Question Number	Scheme	Marks
6 (a)(i)	Area $R = \int y \frac{\mathrm{d}x}{\mathrm{d}t}\,\mathrm{d}t = \int 4\sin t \times -4\sin 2t\,\mathrm{d}t$	M1 A1
	$= -\int 32\sin^2 t\cos t\,\mathrm{d}t$	dM1
	$x = 0 \Rightarrow t = \frac{\pi}{4}$ and $y = 0 \Rightarrow t = 0 \Rightarrow$ Area $= -\int_{\frac{\pi}{4}}^{0} 32\sin^2 t\cos t\,\mathrm{d}t = \int_{0}^{\frac{\pi}{4}} 32\sin^2 t\cos t\,\mathrm{d}t$ *	A1*
		(4)
(ii)	Area $= \left[\frac{32}{3}\sin^3 t\right]_0^{\frac{\pi}{4}} = \frac{32}{3}\times\frac{2\sqrt{2}}{8} = \frac{8\sqrt{2}}{3}$	M1 A1
		(2)
(b)	Attempts to use $\cos 2t = 1 - 2\sin^2 t \Rightarrow \frac{x}{2} = 1 - 2\left(\frac{y}{4}\right)^2$	M1A1
	$y = \sqrt{8 - 4x}$	A1
		(3)
(c)	Range is $0 \leqslant \mathrm{f} \leqslant 4$	B1
		(1)
		(10 marks)

(a)(i)

M1: Attempts to multiply y by $\frac{\mathrm{d}x}{\mathrm{d}t}$ to achieve an integrand of the form $\pm k\sin t\sin 2t$

Look for area $R=\int y\frac{\mathrm{d}x}{\mathrm{d}t}(\mathrm{d}t)=\int (4)\sin t\times\pm k\sin 2t\ (\mathrm{d}t)$ but condone a missing 4 or dt

A1: Correct integrand. Achieves area $R=\int y\frac{\mathrm{d}x}{\mathrm{d}t}(\mathrm{d}t)=\int 4\sin t\times -4\sin 2t\,(\mathrm{d}t)$

Condone a missing dt and do not be concerned by the limits. Allow unsimplified.

dM1: Substitutes $\sin 2t=2\sin t\cos t\rightarrow$ seen or implied $=\pm\int A\sin^2 t\cos t\ \mathrm{d}t$

Dependent upon previous M. Condone a missing dt and do not be concerned by the limits.

A1*: Achieves area $\left(=\int_0^2 y\ \mathrm{d}x\right)=-\int_{\frac{\pi}{4}}^0 32\sin^2 t\cos t\ \mathrm{d}t\rightarrow\int_0^{\frac{\pi}{4}}32\sin^2 t\cos t\ \mathrm{d}t$

This is a given answer so you must see

- evidence of the dt in at least one line other than the given answer
- correct application of the limits as seen above with as a minimum $-\int_{\frac{\pi}{4}}^0\ldots\mathrm{d}t\rightarrow\int_0^{\frac{\pi}{4}}\ldots\mathrm{d}t$

(a)(ii)

M1: Integrates to a form $\left[A\sin^3 t\right]$ with some attempt to apply the limit(s)

You may see a substitution $u=\sin t$ which is fine. Just look for Au^3 with some attempt to apply the adapted limits

A1: Correct answer $\frac{8\sqrt{2}}{3}$ o.e. following correct **algebraic** integration.

Cannot be scored without the M mark.

(b)

M1: Attempts to use a double angle formula of the form $\cos 2t=\pm 1\pm 2\sin^2 t$ with the parametric equations to get a Cartesian equation.

If the parametric equations are substituted into the given form of the answer $y=\sqrt{ax+b}$, marks are only scored when the double angle formula is used

A1: Any correct un-simplified equation $\frac{x}{2}=1-2\left(\frac{y}{4}\right)^2$

On the alternative method, this A mark is scored when the candidate writes down

$a+2b=0.-4b=16\Rightarrow a=\ldots,b=\ldots$

A1: $y=\sqrt{8-4x}$ or $y=\sqrt{-4x+8}$ ONLY

(c)

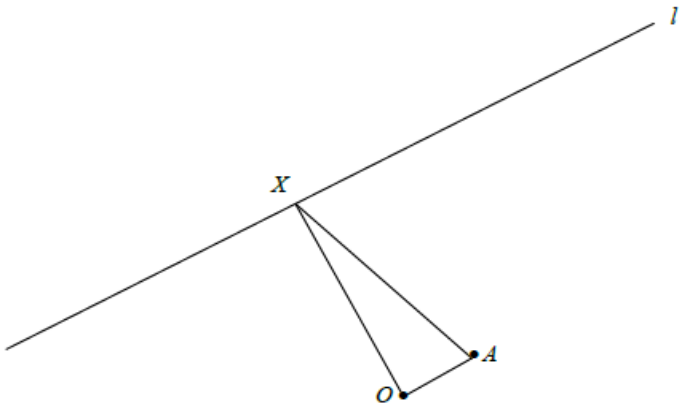
B1: Range is $0\leqslant \mathrm{f}\leqslant 4$

Allow other acceptable forms such as $0\leqslant y\leqslant 4$, $0\leqslant \mathrm{f}(x)\leqslant 4$ and $[0,4]$

Examples of unacceptable forms are $0\leqslant x\leqslant 4$, $[0,4)$

Question Number	Scheme	Marks
7 (a)	Finds $\left\|\begin{pmatrix}4\\4\\2\end{pmatrix}\right\| = \sqrt{4^2+4^2+2^2} = 6$ and attempts $\frac{1}{"6"}\begin{pmatrix}4\\4\\2\end{pmatrix}$	M1
	$\overrightarrow{OA} = \begin{pmatrix}2/3\\2/3\\1/3\end{pmatrix}$ oe	A1
		(2)
(b)	Co-ordinates or position vector of point $X = \begin{pmatrix}1+4\lambda\\-10+4\lambda\\-9+2\lambda\end{pmatrix}$	M1
	$\overrightarrow{OX}.\begin{pmatrix}4\\4\\2\end{pmatrix} = 0 \Rightarrow 4(1+4\lambda)+4(-10+4\lambda)+2(-9+2\lambda) = 0$	dM1
	$36\lambda = 54 \Rightarrow \lambda = 1.5$	ddM1 A1
	$X = (7,-4,-6)$	A1
		(5)
(c)	Finds $OX = \sqrt{7^2+(-4)^2+(-6)^2} = \sqrt{101}$ and $OA = 1$	M1
	Area $OXA = \frac{1}{2}\times 1\times\sqrt{101} = \frac{\sqrt{101}}{2}$	dM1 A1
		(3)
		(10 marks)

Handy diagram



(a)

M1: Correct attempt at the unit vector. Look for an attempt at $\sqrt{4^2+4^2+2^2}$ and use of $\frac{\mathbf{r}}{|\mathbf{r}|}$ where $\mathbf{r} = \begin{pmatrix}4\\4\\2\end{pmatrix}$ or equivalent vector form such as $\mathbf{r} = (4\mathbf{i}+4\mathbf{j}+2\mathbf{k})$. Condone an attempt to find the coordinates of A