Question number	Scheme	Marks
9 (a)	$\frac{\mathrm{d}A}{\mathrm{d}t} = 0.03$	B1
	$A = \frac{1}{2}x^2 \sin 60^\circ = \frac{\sqrt{3}}{4}x^2$	M1
	$\frac{\mathrm{d}A}{\mathrm{d}x} = \frac{\sqrt{3}}{2}x$	A1
	When $x = 2$ $\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{1}{\sqrt{3}} \times 0.03 = 0.0173$ cm/s	M1 A1 (5)
(b)	$V = \sqrt{3}x^3$ $\quad \frac{\mathrm{d}V}{\mathrm{d}x} = 3\sqrt{3}x^2$	M1
	When $x = 2$ $\frac{\mathrm{d}V}{\mathrm{d}t} = 12\sqrt{3} \times 0.0173 = 0.36$	M1 A1 (3)
		Total 8 marks

Part	Mark	Guidance
(a)	**B1**	For stating or using correctly in their Chain Rule $\frac{\mathrm{d}A}{\mathrm{d}t}=0.03$
	M1	For using the **correct** formula $\left(\frac{1}{2}ab\sin C\right)$ with the correct lengths and angle of 60° or $\frac{\pi}{3}$, for the cross-sectional area of the prism to obtain $A=\frac{1}{2}x^2\sin 60^\circ=\left(\frac{\sqrt{3}}{4}x^2\right)$ and differentiating their expression which must be as a minimum $A=px^2$ to obtain $\frac{\mathrm{d}A}{\mathrm{d}x}=qx$ [where p and q are constants]. [The height of the triangle is $\frac{\sqrt{3}}{2}x$ if they use $\frac{1}{2}\times\text{base}\times\text{height}$]
	A1	For the correct $\frac{\mathrm{d}A}{\mathrm{d}x}=\frac{\sqrt{3}}{2}x$
	M1	For applying a **correct** Chain rule using their $\frac{\mathrm{d}A}{\mathrm{d}x}$ and $x = 2$ to obtain $\frac{\mathrm{d}x}{\mathrm{d}t}=\left(\frac{1}{\frac{\mathrm{d}A}{\mathrm{d}x}}\times\frac{\mathrm{d}A}{\mathrm{d}t}\right)=\frac{\mathrm{d}x}{\mathrm{d}A}\times\frac{\mathrm{d}A}{\mathrm{d}t}=\text{'}\frac{2}{\sqrt{3}}\text{'}\times\frac{1}{2}\times 0.03$
	A1	$\frac{\mathrm{d}x}{\mathrm{d}t}=0.0173$
(b)	**M1**	For a correct expression for the volume using their A from part (a) to obtain $V=\frac{\sqrt{3}}{4}x^2\times 4x=\left(\sqrt{3}x^3\right)$ and differentiating their expression which must be as a minimum $V=mx^3$ to obtain as a minimum $\frac{\mathrm{d}V}{\mathrm{d}x}=nx^2$ [where m and n are constants] $\left(\frac{\mathrm{d}V}{\mathrm{d}x}=3\sqrt{3}x^2\right)$
	M1	For applying a correct Chain rule using their $\frac{\mathrm{d}V}{\mathrm{d}x}$ and $x = 2$ to obtain $\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{dV}}{\mathrm{d}x}\times\frac{\mathrm{d}x}{\mathrm{d}t}=12\sqrt{3}\times 0.0173=\lceil 0.359...\rceil$ $\left(\text{ft their }\frac{\mathrm{d}x}{\mathrm{d}t}\right)$ **Note:** $\frac{\mathrm{d}x}{\mathrm{d}t}=0.0173$ or $\frac{\sqrt{3}}{100}$ $\left(\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{dV}}{\mathrm{d}x}\times\frac{\mathrm{d}x}{\mathrm{d}t}=12\sqrt{3}\times\frac{\sqrt{3}}{100}=\frac{9}{25}=0.36\right)$
	A1	For awrt 0.36