Question Number	Scheme	Marks
5(a)	$\frac{dx}{dt}=\frac{2(1-t)-(-1)(3+2t)}{(1-t)^2}=\frac{5}{(1-t)^2}$ and $\frac{dy}{dt}=-2t$	
	At $t=2\Rightarrow\frac{dy}{dx}=\frac{(-1)^2}{5}\times(-2(2))=-\frac{4}{5}$	M1A1
	$(-7,-3)$	B1
	$y+3=\frac{5}{4}(x+7)$	M1
	$5x-4y+23=0$	A1
		(5)
(b)	$x=\frac{3+2t}{1-t}\to t=\frac{x-3}{x+2}$	M1
	$y=1-\left(\frac{x-3}{x+2}\right)^2=\frac{(x+2)^2-(x-3)^2}{(x+2)^2}=\frac{10x-5}{(x+2)^2}$	dM1A1
	$x\neq-2$	B1
		(4)
		(9 marks)

Question	**Scheme**	**Marks**
9(a)	$\frac{dx}{dt}=\sec t\tan t$ and $\frac{dy}{dt}=\sqrt{3}\sec^2\left(t+\frac{\pi}{3}\right)$	**B1**
	$\left(\frac{dy}{dx}=\right)\frac{dy}{dt}\div\frac{dx}{dt}=\frac{\sqrt{3}\sec^2\left(t+\frac{\pi}{3}\right)}{\sec t\tan t}$ 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	Marks
3(a)	$\frac{8x-5}{(2x-1)(4x-3)} \equiv \frac{A}{2x-1}+\frac{B}{4x-3} \Rightarrow 8x-5=A(4x-3)+B(2x-1) \Rightarrow A=\ldots\ B=\ldots$	M1
	$A=1$ or $B=2$	A1
	$\frac{8x-5}{(2x-1)(4x-3)} \equiv \frac{1}{2x-1}+\frac{2}{4x-3}$	A1
		(3)
(b)	$\int\left(\frac{1}{2x-1}+\frac{2}{4x-3}\right)\mathrm{d}x=\frac{1}{2}\ln\lvert 2x-1\rvert+\frac{1}{2}\ln\lvert 4x-3\rvert(+c)$ Follow through their *A* and *B*	M1, A1ft, A1ft
		(3)
(c)	$\left[\frac{1}{2}\ln(2x-1)+\frac{1}{2}\ln(4x-3)\right]_k^{3k}=\frac{1}{2}\ln(6k-1)(12k-3)-\frac{1}{2}\ln(2k-1)(4k-3)$ $=\frac{1}{2}\ln\frac{(6k-1)(12k-3)}{(2k-1)(4k-3)}$	M1
	$\frac{1}{2}\ln\frac{(6k-1)(12k-3)}{(2k-1)(4k-3)}=\frac{1}{2}\ln 20 \Rightarrow \frac{(6k-1)(12k-3)}{(2k-1)(4k-3)}=20$ $\Rightarrow (6k-1)(12k-3)=20(2k-1)(4k-3) \Rightarrow 88k^2-170k+57=0$	dM1A1
	$88k^2-170k+57=0 \Rightarrow k=\ldots$	ddM1
	$k=\frac{3}{2}$	A1
		(5)
		Total 11

Question Number	Scheme	Marks
1(a)	$2y^2-3y=7+13 \Rightarrow 2y^2-3y-20=0 \Rightarrow y=\ldots$	M1
	$y=-\frac{5}{2}$ and $y=4$	A1
		(2)
(b)	$2y^2 \to 4y\frac{\mathrm{d}y}{\mathrm{d}x}$	B1
	$-6xy \to \pm\ldots x\frac{\mathrm{d}y}{\mathrm{d}x}\pm\ldots y$	M1
	$4y\frac{\mathrm{d}y}{\mathrm{d}x}-6x\frac{\mathrm{d}y}{\mathrm{d}x}-6y=14\mathrm{e}^{2x-1}$	A1
	$4(4)\frac{\mathrm{d}y}{\mathrm{d}x}-6\left(\frac{1}{2}\right)\frac{\mathrm{d}y}{\mathrm{d}x}-6(4)=14\mathrm{e}^{2\left(\frac{1}{2}\right)-1} \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x}=\ldots$	M1
	$y-"4"="\frac{38}{13}"\left(x-\frac{1}{2}\right)$	M1
	$38x-13y+33=0$	A1
		(6)
		(8 marks)

Question Number	Scheme	Marks
6	$u=3+4\sin x\Rightarrow\frac{\mathrm{d}u}{\mathrm{d}x}=4\cos x$	B1
	$\int\frac{16\sin 2x}{(3+4\sin x)^2}\,\mathrm{d}x=\int\frac{32\sin x\cos x}{(3+4\sin x)^2}\,\mathrm{d}x=\int\frac{2(u-3)}{u^2}\,\mathrm{d}u$	M1 A1
	$=\int\frac{2}{u}-\frac{6}{u^2}\,\mathrm{d}u=2\ln u+\frac{6}{u}$	dM1 A1
	Uses limits of 5 and 7 $\Rightarrow 2\ln 7+\frac{6}{7}-2\ln 5-\frac{6}{5}=-\frac{12}{35}+\ln\frac{49}{25}$	M1 A1
		(7 marks)

Question	Scheme	Marks
7(a)	$u=4x+2\sin 2x\Rightarrow\frac{\mathrm{d}u}{\mathrm{d}x}=4+4\cos 2x$ oe	**M1 A1**
	$\frac{\mathrm{d}u}{\mathrm{d}x}=4+4\cos 2x=8\cos^2 x\Rightarrow\int_{(0)}^{\left(\frac{\pi}{2}\right)}\mathrm{e}^{4x+2\sin 2x}\cos^2 x\,\mathrm{d}x=\int_{(0)}^{(2\pi)}\frac{\mathrm{e}^u}{8}\,\mathrm{d}u$	**M1**
	$=\left["\frac{1}{8}"\mathrm{e}^u\right]_0^{2\pi}$ or $\left["\frac{1}{8}"\mathrm{e}^{4x+2\sin 2x}\right]_0^{\frac{\pi}{2}}$	**A1ft**
Alt by inspection for first 4 marks	$\int\mathrm{e}^{4x+2\sin 2x}\cos^2 x\,\mathrm{d}x=\int\mathrm{e}^{4x+2\sin 2x}\times\frac{1}{2}(1\pm\cos 2x)\,\mathrm{d}x$	**(M1 A1)**
	$=k\mathrm{e}^{4x+2\sin 2x};=\left["\frac{1}{8}"\mathrm{e}^{4x+2\sin 2x}\right]_0^{\frac{\pi}{2}}$	**(M1; A1ft)**
	$=\left[\frac{1}{8}\mathrm{e}^u\right]_0^{2\pi}$ or $\left[\frac{1}{8}\mathrm{e}^{4x+2\sin 2x}\right]_0^{\frac{\pi}{2}}=\frac{1}{8}\left(\mathrm{e}^{2\pi}-1\right)*$	**A1*cso**
		(5)
(b)	$V\left[=\pi\int_0^{\frac{\pi}{2}}y^2\,\mathrm{d}x=\pi\int_0^{\frac{\pi}{2}}\left(6\mathrm{e}^{2x+\sin 2x}\cos x\right)^2\,\mathrm{d}x\right]=36\pi\int_0^{\frac{\pi}{2}}\mathrm{e}^{4x+2\sin 2x}\cos^2 x\,\mathrm{d}x$	**B1**
	$K\int_0^{\frac{\pi}{2}}\mathrm{e}^{4x+2\sin 2x}\cos^2 x\,\mathrm{d}x=\frac{K}{8}\left(\mathrm{e}^{2\pi}-1\right)$	**M1**
	$=\frac{9\pi}{2}\left(\mathrm{e}^{2\pi}-1\right)$	**A1**
		(3)

Question Number	Scheme	Marks
9 (a)	$\frac{dy}{dt}=\frac{-1}{(t+1)^2}$, $\frac{dx}{dt}=\frac{2}{2t+5}$ $\Rightarrow\left(\frac{dy}{dx}=\right)-\frac{2t+5}{2(t+1)^2}$	M1A1
	Sets $-\frac{2t+5}{2(t+1)^2}=-4\Rightarrow 8t^2+14t+3=0$	M1A1
	$\Rightarrow(4t+1)(2t+3)=0\Rightarrow t=-\frac{1}{4}\Rightarrow(y=)\ \frac{4}{3}$	dM1A1
		(6)
(b) (i)	$a=2, b=5$	B1
	Area = $\int y\frac{dx}{dt}\,dt=\int_2^5\frac{1}{t+1}\times\frac{2}{2t+5}\,dt=\int_2^5\frac{2}{(t+1)(2t+5)}\,dt$	M1A1
(ii)	$\frac{2}{(t+1)(2t+5)}\equiv\frac{A}{(t+1)}+\frac{B}{(2t+5)}\Rightarrow A=\ldots, B=\ldots$	M1
	$=\frac{2/3}{(t+1)}-\frac{4/3}{(2t+5)}$	A1
	$\int\frac{2/3}{(t+1)}-\frac{4/3}{(2t+5)}\,dt=\frac{2}{3}\ln\lvert t+1\rvert-\frac{2}{3}\ln\lvert 2t+5\rvert$	M1A1ft
	$\int_2^5\frac{2}{(t+1)(2t+5)}\,dt=\left(\frac{2}{3}\ln 6-\frac{2}{3}\ln 15\right)-\left(\frac{2}{3}\ln 3-\frac{2}{3}\ln 9\right)$	
	$=\frac{2}{3}\ln\left(\frac{6}{5}\right)=\frac{1}{3}\ln\left(\frac{36}{25}\right)$	dM1A1
		(9)
		(15 marks)

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
	$g(x)=\dfrac{5x-5}{13-2x} \qquad 1<x\leqslant\dfrac{15}{4}$	A1B1
		(5)
(b)	$0<g(x)\leqslant\dfrac{5}{2}$	M1A1
		(2)
		(7 marks)

Question	Scheme	Marks
4(a)	$(l=)\sqrt{25+r^2}$	B1
		(1)
(b)	$(S=\pi r^2+)\pi r\sqrt{25+r^2}\Rightarrow\left(\dfrac{dS}{dr}=2\pi r+\right)\underline{\pi\sqrt{25+r^2}+\pi r.\dfrac{1}{2}(25+r^2)^{-\frac{1}{2}}.2r}$ Or $(S=\pi r^2+)\pi\sqrt{25r^2+r^4}\rightarrow\left(\dfrac{dS}{dr}=2\pi r+\right)\underline{\pi.\dfrac{1}{2}(25r^2+r^4)^{-\frac{1}{2}}\times(50r+4r^3)}$	M1 A1
	$(S=\pi(l^2-25))+\pi l\sqrt{l^2-25}\Rightarrow\left(\dfrac{dS}{dl}=2\pi l+\right)\underline{\pi\sqrt{l^2-25}+\pi l.\dfrac{1}{2}(l^2-25)^{-\frac{1}{2}}.2l}$	(M1 A1)
	$\dfrac{dS}{dt}=\dfrac{dS}{dr}\times\dfrac{dr}{dt}=..\times3$	M1
	$=81.5\ (\text{cm}^2/\text{min})$	A1
		(4)
		(5 marks)

Question Number	Scheme	Marks
3	Differentiates wrt *x* $\quad 3^x \ln 3 + 6\frac{dy}{dx} = \frac{3}{2}y^2 + 3xy\frac{dy}{dx}$	B1 B1, M1, A1
	Substitutes (2, 3) **AND** rearranges to get $\frac{dy}{dx}$ or vice versa $\Rightarrow 9\ln 3 + 6\frac{dy}{dx} = \frac{27}{2} + 18\frac{dy}{dx} \Rightarrow \frac{dy}{dx} = \frac{9\ln 3 - \frac{27}{2}}{12} = \frac{6\ln 3 - 9}{8} = \frac{-9 + \ln 729}{8}$	M1 A1, A1
		(7)
		(7 marks)

Question Number	Scheme	Marks
5 (a)	$2y\frac{dy}{dx} = e^{-2x}\frac{dy}{dx} - 2ye^{-2x} - 3$	B1 M1 A1
	$\left(e^{-2x} - 2y\right)\frac{dy}{dx} = 2ye^{-2x} + 3 \Rightarrow \frac{dy}{dx} = \frac{2ye^{-2x} + 3}{e^{-2x} - 2y}$ *	A1*
		(4)
(b)	Puts $x = 0$ into the equation of the curve $\Rightarrow y = y^2 \Rightarrow y = 1$	B1
	Attempts tangent at $(0,0)$ **or** $(0,1)$ $\quad y = 3x$ **or** $y = -5x + 1$	M1 A1
	Solves $y = 3x$ with $y = -5x + 1 \Rightarrow R = \left(\frac{1}{8}, \frac{3}{8}\right)$	dM1 A1
		(5)
		(9 marks)