Question Number	Scheme	Notes	Marks
2	$\frac{\mathrm{d}x}{\mathrm{d}\theta}=\frac{\sec\theta\tan\theta+\sec^2\theta}{\sec\theta+\tan\theta}-\cos\theta$ Correct derivative. Do not condone missing brackets e.g. $\frac{\mathrm{d}x}{\mathrm{d}\theta}=\frac{1}{\sec\theta+\tan\theta}\times\sec\theta\tan\theta+\sec^2\theta-\cos\theta$ unless a correct expression is implied by subsequent work. Award when a correct expression is seen but note that other forms are possible e.g. $\sec\theta-\cos\theta,\ \tan\theta\sin\theta$		B1
	$\left(\frac{\mathrm{d}x}{\mathrm{d}\theta}\right)^2+\left(\frac{\mathrm{d}y}{\mathrm{d}\theta}\right)^2=\left(\frac{\sec\theta\tan\theta+\sec^2\theta}{\sec\theta+\tan\theta}-\cos\theta\right)^2+\left(-\sin\theta\right)^2$ Attempts $\frac{\mathrm{d}y}{\mathrm{d}\theta}$ and then $\left(\frac{\mathrm{d}x}{\mathrm{d}\theta}\right)^2+\left(\frac{\mathrm{d}y}{\mathrm{d}\theta}\right)^2$		M1
	$S=(2\pi)\int\cos\theta\sqrt{\left(\frac{\mathrm{d}x}{\mathrm{d}\theta}\right)^2+\left(\frac{\mathrm{d}y}{\mathrm{d}\theta}\right)^2}\,\mathrm{d}\theta$ $=(2\pi)\int\cos\theta\sqrt{\left(\frac{\sec\theta\tan\theta+\sec^2\theta}{\sec\theta+\tan\theta}-\cos\theta\right)^2+\left(-\sin\theta\right)^2}\,\mathrm{d}\theta$ Applies a correct surface area formula using their $\frac{\mathrm{d}x}{\mathrm{d}\theta}$ and their $\frac{\mathrm{d}y}{\mathrm{d}\theta}$ with or without the 2π For reference: $\sqrt{\left(\frac{\sec\theta\tan\theta+\sec^2\theta}{\sec\theta+\tan\theta}-\cos\theta\right)^2+\left(-\sin\theta\right)^2}=\tan\theta$ Allow π in front of the integral but must be an integral		M1
	$(2\pi)\int\sin\theta\ \mathrm{d}\theta$	Fully correct simplified integral with or without the 2π	A1
	$=(2\pi)\left[-\cos\theta\right](+c)$	Correct integration with or without the 2π	A1
	$(2\pi)\left[-\cos\theta\right]_0^{\frac{\pi}{4}}=(2\pi)\left(-\frac{1}{\sqrt{2}}+1\right)$ Applies the limits 0 and $\frac{\pi}{4}$. Must see evidence of both limits if necessary but condone e.g. $(2\pi)\left(-\frac{1}{\sqrt{2}}-1\right)$ **Depends on both previous method marks.**		dM1
	TSA = $2\pi\left(-\frac{1}{\sqrt{2}}+1\right)+\pi\times1^2+\pi\times\left(\frac{1}{\sqrt{2}}\right)^2$	**Correct** expressions for the 2 "ends" and adds these to their curved surface area. **Depends on the previous method mark.**	dM1
	$=\frac{\pi}{2}\left(7-2\sqrt{2}\right)$	Correct answer in the required form or correct values for p and q.	A1
	Note: **The final answer should follow correct work. The final mark should be withheld following e.g. $\frac{\mathrm{d}y}{\mathrm{d}\theta}$ clearly seen as +sin θ or $\int\sin\theta\ \mathrm{d}\theta=+\cos\theta$** **Note:** **Without the "ends" the answer is $\frac{\pi}{2}\left(4-2\sqrt{2}\right)$ (usually scores 6/8)**		
			(8)
			Total 8

Alternative for first 4 marks:

	$\frac{\mathrm{d}x}{\mathrm{d}\theta}=\frac{\sec\theta\tan\theta+\sec^2\theta}{\sec\theta+\tan\theta}-\cos\theta$ Correct derivative. Do not condone missing brackets e.g. $\frac{\mathrm{d}x}{\mathrm{d}\theta}=\frac{1}{\sec\theta+\tan\theta}\times\sec\theta\tan\theta+\sec^2\theta-\cos\theta$ unless a correct expression is implied by subsequent work. Award when a correct expression is seen but note that other forms are possible e.g. $\sec\theta-\cos\theta,\ \tan\theta\sin\theta$	B1
	$1+\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2=1+\left(\frac{-\sin\theta}{\sec\theta-\cos\theta}\right)^2$ Attempts $1+\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2$ with $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{\mathrm{d}y}{\mathrm{d}\theta}\times\frac{\mathrm{d}\theta}{\mathrm{d}x}$	M1
	$S=(2\pi)\int\cos\theta\sqrt{1+\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)^2}\,\frac{\mathrm{d}x}{\mathrm{d}\theta}\mathrm{d}\theta$ $=(2\pi)\int\cos\theta\sqrt{1+\left(\frac{-\sin\theta}{\sec\theta-\cos\theta}\right)^2}\,(\sec\theta-\cos\theta)\mathrm{d}\theta$ Applies a correct surface area formula using their $\frac{\mathrm{d}x}{\mathrm{d}\theta}$ and their $\frac{\mathrm{d}y}{\mathrm{d}x}$ with or without the 2π For reference: $\sqrt{1+\left(\frac{-\sin\theta}{\sec\theta-\cos\theta}\right)^2}\,(\sec\theta-\cos\theta)=\tan\theta$ Allow π in front of the integral but must be an integral	M1
	$(2\pi)\int\sin\theta\ \mathrm{d}\theta$ — Fully correct simplified integral with or without the 2π	A1