Question Number	Scheme	Marks
8(a)	$y=(x+2)^2(4-x)=\left(x^2+4x+4\right)(4-x)=\left(16+12x-x^3\right)$	M1
	Area $=\left[16x+6x^2-\frac{1}{4}x^4\right]_{(-2)}^{(4)}$	dM1A1ft
	$=[64+96-64]-[-32+24-4]=108$	ddM1A1
		(5)
(b)	Attempts $4.5\times(a)=486$	B1ft
	Gives a valid reason why the area is 4.5 times greater	B1
		(2)
		(7 marks)

(a) Note that if no integration is seen then maximum score is M1dM0A0ftddM0A0. Attempts at integration by parts send to review.

M1: Attempts to multiply out **to achieve a cubic**. Look for:

eg $y=(x+2)^2(4-x)=\left(x^2+...+4\right)(4-x)=....$ or

$y=(x+2)(x+2)(4-x)=(x+2)\left(8.....-x^2\right)=....$

FYI: $y=16+12x-x^3$ which may be unsimplified.

dM1: Raises the power by one **in at least two terms**. Indices do not need to be processed for this mark. It is dependent on the first method mark.

A1ft: $16x+6x^2-\frac{1}{4}x^4$ follow through **on their cubic** which may be unsimplified. Indices must be processed – may be implied by further work.

ddM1:Uses the limits -2 and 4 and subtracts either way around. The expression with the limits substituted in (or may be partially evaluated) is sufficient to score (condone slips) or

$\left[16x+6x^2-\frac{1}{4}x^4\right]_{-2}^{4}=108$ can score both final marks.

It is dependent on both previous method marks. May be implied by 108 but if no method is shown and just a value stated that is not 108 then ddM0A0. May split the area into separate regions and add together.

A1: 108 provided all previous marks have been scored.

(b) **Note they must be using their answer to part (a) in part (b).**

Condone any reference to incorrect limits which may be seen on their integral expression in (b) which follow through from part (a)

B1ft: $4.5\times(a)=486$ or follow through on their part (a). If just a value is stated then B0ft.

B1: Gives a valid reason why the area is 4.5 times greater than their part (a).

This can done by

- manipulating the expression by taking out factors
  e.g. $\left(y=(3x+6)^2\left(2-\frac{1}{2}x\right)=\right)3^2(x+2)^2\times\frac{1}{2}(4-x)=\frac{9}{2}\times(x+2)^2(4-x)$ oe we would need to see working leading to $\frac{9}{2}$ e.g. both 9 and $\frac{1}{2}$ oe e.g. $\frac{3^2}{2}$ or taking out one of the factors (but not just directly to $\frac{9}{2}$ in one step), or
- multiplying out all of the brackets and proceeding to
  $\left(y=18x^2-\frac{9}{2}x^3+72x-18x^2+72-18x=\right)-\frac{9}{2}x^3+54x+72=\frac{9}{2}\left(-x^3+12x+16\right)$
  Condone just taking out a factor of $\frac{9}{2}$ oe from the correct cubic leading to a correct expression
- showing where 4.5 comes from e.g. $3^2\times\frac{1}{2}=4.5$ or $9\times\frac{1}{2}=4.5$ or $\frac{3^2}{2}=4.5$ but not just $\frac{9}{2}=4.5$
- explaining that the original curve has been stretched by a scale factor of 4.5

There may be other ways of showing this which are credit worthy – send to review if you are unsure.

Question Number	Scheme	Marks
9 (i)	Method of finding r e.g. $r^4 = \dfrac{130}{22}$	M1
	$(r =)$ awrt 1.6	A1
	Max speed in second gear is $22 \times "1.559" =$ awrt 34.3 (kmh^{-1})	dM1A1 **(4)**
(ii)(a)	e.g. $u_n = 208 + (n-1) \times (-0.8) = 0 \Rightarrow n = ...$	M1
	$(n =)$ 261 (or 260) (allow 260.5 see notes)	A1
	e.g. $S_{"261"} = \dfrac{"261"}{2}\left(2 \times 208 + (n-1) \times (-0.8)\right)$	dM1
	Maximum $S_n = 27144$	A1 **(4)**
(b)	522	B1 **(1)**
		(9 marks)

(i)

M1: Either a correct equation in r only e.g. $22r^4 = 130$ or states $a = 22$ and forms a correct equation in a and r e.g. $a = 22, ar^4 = 130$. May be implied by a correct expression for r, which may be part of their calculation to find the maximum speed in second gear.

A1: awrt 1.6. Accept $\sqrt[4]{\dfrac{130}{22}}$ or $\sqrt[4]{\dfrac{65}{11}}$ May be seen within a calculation or implied by awrt 34.3

dM1: For attempting $22 \times "1.559"$ It is dependent on the previous method mark.

A1: awrt $34.3\left(\text{kmh}^{-1}\right)$ Units are not required

(ii)(a) Note candidates must show all stages of their working. Solutions relying entirely on calculator technology are not acceptable. A correct answer only or a correct answer with only 260 or 261 stated send to review.

M1: For an acceptable method of finding the number of terms required to find the maximum value of S. e.g. finds n by e.g. using $u_n = 208 + (n-1)(-0.8) = 0$ (condone missing brackets around -0.8) or alternatively score for $\dfrac{208}{0.8}$. Allow to show trial calculations of $u_{260} = 0.8$ or $u_{261} = 0$. May be implied by 260 or 261

Alternatively sets $S_n = \dfrac{n}{2}\left[2 \times 208 + (n-1) \times (-0.8)\right]$ and either

- differentiates and sets = 0 : $S_n = 208.4n - 0.4n^2 \Rightarrow 208.4 - 0.8n = 0 \Rightarrow n = ...$ look for $n^k \rightarrow n^{k-1}$ for at least one term, set the result equal to zero and finds n (condone slips in the rearrangement)
- uses roots: $S_n = 208.4n - 0.4n^2 = 0 \Rightarrow n(208.4 - 0.4n) = 0 \Rightarrow n = 0,\ n = ...$ and then finds the midpoint of the two roots
- completes the square: $S_n = 208.4n - 0.4n^2 = 0 \Rightarrow -0.4\left(n^2 - 521n\right) \Rightarrow -0.4\left(n - 260.5\right)^2 \pm ... \Rightarrow n = ...$

to find the position of the turning point