Question	Scheme	Marks
6(a)	$\tan 30^\circ = \frac{r}{h} \Rightarrow r = \frac{h}{\sqrt{3}}$	B1
	$V = \frac{1}{3}\pi r^2 h \Rightarrow V = \frac{1}{3}\pi\left(\frac{h}{\sqrt{3}}\right)^2 h \Rightarrow V = \frac{1}{9}\pi h^3$ *	M1A1 cso [3]
(b)	$\frac{\mathrm{d}V}{\mathrm{d}t} = -4$	B1
	$A = \pi r^2 \Rightarrow A = \pi\left(\frac{h}{\sqrt{3}}\right)^2 = \frac{\pi h^2}{3}$	B1
	$\frac{\mathrm{d}A}{\mathrm{d}h} = \frac{2\pi h}{3} \qquad \frac{\mathrm{d}V}{\mathrm{d}h} = \frac{3\pi h^2}{9} = \frac{\pi h^2}{3}$	M1M1A1
	$\frac{\mathrm{d}A}{\mathrm{d}t} = \frac{\mathrm{d}A}{\mathrm{d}h} \times \frac{\mathrm{d}V}{\mathrm{d}t} \times \frac{1}{\frac{\mathrm{d}V}{\mathrm{d}h}}$	M1
	$\frac{\mathrm{d}A}{\mathrm{d}t} = \frac{2\pi h}{3} \times (-4) \times \frac{3}{\pi h^2} = -\frac{8}{h} \Rightarrow \frac{\mathrm{d}A}{\mathrm{d}t} = -\frac{8}{24} = -\frac{1}{3} \quad (\mathrm{cm}^2/\mathrm{s})$	dM1A1 [8]
	ALT – working in terms of *r* rather than *h*	
	$\frac{\mathrm{d}V}{\mathrm{d}t} = -4$	[B1
	$V = \frac{1}{3}\pi r^2 h \Rightarrow V = \frac{1}{3}\pi r^2\left(\sqrt{3}r\right) = \frac{\sqrt{3}}{3}\pi r^3$	B1
	$A = \pi r^2 \Rightarrow \frac{\mathrm{d}A}{\mathrm{d}r} = 2\pi r \qquad V = \frac{\sqrt{3}}{3}\pi r^3 \Rightarrow \frac{\mathrm{d}V}{\mathrm{d}r} = \sqrt{3}\pi r^2$	M1M1A1
	$\frac{\mathrm{d}A}{\mathrm{d}t} = \frac{\mathrm{d}A}{\mathrm{d}r} \times \frac{1}{\frac{\mathrm{d}V}{\mathrm{d}r}} \times \frac{\mathrm{d}V}{\mathrm{d}t}$	M1
	$\frac{\mathrm{d}A}{\mathrm{d}t} = 2\pi r \times \frac{1}{\sqrt{3}\pi r^2} \times -4 = -\frac{8}{\sqrt{3}r} \Rightarrow \frac{\mathrm{d}A}{\mathrm{d}t} = -\frac{8}{\sqrt{3}\times\frac{24}{\sqrt{3}}} = -\frac{1}{3}$	dM1A1]
		Total 11 marks

Part	Mark	Notes
(a)	B1	For $r = \frac{h}{\sqrt{3}}$ or $r^2 = \frac{1}{3}h^2$ $r = \frac{h}{\sqrt{3}}$ may be implied by substitution into the correct formula for volume of a cone.
	M1	For using the correct volume of a cone and substituting in their expression for r or r^2 to find an expression for the volume in terms of h
	A1	For the correct expression with no errors seen. Must have $V =$
(b)	B1	For stating $\frac{dV}{dt} = -4$ (allow +) May be embedded in working.
	B1	For finding the correct expression for the area of a circle in terms of h Note: if differentiation is attempted before writing in terms of h then award 1st M1 for $\frac{dA}{dh} = \frac{dA}{dr} \times \frac{dr}{dh}$ with attempts at $\frac{dA}{dr}, \frac{dr}{dh}$ found and substituted in and attempt to substitute for r in terms of h. B1 once $\frac{dA}{dh}$ found completely in terms of h
	M1	For attempting to differentiate their expression for A in terms of h See general guidance for what constitutes an attempt to differentiate. A must have the form $A = kh^2$ (dimensionally correct for area).
	M1	For attempting to differentiate the given V See general guidance for what constitutes an attempt to differentiate.
	A1	Both derivatives correct. $\frac{dA}{dh}$ and $\frac{dV}{dh}$
	M1	For a correct expression of chain rule to find $\frac{dA}{dt}$
	dM1	For substituting their derivatives into a correct chain rule. Dep on previous three M marks.
	A1	For the correct $\frac{dA}{dt} = -\frac{1}{3}$ (cm^2/s) Allow $-0.\dot{3}$ but not -0.3. ISW once exact answer found.
	ALT	
	B1	For stating $\frac{dV}{dt} = -4$ (allow +) May be embedded in working.
	B1	For finding the correct expression for the volume in terms of r Must be working with correct volume expression as given in (a).
	M1	For attempting to differentiate expression for A in terms of r See general guidance for what constitutes an attempt to differentiate. A must have the form $A = kr^2$ (dimensionally correct for area).
	M1	For attempting to differentiate expression for V in terms of r See general guidance for what constitutes an attempt to differentiate.

	A1	Both derivatives correct. $\frac{dA}{dr}$ and $\frac{dV}{dr}$
	M1	For a correct expression of chain rule to find $\frac{dA}{dt}$
	dM1	For substituting their derivatives into a correct chain rule. Dep on previous three M marks.
	A1	For the correct $\frac{dA}{dt} = -\frac{1}{3}$ $\left(\text{cm}^2/\text{s}\right)$ Allow $-0.\dot{3}$ but not -0.3. ISW once exact answer found.