Question	Scheme	Marks
3(a)	$\frac{dA}{dt} = -0.5$	B1
	$A = \pi x^2 \Rightarrow \frac{dA}{dx} = 2\pi x$	B1
	$\frac{dx}{dt} = \frac{dA}{dt} \div \frac{dA}{dx} = \frac{"-0.5"}{"2\pi x"} \quad \left(= \frac{-1}{4\pi x}\right)$	M1
	$\frac{dx}{dt} = -0.011368...$	A1cso
		(4)
(b)	$V = \pi x^2 (3x) = 3\pi x^3$	B1
	$\frac{dV}{dx} = 9\pi x^2$	B1ft
	$\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dt} = 9\pi x^2 \times "-\frac{1}{4\pi x}" \ \left(= -2.25x\right)$	M1
	$\left(\frac{dV}{dt} =\right) -9 \Rightarrow$ (Rate of decrease $=$) $9 \ \left(\text{mm}^3\ \text{s}^{-1}\right)$	A1
		(4)
		(8 marks)

Notes

(a)

B1: $\frac{dA}{dt} = -0.5$ seen or implied from working

B1: $\frac{dA}{dx} = 2\pi x$ seen or implied from working. Must be in terms of x, but allow recovery if in terms of r and later work uses $r = 7$ to achieve a solution.

M1: Attempts to use an appropriate chain rule with their $\frac{dA}{dt}$ and $\frac{dA}{dx}$ e.g. $\frac{dx}{dt} = \frac{dA}{dt} \div \frac{dA}{dx} = ...$

A1: awrt -0.0114 or $-\frac{1}{28\pi}$ cso (must have the negative sign)

(b)

B1: $V = \pi x^2 (3x)$ or $V = 3\pi x^3$

B1ft: $\frac{dV}{dx} = 9\pi x^2$ or ft from their equation for V in one variable

M1: Their $\frac{dV}{dx} \times$ their $\frac{dx}{dt}$. Note the $\frac{dx}{dt}$ must be in terms of x or with $x = 4$ substituted first, M0 if they use their answer to (a).

A1: (Rate of decrease =) $9 \ \left(\text{mm}^3\ \text{s}^{-1}\right)$ (with or without the negative sign). May be scored following $\frac{dA}{dt} = 0.5$ in part (a)

Question	Scheme	Marks
4(a)	$16x^3 - 9kx^2y + 8y^3 = 875$	
	$(8)y^3 \to (8\times)3y^2\dfrac{dy}{dx}$	B1
	$-9kx^2y \to ...kxy \pm ... - 9kx^2\dfrac{dy}{dx}$	M1
	$48x^2 - 18kxy - 9kx^2\dfrac{dy}{dx} + 24y^2\dfrac{dy}{dx} = 0 \Rightarrow \dfrac{dy}{dx}(24y^2 - 9kx^2) = 18kxy - 48x^2 \Rightarrow \dfrac{dy}{dx} = ...$	M1
	$\dfrac{dy}{dx} = \dfrac{6kxy - 16x^2}{8y^2 - 3kx^2}$ *	A1*
		(4)
(b)	$\dfrac{dy}{dx} = 0, x = \dfrac{5}{2} \Rightarrow \dfrac{6k\left(\frac{5}{2}\right)y - 16\left(\frac{5}{2}\right)^2}{8y^2 - 3k\left(\frac{5}{2}\right)^2} = 0$ or $x = \dfrac{5}{2} \Rightarrow 16\left(\dfrac{5}{2}\right)^3 - 9k\left(\dfrac{5}{2}\right)^2 y + 8y^3 = 875$	M1
	$15ky - 100 = 0$ or $250 - \dfrac{225}{4}ky + 8y^3 = 875$	A1
	E.g. $16\left(\dfrac{5}{2}\right)^3 - 9k\left(\dfrac{5}{2}\right)^2\left(\dfrac{20}{3k}\right) + 8\left(\dfrac{20}{3k}\right)^3 = 875 \Rightarrow k^3 = ... \left(= \dfrac{64}{27}\right) \Rightarrow k = ...$	M1
	$k = \dfrac{4}{3}$	A1
		(4)
		(8 marks)