Question 13 (Total 10 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$5.4 = \pi r^2 h + \dfrac{2}{3}\pi r^3$	B1	This mark is given for a method to find the volume of the cylinder and the semi-hemisphere
	$A = 3\pi r^2 + 2\pi\left(\dfrac{5.4 - \dfrac{2}{3}\pi r^3}{\pi r^2}\right)$	M1	This mark is given for a method to find the surface area of the tank
		A1	This mark is given for finding an expression for the surface area of the tank
	$A = 3\pi r^2 + \dfrac{10.8}{r} - \dfrac{4\pi r^2}{3}$ $= \dfrac{10.8}{r} + \dfrac{5\pi r^2}{3}$	A1	This mark is given for the correct answer only
(b)	$A = \dfrac{10.8}{r} + \dfrac{5\pi r^2}{3}$	M1	This mark is given for a method to differentiate to find r
	$\Rightarrow \dfrac{dA}{dr} = -\dfrac{10.8}{r^2} + \dfrac{10\pi r}{3}$	A1	This mark is given for accurately differentiating to find r
	When $\dfrac{dA}{dr} = 0$, $-\dfrac{10.8}{r^2} + \dfrac{10\pi r}{3} = 0$	M1	This mark is given for a method to set $\dfrac{dA}{dr} = 0$ to find a value for r
	$r = 1.3$	A1	This mark is given for finding the radius for which the surface area is a minimum
(c)	$A = \dfrac{10.8}{1.01} + \dfrac{5\pi(1.01)^2}{3}$	M1	This mark is given for a method to substitute a value for r
	$A = 16.03 \text{ m}^2$ $A = 16 \text{ m}^2$	A1	This mark is given for correctly finding the minimum surface area of the tank (to the nearest integer)