Question	Scheme	Marks
6	Assume the sequence is geometric	B1
	So $\left(r=\right)\dfrac{1+2k}{k}=\dfrac{3+3k}{1+2k}$	M1
	$\Rightarrow (1+2k)^2=k(3+3k)\Rightarrow k^2+k+1=0$	A1
	But $k^2+k+1=\left(k+\dfrac{1}{2}\right)^2-\dfrac{1}{4}+1\geqslant\dfrac{3}{4}>0$ (since $\left(k+\dfrac{1}{2}\right)^2\geqslant 0$ for all (real) k)	dM1
	This is a contradiction and hence the original assumption is not true. The sequence is not geometric.	A1
		(5)
		(5 marks)

Notes:

(a)

B1: States an appropriate assumption to set up the contradiction.

M1: Uses the assumption to set up an equation in k only.

Allow equivalent work e.g. $kr=1+2k,\ kr^2=3+3k\Rightarrow 3+3k=k\left(\dfrac{1+2k}{k}\right)^2$

Allow use of $\neq$ for = e.g. $\sqrt{\dfrac{3+3k}{k}}\neq\dfrac{1+2k}{k}$

This may be implied by e.g. $\dfrac{1+2k}{k}$ is not the same as $\dfrac{3+3k}{1+2k}$.

A1: Reaches a correct quadratic equation in k, need not be all on one side, but terms in k and k^2 should be collected. Allow use of $\neq$ for = e.g. $k^2+k+1\neq 0$

dM1: Completes the square, considers the discriminant or other valid means used to reach a point where a contradiction can be deduced. E.g. as scheme, or $b^2-4ac=1^2-4(1)(1)=-3<0$ may be used. Accept use of calculator to give roots $k=\dfrac{-1\pm i\sqrt{3}}{2}$ so k is not real, which contradicts k being a member of the real sequence.

Depends on the previous M.

A1: Correct work leading to a contradiction with deduction of a contradiction made and conclusion given. **This mark is available even if B0 is given at the start. So 01111 is possible.**

If they are using the discriminant or calculator route then there is no need to mention "real" as long as they conclude that e.g. the geometric sequence is not possible. This can score both the dM1 and A1.

Question	Scheme	Marks
7(a)	$V = (\pi)\int_{(0)}^{(4)} \left(\frac{1}{4}(4-x)\mathrm{e}^{x}\right)^2 \mathrm{d}x$	M1
	$\int (\mathrm{f}(x))^2 \mathrm{d}x = \frac{1}{16}\int (4-x)^2\mathrm{e}^{2x}\mathrm{d}x = \ldots$	M1
	$V = \frac{\pi}{16}\int_0^4 \left(x^2-8x+16\right)\mathrm{e}^{2x}\,\mathrm{d}x$	A1
		(3)
(b)	$= \left("\frac{\pi}{16}"\right)\left((x^2-8x+16)\frac{\mathrm{e}^{2x}}{2} - \int (2x-8)\times\frac{\mathrm{e}^{2x}}{2}\mathrm{d}x\right)$	M1 A1
	$= \left("\frac{\pi}{16}"\right)\left(\left(x^2-8x+16\right)\frac{\mathrm{e}^{2x}}{2} - \left[(2x-8)\frac{\mathrm{e}^{2x}}{4} - \int 2\times\frac{\mathrm{e}^{2x}}{4}\mathrm{d}x\right]\right)$ $= \left("\frac{\pi}{16}"\right)\left(\left(x^2-8x+16\right)\frac{\mathrm{e}^{2x}}{2} - (2x-8)\frac{\mathrm{e}^{2x}}{4} + \frac{\mathrm{e}^{2x}}{4}\right)$ **Depends on the first method mark.**	dM1
	$V = "\frac{\pi}{16}"\left[\left(x^2-8x+16\right)\frac{\mathrm{e}^{2x}}{2} - (2x-8)\frac{\mathrm{e}^{2x}}{4} + \frac{\mathrm{e}^{2x}}{4}\right]_0^4 = "\frac{\pi}{16}"\left(0+0+\frac{\mathrm{e}^8}{4} - \frac{16}{2} - \frac{8}{4} - \frac{1}{4}\right)$ **Depends on both previous method marks.**	ddM1
	$= \frac{\pi}{64}\left(\mathrm{e}^8-41\right)$ (cm^3)	A1
		(5)
(b) Way 2	$= \left("\frac{\pi}{16}"\right)\left((4-x)^2\frac{\mathrm{e}^{2x}}{2} + \int (4-x)\mathrm{e}^{2x}\,\mathrm{d}x\right)$	M1 A1
	$= \left("\frac{\pi}{16}"\right)\left((4-x)^2\frac{\mathrm{e}^{2x}}{2} + \frac{1}{2}(4-x)\mathrm{e}^{2x} + \int \frac{1}{2}\mathrm{e}^{2x}\,\mathrm{d}x\right)$ $= \left("\frac{\pi}{16}"\right)\left((4-x)^2\frac{\mathrm{e}^{2x}}{2} + \frac{1}{2}(4-x)\mathrm{e}^{2x} + \frac{1}{4}\mathrm{e}^{2x}\right)$ **Depends on the first method mark.**	dM1
	$= \left("\frac{\pi}{16}"\right)\left[(4-x)^2\frac{\mathrm{e}^{2x}}{2} + \frac{1}{2}(4-x)\mathrm{e}^{2x} + \frac{1}{4}\mathrm{e}^{2x}\right]_0^4 = \left("\frac{\pi}{16}"\right)\left(\frac{1}{4}\mathrm{e}^8 - 8 - 2 - \frac{1}{4}\right)$ **Depends on both previous method marks.**	ddM1
	$= \frac{\pi}{64}\left(\mathrm{e}^8-41\right)$ (cm^3)	A1

(b) **Way 3**	$\int_0^4 \left(x^2-8x+16\right)\mathrm{e}^{2x}\,\mathrm{d}x = \int_0^4 x^2\mathrm{e}^{2x}\,\mathrm{d}x - \int_0^4 8x\mathrm{e}^{2x}\,\mathrm{d}x + \int_0^4 16\mathrm{e}^{2x}\,\mathrm{d}x$	
	$= \left("\frac{\pi}{16}"\right)\left(x^2\frac{\mathrm{e}^{2x}}{2} - \int 2x\times\frac{\mathrm{e}^{2x}}{2}\mathrm{d}x + \ldots\right)$	**M1A1**
	$\int_0^4 x^2\mathrm{e}^{2x}\,\mathrm{d}x - \int_0^4 8x\mathrm{e}^{2x}\,\mathrm{d}x + \int_0^4 16\mathrm{e}^{2x}\,\mathrm{d}x$ $= \left("\frac{\pi}{16}"\right)\left(x^2\frac{\mathrm{e}^{2x}}{2} - \left\{x\times\frac{\mathrm{e}^{2x}}{2} - \int\frac{\mathrm{e}^{2x}}{2}\mathrm{d}x\right\} - 8\left\{x\times\frac{\mathrm{e}^{2x}}{2} - \int\frac{\mathrm{e}^{2x}}{2}\mathrm{d}x\right\} + 8\mathrm{e}^{2x}\right)$ **Depends on the first method mark.**	**dM1**
	$\left(\frac{\pi}{16}\right)\left[\frac{x^2\mathrm{e}^{2x}}{2} - \frac{9x\mathrm{e}^{2x}}{2} + \frac{41\mathrm{e}^{2x}}{4}\right]_0^4 = \frac{\pi}{16}\left(8e^8 - 18e^8 + \frac{41}{4}e^8 - \frac{41}{4}\right)$ **Depends on both previous method marks.**	**ddM1**
	$= \frac{\pi}{64}\left(\mathrm{e}^8 - 41\right)$ (cm^3)	**A1**

(8 marks)

Notes:

(a)

M1: Sets up the volume using the volume formula, but allow limits and π and the "dx" to be missing. No need to square f(x) for this mark as long as the intent to do so is clear. There should be an integral

M1: Attempts to square f(x) (need not be part of an integral). The power of e should be correct and the bracket expanded, but allow if the $\frac{1}{4}$ is not squared.

A1: Correct expression for the integral, π and limits must be included, and no errors seen in working so the "dx" must be present throughout.

(b)

M1: Attempts integration by parts the correct way at least once on the given integral to obtain

$$\alpha\left(x^2-8x+16\right)\mathrm{e}^{2x} \pm \beta\int\left(ax-b\right)\mathrm{e}^{2x}\,\mathrm{d}x$$

A1: Correct first application of parts: $(x^2-8x+16)\frac{\mathrm{e}^{2x}}{2} - \int\left(2x-8\right)\times\frac{\mathrm{e}^{2x}}{2}\mathrm{d}x$ or equivalent.

dM1: Attempts integration by parts again in the same direction on $\int\left(2x-8\right)\times\frac{\mathrm{e}^{2x}}{2}\mathrm{d}x$ and proceeds to complete the integration. Look for $K\left(\ldots+\alpha\left(ax-b\right)\mathrm{e}^{2x} \pm \beta\int\mathrm{e}^{2x}\mathrm{d}x\right)$.

ddM1: Applies the limits to their integral and subtracts, (but this need not have the K or π for this mark.) May be done in stages, so look for reaching a value using correct limits on each part of their integral.

A1: Correct answer achieved from correct work and the π must have been introduced before the final step, it should have been part of their answer to (a). Condone lack of units.

Way 2