Question Number	Scheme	Marks
8 (a)	$355 = \pi r^2 h \Rightarrow h = \dfrac{355}{\pi r^2}$ or $\pi r h = \dfrac{355}{r}$	B1
	$S = 2\pi r^2 + 2\pi r h \Rightarrow S = 2\pi r^2 + 2\pi r\left(\dfrac{355}{\pi r^2}\right) = 2\pi r^2 + \dfrac{710}{r}$ *	M1A1 A1cso (4)
(b)	$\dfrac{\mathrm{d}S}{\mathrm{d}r} = 4\pi r - 710 r^{-2}$	M1
	$4\pi r - 710 r^{-2} = 0 \Rightarrow 4\pi r = \dfrac{710}{r^2} \Rightarrow r^3 = \dfrac{710}{4\pi}$	dM1
	$r = \sqrt[3]{\dfrac{710}{4\pi}}$ $(r = 3.837215...)$ cm	A1
	$S = 2\pi \times \left(\sqrt[3]{\dfrac{710}{4\pi}}\right)^2 + \dfrac{710}{\sqrt[3]{\dfrac{710}{4\pi}}} = 277.5450... \approx 278\ (\mathrm{cm}^2)$	dM1A1cao (5)
(c)	$\dfrac{\mathrm{d}^2 S}{\mathrm{d}r^2} = 4\pi + \dfrac{1420}{r^3}$ $\left\{= 4\pi + \dfrac{1420}{3.837215^3} = 37.699\right\}$	M1
	(r positive so) $\dfrac{\mathrm{d}^2 S}{\mathrm{d}r^2} > 0$ $\therefore S$ is minimum	A1ft (2) [11]
(a)		
B1	$h = \dfrac{355}{\pi r^2}$ or $\pi r h = \dfrac{355}{r}$ ..seen explicitly	
M1	Use a correct formula for the surface area and substitute their expression for h which must have been seen explicitly. (eg $S = 2\pi r^2 + 2\pi r h \Rightarrow S = 2\pi r^2 + \left(\dfrac{355 \times 2}{r}\right)$ alone scores M0 as does any other re-arrangement of the answer.)	
A1	Correct expression for h used	
A1cso	Obtain the **given** result from a fully correct solution. Must see $S = ...$	
(b)		
M1	Differentiate the **given** expression for S - power of either term to decrease	
dM1	Equate their derivative to 0 and solve for r Depends on the first M mark	
A1	Correct value for r, exact or decimal (3 sf sufficient) seen explicitly or used to calculate the minimum value of S.	
dM1	Substitute their value for r in the given expression for S Depends on the previous 2 M marks.	
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(c)		
M1	Obtain the second derivative (or use an other method to test for a min value of S). Methods involving testing value of S on either side of their value of r or looking at the change of sign of the first derivative must include evaluating S or dS/dt	
A1ft	Concluding (correct) statement. No need to evaluate the second derivative provided their value of r is positive and the second derivative is algebraically correct. (Ignore incorrect evaluation unless negative.)	