Question	Scheme	Marks	AOs
3(a)(i)	$2(0.4+a)=1.2$ or $0.4+a=0.6$ or $0.4+a\cos 0=0.6$ $\Rightarrow a = ...$	M1	3.4
	$a=0.2$ * cso	A1*	1.1b
		(2)	
(b)	Area of rectangle is $1.2 \times 0.6 \, (=0.72)$	B1	1.1b
	Area enclosed by curve $= \dfrac{1}{2}\int \left(0.4+0.2\cos 2\theta\right)^2 (\mathrm{d}\theta)$	M1	3.1a
	$\left(0.4+0.2\cos 2\theta\right)^2 = 0.16+0.16\cos 2\theta+0.04\cos^2 2\theta$ $= 0.16+0.16\cos 2\theta+0.04\left(\dfrac{\cos 4\theta+1}{2}\right)$	M1	2.1
	$\dfrac{1}{2}\int \left(0.4+0.2\cos 2\theta\right)^2 \mathrm{d}\theta = \dfrac{1}{2}\left[0.18\theta+0.08\sin 2\theta+0.005\sin 4\theta\,(+c)\right]$ $= 0.09\theta+0.04\sin 2\theta+0.0025\sin 4\theta\,(+c)$ o.e.	A1ft	1.1b
	Area enclosed by curve $= \left[0.09\theta+0.04\sin 2\theta+0.0025\sin 4\theta\right]_0^{2\pi}$ or Area enclosed by curve $= 2\left[0.09\theta+0.04\sin 2\theta+0.0025\sin 4\theta\right]_0^{\pi}$ or Area enclosed by curve $= 4\left[0.09\theta+0.04\sin 2\theta+0.0025\sin 4\theta\right]_0^{\pi/2}$	dM1	3.1a
	$= \dfrac{9}{50}\pi$ or $0.18\pi\,(=0.5654...)$	A1	1.1b

	Area of wood $=1.2\times0.6-0.18\pi$	M1	1.1b
	$=$ awrt 0.155 (m^2)	A1	1.1b
		(8)	
			(10 marks)

Notes

(a)

M1: Interprets the information from the model and realises that the maximum value of r gives half the length of the table top (or equivalent) and solves to find a value for a. Use $\theta=0$ and $r=0.6$ or $\theta=\pi$ and $r=-0.6$ to find a value for a.

Using $\theta=2\pi$ is M0

A1*: Correct value for a.

Alternative

M1: Uses $a=0.2$ and $\theta=0$ to find a value for r

A1: Finds $r=0.6$ and concludes that $a=0.2$

(b)

B1: 1.2×0.6 or 0.72

M1: A correct strategy identified for finding an area enclosed by the polar curve using a correct

formula with r substituted. Attempt at area $=\dfrac{1}{2}\displaystyle\int (0.4+0.2\cos 2\theta)^2 \, d\theta = ...$

Look for $=\lambda\times\dfrac{1}{2}\displaystyle\int (0.4+0.2\cos 2\theta)^2 \, d\theta = ...$

If the $\dfrac{1}{2}$ is not explicitly seen then look at the limits and it must be either

$$=\int_0^\pi (0.4+0.2\cos 2\theta)^2 \, d\theta = ... \text{ or } =2\int_0^{\frac{\pi}{2}}(0.4+0.2\cos 2\theta)^2 \, d\theta = ...$$

Condone missing $d\theta$

M1: Squares to achieve three terms and uses $\cos^2 2\theta = \dfrac{\pm 1\pm\cos 4\theta}{2}$ to obtain an expression in an integrable form.

A1ft: Correct follow through integration as long as the previous two method marks have been awarded.

dM1: Dependent of first method mark. Finds the required area enclosed by the curve using the correct limits.

There are only three cases either $\dfrac{1}{2}\displaystyle\int_0^{2\pi}(0.4+0.2\cos 2\theta)^2 \, d\theta$ or $\displaystyle\int_0^\pi (0.4+0.2\cos 2\theta)^2 \, d\theta$ or

$2\displaystyle\int_0^{\frac{\pi}{2}}(0.4+0.2\cos 2\theta)^2 \, d\theta$

The use of the limit 0 can be implied if it gives 0 but the use of 0 must been seen or implied if it does not result in 0 (just writing 0 is insufficient)

A1: Correct area of the glass following fully correct working. **Do not award for the correct answer following incorrect working.**

M1: Subtracts their area of the glass from their area of the rectangle, as long as it does not give a negative area

A1: awrt 0.155 or awrt $0.155\,\text{m}^2$ (If the units are stated they must be correct)

Note: Using a calculator to find the area scores a maximum of B1M0M0A0M0A0M1A1