Question Number	Scheme	Marks
3 (a)	$x=\dfrac{t+15}{t+4}\Rightarrow t=\dfrac{15-4x}{x-1}$	M1
	$y=\dfrac{5}{t+2}\Rightarrow y=\dfrac{5}{\dfrac{15-4x}{x-1}+2}$	M1
	$y=\dfrac{5(x-1)}{15-4x+2(x-1)}$	dM1
	$g(x)=\dfrac{5x-5}{13-2x}\qquad 1<x\,,,\,\dfrac{15}{4}$	A1B1
		(5)
(b)	$0<g(x)\,,,\,\dfrac{5}{2}$	M1A1
		(2)
		(7 marks)

Question Number	Scheme	Marks
2 (a)	E.g. $x=\dfrac{t-1}{2t+1}\Rightarrow t=\dfrac{x+1}{1-2x}$ or $y=\dfrac{6}{2t+1}\Rightarrow t=\dfrac{6-y}{2y}$	**M1**
	E.g. $y=\dfrac{6}{2t+1}\Rightarrow y=\dfrac{6}{2\times\left(\dfrac{x+1}{1-2x}\right)+1}$ or $t=\dfrac{6-y}{2y}\Rightarrow x=\dfrac{\dfrac{6-y}{2y}-1}{2\times\dfrac{6-y}{2y}+1}$	**A1**
	E.g. $y=\dfrac{6}{2\times\left(\dfrac{x+1}{1-2x}\right)+1}\Rightarrow y=\dfrac{6(1-2x)}{2\times(x+1)+1(1-2x)}=ax+b$	**dM1**
	E.g. $y=\dfrac{6(1-2x)}{3}$, $y=2(1-2x)$ oe so linear *	**A1***
		(4)
(b)	$y=2(1-2x)$ and $y=x+12\Rightarrow 2(1-2x)=x+12\Rightarrow x=...$	**M1**
	$x=-2$	**A1cao**
		(2)

Question	Scheme	Marks
9(a)	$\dfrac{dx}{dt}=\sec t\tan t$ and $\dfrac{dy}{dt}=\sqrt{3}\sec^2\left(t+\dfrac{\pi}{3}\right)$	**B1**
	$\left(\dfrac{dy}{dx}=\right)\dfrac{dy}{dt}\div\dfrac{dx}{dt}=\dfrac{\sqrt{3}\sec^2\left(t+\dfrac{\pi}{3}\right)}{\sec t\tan t}$ oe	**M1 A1**
		(3)

(b)	$t=\frac{\pi}{3}\Rightarrow x=2, y=-3$	**B1**
	$t=\frac{\pi}{3}\Rightarrow \frac{dy}{dx}=\frac{\sqrt{3}\sec^2\frac{2\pi}{3}}{\sec\frac{\pi}{3}\tan\frac{\pi}{3}}=...(=2)$	**M1**
	Tangent is $y+3=2(x-2)\Rightarrow y=2x-7$ cso	**M1A1**
		(4)
(c)	$y=\sqrt{3}\frac{\tan t\pm\tan\frac{\pi}{3}}{1\pm\tan t\tan\frac{\pi}{3}}$	**M1**
	$x^2=\sec^2 t=1+\tan^2 t\Rightarrow \tan t=\sqrt{x^2-1}\Rightarrow y=\sqrt{3}\frac{\sqrt{x^2-1}+\sqrt{3}}{1-\sqrt{3}\sqrt{x^2-1}}$	**M1 A1**
	$=\sqrt{3}\frac{\sqrt{x^2-1}+\sqrt{3}}{1-\sqrt{3}\sqrt{x^2-1}}\times\frac{1+\sqrt{3}\sqrt{x^2-1}}{1+\sqrt{3}\sqrt{x^2-1}}=..$	
	$=\sqrt{3}\frac{\sqrt{x^2-1}+\sqrt{3}(x^2-1)+\sqrt{3}+3\sqrt{x^2-1}}{1-(3x^2-3)}=\frac{..\sqrt{x^2-1}+..x^2}{4-3x^2}$	**M1**
	$=\frac{3x^2+4\sqrt{3x^2-3}}{4-3x^2}$	**A1**
		(5)

Question Number	Scheme	Notes	Marks
2(a)	$\frac{x}{y}=t$	Cao	B1
			(1)
(b)	$y=\frac{\left(\frac{x}{y}\right)^3}{2\left(\frac{x}{y}\right)+1}$ or $x=\frac{\left(\frac{x}{y}\right)^4}{2\left(\frac{x}{y}\right)+1}$	Uses the y coordinate to obtain y in terms of x and y or uses the x coordinate to obtain x in terms of y and x	M1
	$y=\frac{x^3}{2xy^2+y^3}\Rightarrow y(2xy^2+y^3)=x^3$ or $x=\frac{x^4}{2xy^3+y^4}\Rightarrow x(2xy^3+y^4)=x^4$	Uses correct algebra to eliminate the fractions	M1
	$x^3-2xy^3-y^4=0$*	Cso	A1*
			(3)
			Total 4

Question Number	Scheme	Marks
9(a)	$\tan\theta=\sqrt{3}\Rightarrow k=\frac{\pi}{3}\left(\text{or } 60°\right)$ (Allow $x=\sqrt{3}\Rightarrow\theta=\frac{\pi}{3}\left(\text{or } 60°\right)$)	B1
	$V=(\pi)\int y^2\mathrm{d}x=(\pi)\int\left(2\sin 2\theta\right)^2\sec^2\theta\,\mathrm{d}\theta$ oe	M1A1
	$4(\pi)\int\sin^2 2\theta\sec^2\theta\ \mathrm{d}\theta=4(\pi)\int 4\sin^2\theta\cancel{\cos^2\theta}\times\frac{1}{\cancel{\cos^2\theta}}\ \mathrm{d}\theta$	**d**M1
	$=16(\pi)\int\sin^2\theta\,\mathrm{d}\theta$ oe e.g. $16(\pi)\int\left(1-\cos^2\theta\right)\mathrm{d}\theta$	A1
	$\sin^2\theta=\frac{1-\cos 2\theta}{2}\Rightarrow 16(\pi)\int\sin^2\theta\ \mathrm{d}\theta=16(\pi)\int\frac{1-\cos 2\theta}{2}\ \mathrm{d}\theta$	**d**M1
	Volume $=\int_0^{\frac{\pi}{3}}8\pi\left(1-\cos 2\theta\right)\mathrm{d}\theta$	A1 **Cso**
		(7)
(b)	$\int\left(1-\cos 2\theta\right)\mathrm{d}\theta\rightarrow\theta-\frac{\sin 2\theta}{2}$	B1
	Volume $=\int_0^{\frac{\pi}{3}}8\pi\left(1-\cos 2\theta\right)\mathrm{d}\theta=\left[8\pi\theta-4\pi\sin 2\theta\right]_0^{\frac{\pi}{3}}=\frac{8}{3}\pi^2-2\sqrt{3}\pi$	M1 A1
		(3)
		(10 marks)

Question	Scheme	Marks
3(a)	$x=3+2\sin t \qquad y=\dfrac{6}{7+\cos 2t} \qquad -\dfrac{\pi}{2}\leqslant t\leqslant\dfrac{\pi}{2}$	
	$y=\dfrac{6}{7+1-2\sin^2 t}$	M1
	$\sin t=\dfrac{x-3}{2}\Rightarrow y=\dfrac{6}{8-2\left(\dfrac{x-3}{2}\right)^2}$	M1A1
	$\Rightarrow y=\dfrac{12}{16-(x-3)^2}=\dfrac{12}{(4-x+3)(4+x-3)}=\dfrac{12}{(7-x)(1+x)}*$	M1A1*
	$\left(t=-\dfrac{\pi}{2}\Rightarrow x=1, t=\dfrac{\pi}{2}\Rightarrow x=5 \text{ so}\right)\quad p=1 \text{ and } q=5$	B1
		(6)
(a) Way 2	$y=\dfrac{6}{7+1-2\sin^2 t}$	M1
	$y=\dfrac{12}{16-4\sin^2 t}=\dfrac{12}{(4+2\sin t)(4-2\sin t)}$	M1A1
	$=\dfrac{12}{(4+x-3)(4-(x-3))}=\dfrac{12}{(7-x)(1+x)}*$	M1A1*
	$\left(t=-\dfrac{\pi}{2}\Rightarrow x=1, t=\dfrac{\pi}{2}\Rightarrow x=5 \text{ so}\right)\quad p=1 \text{ and } q=5$	B1
(a) Way 3	$y=\dfrac{12}{(7-x)(1+x)}=\dfrac{12}{(4-2\sin t)(4+2\sin t)}$	M1
	$=\dfrac{12}{16-4\sin^2 t}$	M1A1
	$=\dfrac{12}{16-4\left(\dfrac{1-\cos 2t}{2}\right)}$	M1
	$=\dfrac{12}{16-2+2\cos 2t}=\dfrac{12}{14+2\cos 2t}=\dfrac{6}{7+\cos 2t}=y*$	A1*
	$\left(t=-\dfrac{\pi}{2}\Rightarrow x=1, t=\dfrac{\pi}{2}\Rightarrow x=5 \text{ so}\right)\quad p=1 \text{ and } q=5$	B1

(a) Way 4	$y=\dfrac{6}{7+\cos 2t}\Rightarrow \cos 2t=\dfrac{6}{y}-7\Rightarrow 1-2\sin^2 t=\dfrac{6}{y}-7$	**M1**
	$\sin t=\dfrac{x-3}{2}\Rightarrow \dfrac{6}{y}-7=1-2\left(\dfrac{x-3}{2}\right)^2$	**M1A1**
	$\Rightarrow \dfrac{12}{y}=-x^2+6x+7\Rightarrow y=\dfrac{12}{-x^2+6x+7}=\dfrac{12}{(7-x)(1+x)}$*	**M1A1***
	$\left(t=-\dfrac{\pi}{2}\Rightarrow x=1, t=\dfrac{\pi}{2}\Rightarrow x=5 \text{ so}\right)$ $p=1$ and $q=5$	**B1**
(b)	$\dfrac{12}{(7-x)(1+x)}=\dfrac{A}{7-x}+\dfrac{B}{1+x}\Rightarrow 12=A(x+1)+B(7-x)\Rightarrow A=\ldots, B=\ldots$	**M1**
	So $(y=)\dfrac{3}{2(x+1)}-\dfrac{3}{2(x-7)}$ oe	**A1A1**
		(3)
		(9 marks)

Question Number	Scheme	Marks
8(a)	$x=2$	B1
		(1)
(b)	$(2.5, 1.5)$	B1
		(1)
(c)	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{1+\dfrac{1}{t^2}}{1-\dfrac{1}{t^2}}$	M1
	$t=2\Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{5}{3}\ \Rightarrow y-1.5=-\dfrac{3}{5}(x-2.5)$	dM1
	$3x+5y=15$*	A1*
		(3)
(d)	l crosses x-axis at $x=5$	B1
	$\dfrac{1}{3}\pi\times 1.5^2(5-2.5)\left(=\dfrac{15}{8}\pi\right)$	M1
	$V=\pi\displaystyle\int y^2\mathrm{d}x=\pi\int y^2\frac{\mathrm{d}x}{\mathrm{d}t}\,\mathrm{d}t=\pi\int\left(t-\frac{1}{t}\right)^2\left(1-\frac{1}{t^2}\right)\mathrm{d}t$	M1
	$\pi\displaystyle\int\left(t^2-2+\frac{1}{t^2}\right)\left(1-\frac{1}{t^2}\right)\mathrm{d}t=\pi\int\left(t^2+\frac{3}{t^2}-\frac{1}{t^4}-3\right)\mathrm{d}t=\ldots$	M1
	$\pi\left[\dfrac{t^3}{3}-\dfrac{3}{t}+\dfrac{1}{3t^3}-3t\right]$	A1
	$\pi\left[\dfrac{t^3}{3}-\dfrac{3}{t}+\dfrac{1}{3t^3}-3t\right]_1^2=\pi\left(\left(\dfrac{8}{3}-\dfrac{3}{2}+\dfrac{1}{24}-6\right)-\left(\dfrac{1}{3}-3+\dfrac{1}{3}-3\right)\right)$	M1
	$V=\dfrac{13}{24}\pi+\dfrac{15}{8}\pi=\dfrac{29}{12}\pi$ Cao	A1
		(7)
		Total 12

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 $0 \leqslant f \leqslant 4$	B1
		(1)
		(10 marks)

Question Number	Scheme	Marks
8 (a)	At $t=\frac{\pi}{4}$ $P=\left(\frac{1}{2},2\right)$	**B1**
	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\mathrm{d}y/\mathrm{d}t}{\mathrm{d}x/\mathrm{d}t} = \frac{2\sec^2 t}{2\sin t\cos t} = 4$ when $t=\frac{\pi}{4}$	**M1 A1**
	Equation of l: $y-2 = -\frac{1}{4}\left(x-\frac{1}{2}\right) \Rightarrow 8y-16 = -2x+1 \Rightarrow 8y+2x=17$*	**dM1 A1 * cso**
		(5)
(b)	$\int y\frac{\mathrm{d}x}{\mathrm{d}t}\,\mathrm{d}t = \int 2\tan t \times 2\sin t\cos t\,\mathrm{d}t$	**M1**
	$= \int 4\sin^2 t\,\mathrm{d}t$	**A1**
	$= \int 2-2\cos 2t\,\mathrm{d}t = 2t-\sin 2t$	**dM1 A1**
	Total area of $S = \left[2t-\sin 2t\right]_0^{\frac{\pi}{4}} + \frac{1}{2}\times 8\times 2 = \frac{\pi}{2}-1+8 = \frac{\pi}{2}+7$	**M1 A1**
		(6)
		(11 marks)

Question Number	Scheme	Marks
5 (a)	$\frac{dy}{dx}=\frac{dy/dt}{dx/dt}=\frac{16\sec^2 t\tan t}{2\sec^2 t}=8\tan t$	M1 A1
	At $x=3, \tan t=-1 \Rightarrow$ Gradient $=-8$	dM1 A1 **(4)**
(b)	Attempts to use $1+\tan^2 t=\sec^2 t \Rightarrow 1+\frac{(x-5)^2}{4}=\frac{y}{8}$	M1 A1
	$y=2(x-5)^2+8$	A1 **(3)**
(c)	8„ f„ 32	M1 A1 **(2)** **(9 marks)**

Question Number	Scheme	Marks
10(a)	$\frac{dx}{dt}=6t$ o.e.	B1
	$\text{Area}=\left(\int \sin t\sin 2t\times 6t\,dt=\right)\int \sin t\times 2\sin t\cos t\times 6t\,dt$	M1
	$=12\int_0^{\frac{\pi}{2}} t\sin^2 t\cos t\,dt$	A1
		(3)
(b)	$=(12)\left[\frac{t}{3}\sin^3 t\right]_0^{\frac{\pi}{2}}-(12)\int_0^{\frac{\pi}{2}}\frac{1}{3}\sin^3 t\,dt$	M1
	$=(12)\left[\frac{t}{3}\sin^3 t\right]_0^{\frac{\pi}{2}}-\left(\frac{12}{3}\right)\int_0^{\frac{\pi}{2}}\sin t\left(1-\cos^2 t\right)dt$	M1
	$=\left[4t\sin^3 t+4\cos t-\frac{4}{3}\cos^3 t\right]_0^{\frac{\pi}{2}}$	A1
	$=2\pi-\left(4-\frac{4}{3}\right)$	M1
	$=2\pi-\frac{8}{3}$	A1
		(5)
		Total 8

(a) On EPEN this is M1M1A1 but we are marking this as B1M1A1