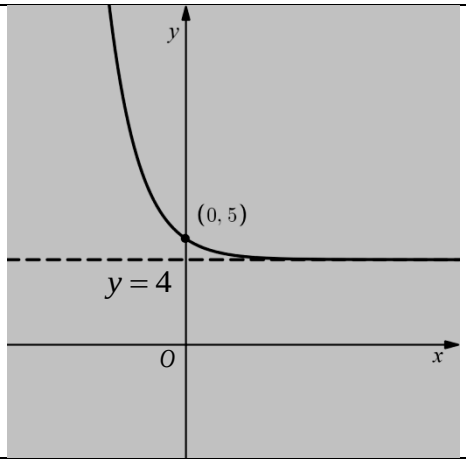
| Question Number | Scheme | Marks |
|---|---|---|
| **4(a)** |  Correct shape<br>Correct intercept<br>Correct equation for asymptote | B1<br>B1<br>B1 |
| | | **(3)** |
| **(b)** | Strip width = 2.5 | B1 |
| | $\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}+4\right)\mathrm{d}x \approx \frac{5}{4}\left\{13+4.009+2\times(6.280+4.577+4.146+4.037)\right\}$<br>$=68.86125\left(=\text{awrt } 69\right)$ | M1 A1 |
| | | **(3)** |
| **(c)** | (i) $\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}\right)\mathrm{d}x = 69-4\times\left(8.5--4\right)=\text{awrt } 19$ | M1, A1ft |
| | (ii) $\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}+4\right)\mathrm{d}x + \int_{-8.5}^{4}\left(3^{\frac{1}{2}x}+4\right)\mathrm{d}x = \text{awrt } 138$ | B1ft |
| | | **(3)** |
| | | **(9 marks)** |

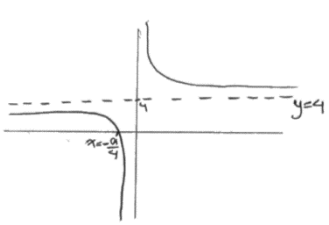
(a) **If there are multiple attempts then mark the most complete attempt. If coordinates/the equation of the asymptote are stated by the question and on their diagram, then the sketch takes precedence.**

B1: Correct shape in quadrants 1 and 2 and does not appear in quadrants 3 or 4 or touch the *x*-axis. Do not be concerned about the y intercept or asymptote. Mark the intention to draw an exponentially decreasing graph – do not penalise parts of the curve which may appear linear.

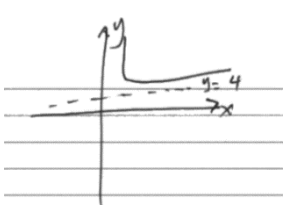
B1: Intercept at (0, 5). Condone invisible brackets, or may just have 5 marked on the *y*-axis, or $x=0,\ y=5$. If the point is labelled as $(5,\ 0)$ then condone provided it is a *y* intercept which is above the *x*-axis.

B1: Graph with asymptote at $y=4$ (asymptote does not need to be drawn) Must be an equation. There must be a graph with the intention of a horizontal asymptote above the *x*-axis to score the mark. If more than one horizontal asymptote is given, then B0. Where the asymptote is not drawn (e.g. with dashed lines) it must be clear that $y=4$ refers to the asymptote of the graph and not the *y*-intercept.

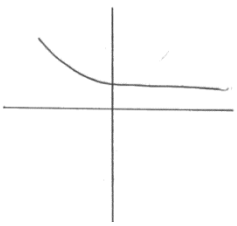
Examples:



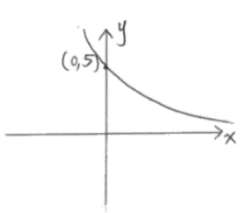

B0B0B1




B0B0B1



B1B0B0




B1B1B0

(b)

B1: For a correct strip width of $h = 2.5$ o.e. May be implied by 1.25 or equivalent in front of the bracket

M1: Correct application of the trapezium rule with all the *y* values and their *h* (which may be 1 and condone if negative)
Condone a missing trailing bracket. Condone other bracketing errors only if followed by a correct answer for their values. Condone miscopying of the *y* values from the table but the intended values must be used in the correct places.
Also award for attempts at forming individual trapezia and adding these together.
e.g.

$$2.5\left(\frac{13+6.280}{2}\right)+2.5\left(\frac{6.280+4.577}{2}\right)+2.5\left(\frac{4.577+4.146}{2}\right)+2.5\left(\frac{4.146+4.037}{2}\right)+2.5\left(\frac{4.037+4.009}{2}\right)$$

A1: awrt 69 (exact answer is 68.86125) isw once a correct answer is seen. awrt 69 following a correct calculation.

Note that the calculator answer for $\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}+4\right)\mathrm{d}x$ is 66.367... which scores 0 marks.

(c) They may use their 69 or a more accurate value of their 69 which is acceptable.

(i) **Attempts at redoing the trapezium rule with new values is M0A0**

M1: Attempts $"69"\pm 4\times(8.5--4)$ or $"69"\pm\int_{-4}^{8.5}4\,\mathrm{d}x$ or $(b)\pm 50$

May also be implied by just stating the value of $(b)\pm 50$

A1ft: awrt 19 but follow through on $(b)-50$.

(c)(ii)

B1ft: awrt 138 but follow through on $2\times(b)$

**Part (c) when the answer to part (b) is awrt 66 (where (b) has been done using the calculator)**

(c)(i) **If a method is shown** then M1A1ft is possible e.g. $66\pm 4\times(8.5--4)$ or e.g. $66-50$ for awrt 16.
awrt 16 with no working is M0A0ft (as this could have been done using the calculator)

(c)(ii) awrt 132 scores B1ft (condoned)

| Question Number | Scheme | Marks |
|---|---|---|
| **5(i)** | $r = 0.25$ | B1 |
| | $S_\infty = \dfrac{1.5}{1-0.25} = 2$ | M1 A1 |
| | | **(3)** |
| **(ii)** | (a) $\left(u_1 = 3,\right)\ u_2 = 0, u_3 = \dfrac{3}{2}, u_4 = 3, ...$ | M1 |
| | $\left(u_1 = 3\right), u_2 = 0, u_3 = \dfrac{3}{2}, u_4 = 3, ...$ and e.g. states that $u_4 = u_1$ so sequence will repeat (is periodic) | A1 |
| | | **(2)** |
| | (b) (Order) 3 | A1 |
| | | **(1)** |
| | (c) $\displaystyle\sum_{n=1}^{70} u_n = 23 \times \left(3 + 0 + \frac{3}{2}\right) + 3 = 106.5$ | M1, A1 |
| | | **(2)** |
| | | **(8 marks)** |

(i)

B1: States or uses $r = 0.25$ (may be implied by using $r = 0.25$ in the sum to infinity formula). $6 \times 0.25$ or any other term in the sequence is not sufficient evidence that this is a geometric sequence.
Alternatively, shows an understanding of the sigma notation by writing at least the first three terms in the sequence e.g. $6 \times \frac{1}{4} + 6 \times \left(\frac{1}{4}\right)^2 + 6 \times \left(\frac{1}{4}\right)^3 + ...$

Condone invisible brackets and may be written as a list.

M1: Attempts $S_\infty = \dfrac{a}{1-r}$ with $a = 1.5$ (or $6 \times 0.25$), $r = 0.25$ or $a = 6, r = 0.25$

You may also see $S_\infty = \dfrac{a}{1-r} - a$ with $a = 6, r = 0.25$ which is acceptable

Beware of other variants such as taking a factor of 6 out and using $a = 0.25, r = 0.25$

The values embedded in the expression is sufficient to score this mark.

A1: 2 cao **following evidence of the use of the sum to infinity formula**

**Note** $6 \times \frac{1}{4} + 6 \times \left(\frac{1}{4}\right)^2 + 6 \times \left(\frac{1}{4}\right)^3 + ... = 2$ is B1M0A0 (no evidence of using the sum to infinity formula)

(ii)(a)

M1: Uses the recurrence relation correctly at least once. If they do not achieve a correct $u_2 = 0$ then check e.g. their $u_3$ is a correct follow through for their $u_2$

A1: $\left(u_1 = 3\right), u_2 = 0, u_3 = \dfrac{3}{2}, u_4 = 3, ...$ with a statement or conclusion such as $u_4 = u_1$ /repeats/cycles (is periodic) As a minimum accept (3), 0, $\frac{3}{2}$, 3 (hence) periodic

(ii)(b) **This mark can only be scored following correct values in (ii)(a)** (or a restart in (ii)(b))

A1: (Order is) 3 (do not accept (repeats every) third). Cannot be for just listing the terms of the sequence.

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