 2 \times 5.5^2 - 2 \times 0.5^2$ **or** $\int_{0.5}^{5.5} \left(\mathrm{f}\left(x\right) + 4x\right) \mathrm{d}x = \int_{0.5}^{5.5} \mathrm{f}\left(x\right) \mathrm{d}x + \frac{1}{2}\left(4 \times 0.5 + 4 \times 5.5\right) \times 5 = \ldots$	M1
	= 30.9 + 60 = 90.9	A1ft
		(2)
		Total 5

(a)

B1: Correct strip width of 1.25. Allow equivalent numerical expressions e.g. $\frac{5.5-0.5}{4}$.

May be implied by sight of e.g. $\frac{1.25}{2}$ or $\frac{5}{8}$ or 0.625 in front of the bracket. May also be implied by a correct answer if no incorrect working seen. $h = -1.25$ is B0 unless they recover and subsequently use $h = +1.25$

M1: Correct application of the trapezium rule with their h (which may be 1).

This requires a correct inner bracket structure $3.479 + 5.182 + 2\left(6.101 + 7.448 + 6.823\right)$ multiplied by $\frac{1}{2}h$. Condone slips copying values from the table or the omission of the final bracket on the rhs e.g. $\frac{1}{2} \times "1.25"(3.479 + 5.182 + 2(6.101 + 7.448 + 6.823)$ is M1

but $\frac{1}{2} \times "1.25" \times 3.479 + 5.182 + 2\left(6.101 + 7.448 + 6.823\right)$ is M0 unless the missing brackets are recovered or implied by the correct answer (you may need to check).

Also allow for a correct method adding individual trapezia using their h condoning copying errors but the brackets must be correct (or recovered or implied by later work)

e.g. $\frac{1}{2} \times "1.25"(3.479 + 6.101) + \frac{1}{2} \times "1.25"(6.101 + 7.448) + \frac{1}{2} \times "1.25"(7.448 + 6.823) + \frac{1}{2} \times "1.25"(6.823 + 5.182)$

A1: For awrt 30.9. isw once a correct answer is seen. Correct answer with no working scores B1M1A1 but if there is evidence of using $h = -1.25$ then maximum awarded is B0M1A0. The A mark cannot be awarded without both B1M1 being awarded in this question. The exact answer is $\frac{9881}{320}$ and scores A0 unless followed by awrt 30.9

For reference, note that use of h = 1 (from using 5 strips) gives 24.7… or $\frac{9881}{400}$

(a) $\int_{0.5}^{5.5} 1.25\,(3.479 + 6.101 + 7.448 + 6.823 + 5.182) = 36.3$ Scores B1M0A0 (BOD)

(b)

M1: Attempts their answer to (a) + $\left[...x^2\right]_{0.5}^{5.5}$ = their answer to $(a)+...5.5^2-...0.5^2$

May be implied by e.g. their answer to $(a)+2\times5.5^2-2\times0.5^2$ if the integration is not seen explicitly.

Or

their answer to (a) $+\frac{1}{2}(4\times0.5+4\times5.5)\times5$ (trapezium)

oe e.g. their answer to (a) $+(4\times0.5\times5)+\frac{1}{2}(5\times(5\times5.5-5\times0.5))$ (rectangle + triangle)

May be implied by their answer to (a) + 60

Condone clear misreads of the 4 in the 4*x* but do not condone a misread of e.g. 4*x* for 4.

Condone clear mis-copy/mis-read of limits as long as they are non-zero E.g. 5 for 5.5.

Condone poor notation e.g. $\int_{0.5}^{5.5}(f(x)+4x)\,dx=30.9+\int_{0.5}^{5.5}2x^2\,dx=30.9+2\times5.5^2-2\times0.5^2$

A1ft: Correct answer of awrt 90.9 or correct ft e.g. 60 + their answer to part (a)

Allow exact or exact ft answers e.g. $\frac{29081}{320}$ for 90.9

Correct answer **only** scores no marks as the questions says "making your method clear"

Attempts to use the trapezium rule again by adding 4*x* to the *y* values score M0 in (b)

Note that $30.9+4(0.5+1.75+3+4.25+5.5)=90.9$ is fortuitous and scores M0

But $30.9+\frac{1}{2}\times\frac{5}{4}(2+22+2(7+12+17))=90.9$ scores M1A1

Condone an error with the strip width as in part (a) for this method but the ft is not available in this case.

<u>Examples of minimal acceptable working in (b) for both marks:</u>

30.9 + 60 = 90.9

$30.9+\left[2x^2\right]_{0.5}^{5.5}=90.9$

$\int_{0.5}^{5.5}f(x)\,dx+\int_{0.5}^{5.5}4x\,dx=30.9+60=90.9$

$30.9+2\times5.5^2-2\times0.5^2=90.9$

All score M1A1

Question Number	Scheme	Marks
2(a)	$u_1 = 7 \Rightarrow u_2 = k - 7$	B1
	$u_2 = k-7 \Rightarrow u_3 = k+k-7 \Rightarrow u_4 = k-(2k-7)$ $u_5 = k+(-k+7) = 7*$	M1A1*
		(3)
(b)	$\sum_{r=1}^{4} u_r = 30 \Rightarrow 7+k-7+2k-7-k+7 = 30 \Rightarrow k = ...$	M1
	$k = 15$	A1cso
		(2)
(c)	$\sum_{r=1}^{150} u_r = 37 \times 30 + 7 + "15" - 7$	M1
	$= 1125$	A1cso
		(2)
		Total 7

General Guidance

Note that it is possible to obtain correct answers in all parts of this question fortuitously. The A marks should only be awarded following correct work.

(a)

B1: Correct expression for u_2 e.g. $k-7$ with no incorrect work seen e.g.

$u_2 = (-1)^7 \times 7 + k = -7 + k$ scores B0. Must be seen in part (a).

Allow e.g. $u_2 = (-1)^1 \times 7 + k$ or e.g. $u_2 = (-1) \times 7 + k$ or e.g. $u_2 = -1 \times 7 + k$

M1: Attempts to use the recurrence formula **to reach the 5th term** but condone **consistent** use of $(n + 1)$ for n on the $(-1)^n$ term so e.g. $u_2 = (-1)^2 \times 7 + k$ is condoned but e.g. $u_2 = (-1)^7 \times 7 + k$ is M0

Allow even if any slips mean their sequence is not of order 4.

A1*: Obtains $u_5 = 7$ with no errors or omissions. The "$u_5 =$" must appear at some point but allow e.g. "$u_{4+1} =$"

For reference the terms are: $u_1 = 7,\ u_2 = k-7,\ u_3 = 2k-7,\ u_4 = 7-k,\ u_5 = 7$

(a) Alternatives:

1 $u_2 = -u_1 + k,\ u_3 = -u_1 + 2k,\ u_4 = u_1 - k,\ u_5 = u_1 = 7$

B1: Implied by $u_2 = -u_1 + k$

M1: Attempts to use the recurrence formula **to reach the 5th term** but condone use of $(n + 1)$ for n on the $(-1)^n$ term as above

A1*: Fully correct work to reach $u_5 = 7$

(Allow the above approach to be used with a made up k or a wrong k as the result is independent of k)

2 $u_5 = 7 \Rightarrow u_4 = 7-k \Rightarrow u_3 = 2k-7 \Rightarrow u_2 = k-7 \Rightarrow u_1 = 7$ Hence true.

B1: $u_4 = 7 - k$

M1: Attempts to use the recurrence formula correctly backwards **to reach the 1st term** but condone use of $(n + 1)$ for n on the $(-1)^n$ term as above.

A1*: Fully correct work to reach $u_1 = 7$ with a (minimal) conclusion.