

Q	Marking instructions	AO	Mark	Typical solution
10	Models the rate of change of volume with a differential equation of the correct form. With respect to time, not contradicted.	3.3	B1	$\frac{dv}{dt} = k$
	Obtains $4\pi r^2$ by differentiation.	1.1b	B1	$\frac{dv}{dr} = 4\pi r^2$
	Uses the chain rule to connect rates of change substituting their expressions for dv/dt and dv/dr . Or Integrates to obtain expression for $v=kt+c$ Then differentiates wrt r $dv/dr=kd/dr$ Substitutes their expression for dv/dr	3.1b	M1	$\frac{dv}{dt} = \frac{dv}{dr} \times \frac{dr}{dt}$
	Completes argument, obtaining a correct expression for $\frac{dr}{dt}$ and concluding that $\frac{dr}{dt} \propto \frac{1}{r^2}$ OE statement	2.1	R1	$k = 4\pi r^2 \times \frac{dr}{dt}$ $\frac{dr}{dt} = \frac{k}{4\pi r^2}$ $\therefore \frac{dr}{dt} \propto \frac{1}{r^2}$
	Total		4	