

Q	Marking Instructions	AO	Marks	Typical Solution
14(a)	Identifies and clearly defines variables.	AO3.1b	B1	Let C = total cost x = length of base edges h = length of height
	Models the cost with an expression of the form $ax^2 + bxh$	AO3.3	M1	$C = 15x^2 + 32xh$
	Eliminates either variable, using volume equation, to form a model for the cost in one variable.	AO3.3	M1	$x^2h = 60$ $h = \frac{60}{x^2}$
	Obtains a correct equation to model cost in one variable	AO3.1b	A1	$C = 15x^2 + \frac{1920}{x}$ (*)
	Uses their model to find minimum. (at least one term correctly differentiated and equated to zero)	AO3.4	M1	Differentiating $30x - \frac{1920}{x^2} = 0$ $x^3 = 64$ $x = 4$
	Obtains correct equation	AO1.1b	A1	$h = \frac{60}{4^2} = 3.75$
	Obtains correct value for h with correct units in context Award FT from correct substitution into incorrect equation for h but only if all three M1 marks have been awarded, must have correct units.	AO3.2a	A1F	Height of tank is 3.75 m $\frac{d^2C}{dx^2} = 30 + \frac{3840}{x^3}$ $x = 4 \Rightarrow \frac{d^2C}{dx^2} > 0$ therefore minimum ALT from (*) onwards $C = 900h^{-1} + 32\sqrt{60}h^{\frac{1}{2}}$
	Performs a correct test of 'their' solution: uses the second derivative of 'their' expression for C in terms of x or h to justify that a minimum value for h has been found OE (Second derivative > 0 or test gradient/values either side)	AO2.4	R1	$0 = -900h^{-2} + 16\sqrt{60}h^{-\frac{1}{2}}$ Height of tank is 3.75 m $\frac{d^2C}{dh^2} = 1800h^{-3} - 8\sqrt{60}h^{-\frac{3}{2}}$ $h = 3.75 \Rightarrow \frac{d^2C}{dh^2} = 25.6 > 0$ \therefore minimum

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14(b)(i)	Explains that two of the sides of the tank will need to have length $x \pm 0.05$ in order to join them	AO3.5c	E1	The sides will need to overlap to be joined, so two of the side lengths will need to be $x + 0.05$
(b)(ii)	Explains that the refinement is relatively small and unlikely to have a significant effect on the result.	AO3.5a	R1	The minimum cost is likely to increase slightly, but relative to the size of the tank, an extra 5cm is unlikely to make a significant difference.
	Total		10	