Question			Answer	Marks	AOs	Guidance	
11	(a)		$\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{k}{x}$	M1	3.3	Expresses inverse proportionality with a constant	
			When $t=0$, $x=5$ and $\frac{\mathrm{d}V}{\mathrm{d}t}=21$, so $\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{105}{x}$	A1	3.3	Evaluating k, oe (may be done later)	
			$\frac{\mathrm{d}V}{\mathrm{d}x}=4\pi x^2$,	B1	2.1	may be embedded in chain rule	
			so the chain rule gives $\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{d}V}{\mathrm{d}x}\times\frac{\mathrm{d}x}{\mathrm{d}t}=4\pi x^2\frac{\mathrm{d}x}{\mathrm{d}t}$	M1	2.1	Use of the chain rule	
			Hence $\frac{\mathrm{d}x}{\mathrm{d}t}=\frac{1}{4\pi x^2}\times\frac{105}{x}=\frac{105}{4\pi x^3}$ **AG**	A1 [5]	3.3	Convincing argument	
11	(b)		$\int 4\pi x^3\ \mathrm{d}x=\int 105\ \mathrm{d}t$	M1	3.1a	Separating the variables	
			$\pi x^4=105t+c$	A1	1.1b	Condone missing +c here	
			When $t=0, x=5$ so $c=625\pi$	M1	3.3	Using initial conditions	
				A1	3.3	Correct value for c	
			When $t=120$ $x=\sqrt[4]{\frac{105}{\pi}\times120+625}=8.25$ cm	A1 [5]	3.4	cao	
11	(c)		As t gets very large, the volume gets very large so the balloon will get beyond the maximum it can be without bursting and so burst.	E1 [1]	3.5b	Conveys the idea that $t\to\infty\Rightarrow V\to\infty$ or $x\to\infty$ Indicates a practical problem with very large volume	