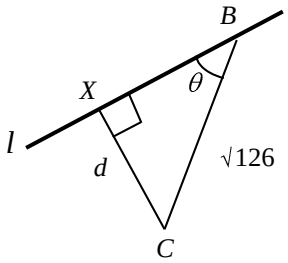
Question Number	Scheme	Marks
1.	$f(x) = \frac{1}{\sqrt{4+x}} = (4+x)^{-\frac{1}{2}}$	M1
	$= 4^{-\frac{1}{2}}\left(1+\ldots\right)^{\ldots}$ $\frac{1}{2}\left(1+\ldots\right)^{\ldots}$ or $\frac{1}{2\sqrt{1+\ldots}}$	B1
	$= \ldots\left(1+\left(-\frac{1}{2}\right)\left(\frac{x}{4}\right)+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2}\left(\frac{x}{4}\right)^2+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{5}{2}\right)}{3!}\left(\frac{x}{4}\right)^3+\ldots\right)$ ft their $\left(\frac{x}{4}\right)$	M1 A1ft
	$= \frac{1}{2}-\frac{1}{16}x,+\frac{3}{256}x^2-\frac{5}{2048}x^3+\ldots$	A1, A1 (6)
		(6 marks)
2. (a)	1.14805 awrt 1.14805	B1 (1)
(b)	$A \approx \frac{1}{2}\times\frac{3\pi}{8}$ ...	B1
	$= \ldots \frac{3}{2}\left(2.77164+2.12132+1.14805+0\right)$ 0 can be implied	M1
	$= \frac{3\pi}{16}\left(3+2\right)\left(2.77164+2.12132+1.14805\right)$ ft their (a)	A1ft
	$= \frac{3\pi}{16}\times 15.08202\ldots = 8.884$ cao	A1 (4)
(c)	$\int 3\cos\left(\frac{x}{3}\right)dx = \frac{3\sin\left(\frac{x}{3}\right)}{\frac{1}{3}}$	M1 A1
	$= 9\sin\left(\frac{x}{3}\right)$	
	$A = \left[9\sin\left(\frac{x}{3}\right)\right]_0^{\frac{3\pi}{2}} = 9-0=9$ cao	A1 (3)
		(8 marks)

Question Number	Scheme	Marks
3. (a)	$\mathrm{f}\ x = \dfrac{4-2x}{2x+1\ \ x+1\ \ x+3} = \dfrac{A}{2x+1} + \dfrac{B}{x+1} + \dfrac{C}{x+3}$	
	$4-2x = A\ x+1\ \ x+3\ + B\ 2x+1\ \ x+3\ + C\ 2x+1\ \ x+1$	M1
	A method for evaluating one constant	M1
	$x \to -\frac{1}{2},\ \ 5 = A\ \frac{1}{2}\ \ \frac{5}{2}\ \Rightarrow A = 4$ any one correct constant	A1
	$x \to -1,\ \ 6 = B\ -1\ \ 2\ \Rightarrow B = -3$	
	$x \to -3,\ 10 = C\ -5\ \ -2\ \Rightarrow C = 1$ all three constants correct	A1 (4)
(b) (i)	$\int\left(\dfrac{4}{2x+1} - \dfrac{3}{x+1} + \dfrac{1}{x+3}\right)\mathrm{d}x$	
	$= \dfrac{4}{2}\ln\ 2x+1\ - 3\ln\ x+1\ + \ln\ x+3\ + C$ A1 two ln terms correct	M1 A1ft
	All three ln terms correct and "+C" ; ft constants	A1ft (3)
(ii)	$\left[2\ln\ 2x+1\ - 3\ln\ x+1\ + \ln\ x+3\ \right]_0^2$	
	$= 2\ln 5 - 3\ln 3 + \ln 5\ - 2\ln 1 - 3\ln 1 + \ln 3$	M1
	$= 3\ln 5 - 4\ln 3$	
	$= \ln\left(\dfrac{5^3}{3^4}\right)$	M1
	$= \ln\left(\dfrac{125}{81}\right)$	A1 (3)
		(10 marks)

Question Number	Scheme	Marks
4. (a)	$e^{-2x}\frac{dy}{dx} - 2ye^{-2x} = 2 + 2y\frac{dy}{dx}$ A1 correct RHS	M1 A1
	$\frac{d}{dx}\left(ye^{-2x}\right) = e^{-2x}\frac{dy}{dx} - 2ye^{-2x}$	B1
	$e^{-2x} - 2y\frac{dy}{dx} = 2 + 2ye^{-2x}$	M1
	$\frac{dy}{dx} = \frac{2 + 2ye^{-2x}}{e^{-2x} - 2y}$	A1 (5)
(b)	At P, $\frac{dy}{dx} = \frac{2 + 2e^{0}}{e^{0} - 2} = -4$	M1
	Using $mm' = -1$ $m' = \frac{1}{4}$	M1
	$y - 1 = \frac{1}{4}(x - 0)$	M1
	$x - 4y + 4 = 0$ or any integer multiple	A1 (4)
		(9 marks)
5. (a)	$\frac{dx}{dt} = -4\sin 2t$, $\frac{dy}{dt} = 6\cos t$	B1, B1
	$\frac{dy}{dx} = -\frac{6\cos t}{4\sin 2t}$ $\left(= -\frac{3}{4\sin t}\right)$	M1
	At $t = \frac{\pi}{3}$, $m = -\frac{3}{4 \times \frac{\sqrt{3}}{2}} = -\frac{\sqrt{3}}{2}$ accept equivalents, awrt -0.87	A1 (4)
(b)	Use of $\cos 2t = 1 - 2\sin^2 t$	M1
	$\cos 2t = \frac{x}{2}$, $\sin t = \frac{y}{6}$	
	$\frac{x}{2} = 1 - 2\left(\frac{y}{6}\right)^2$	M1
	Leading to $y = \sqrt{18 - 9x} = 3\sqrt{2 - x}$ cao	A1
	$-2 \le x \le 2$ $k = 2$	B1 (4)
(c)	$0 \le f(x) \le 6$ either $0 \le f(x)$ or $f(x) \le 6$	B1
	Fully correct. Accept $0 \le y \le 6$, $0, 6$	B1 (2)
		(10 marks)

Question Number	Scheme	Marks
6. (a)	$\int \sqrt{5-x}\,dx = \int (5-x)^{\frac{1}{2}}\,dx = \dfrac{(5-x)^{\frac{3}{2}}}{-\frac{3}{2}} + C$	M1 A1 (2)
	$\left(= -\dfrac{2}{3}(5-x)^{\frac{3}{2}} + C\right)$	
(b)(i)	$\int (x-1)\sqrt{5-x}\,dx = -\dfrac{2}{3}(x-1)(5-x)^{\frac{3}{2}} + \dfrac{2}{3}\int (5-x)^{\frac{3}{2}}\,dx$	M1 A1ft
	$= \quad \ldots \quad + \dfrac{2}{3} \times \dfrac{(5-x)^{\frac{5}{2}}}{-\frac{5}{2}} + C$	M1
	$= -\dfrac{2}{3}(x-1)(5-x)^{\frac{3}{2}} - \dfrac{4}{15}(5-x)^{\frac{5}{2}} + C$	A1 (4)
(ii)	$\left[-\dfrac{2}{3}(x-1)(5-x)^{\frac{3}{2}} - \dfrac{4}{15}(5-x)^{\frac{5}{2}}\right]_1^5 = (0-0) - \left(0 - \dfrac{4}{15} \times 4^{\frac{5}{2}}\right)$	
	$= \dfrac{128}{15}\left(= 8\dfrac{8}{15} \approx 8.53\right)$ awrt 8.53	M1 A1 (2)
		(8 marks)

Question Number	Scheme	Marks
7. (a)	$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = \begin{pmatrix}10\\14\\-4\end{pmatrix} - \begin{pmatrix}8\\13\\-2\end{pmatrix} = \begin{pmatrix}2\\1\\-2\end{pmatrix}$ or $\overrightarrow{BA} = \begin{pmatrix}-2\\-1\\2\end{pmatrix}$	M1
	$\mathbf{r} = \begin{pmatrix}8\\13\\-2\end{pmatrix} + \lambda\begin{pmatrix}2\\1\\-2\end{pmatrix}$ *or* $\mathbf{r} = \begin{pmatrix}10\\14\\-4\end{pmatrix} + \lambda\begin{pmatrix}2\\1\\-2\end{pmatrix}$ accept equivalents	M1 A1ft (3)
(b)	$\overrightarrow{CB} = \overrightarrow{OB} - \overrightarrow{OC} = \begin{pmatrix}10\\14\\-4\end{pmatrix} - \begin{pmatrix}9\\9\\6\end{pmatrix} = \begin{pmatrix}1\\5\\-10\end{pmatrix}$ or $\overrightarrow{BC} = \begin{pmatrix}-1\\-5\\10\end{pmatrix}$	
	$CB = \sqrt{1^2 + 5^2 + (-10)^2} = \sqrt{126} = 3\sqrt{14} \approx 11.2$ awrt 11.2	M1 A1 (2)
(c)	$\overrightarrow{CB}.\overrightarrow{AB} = \left\|\overrightarrow{CB}\right\|\left\|\overrightarrow{AB}\right\|\cos\theta$	
	$\pm\ 2 + 5 + 20 = \sqrt{126}\sqrt{9}\cos\theta$	M1 A1
	$\cos\theta = \frac{3}{\sqrt{14}} \Rightarrow \theta \approx 36.7°$ awrt 36.7°	A1 (3)
(d)	 $\frac{d}{\sqrt{126}} = \sin\theta$	M1 A1ft
	$d = 3\sqrt{5} \approx 6.7$ awrt 6.7	A1 (3)
(e)	$BX^2 = BC^2 - d^2 = 126 - 45 = 81$	M1
	! $CBX = \frac{1}{2} \times BX \times d = \frac{1}{2} \times 9 \times 3\sqrt{5} = \frac{27\sqrt{5}}{2} \approx 30.2$ awrt 30.1 or 30.2	M1 A1 (3)
		(14 marks)

Question Number	Scheme	Marks
8. (a)	$\int \sin^2\theta \, d\theta = \frac{1}{2}\int 1-\cos 2\theta \; d\theta = \frac{1}{2}\theta - \frac{1}{4}\sin 2\theta \quad + C$	M1 A1 (2)
	$x = \tan\theta \Rightarrow \frac{dx}{d\theta} = \sec^2\theta$	
(b)	$\pi\int y^2\,dx = \pi\int y^2 \frac{dx}{d\theta}d\theta = \pi\int (2\sin 2\theta)^2 \sec^2\theta \, d\theta$	M1 A1
	$= \pi\int \frac{2\times 2\sin\theta\cos\theta)^2}{\cos^2\theta}d\theta$	M1
	$= 16\pi\int \sin^2\theta\,d\theta \qquad k = 16\pi$	A1
	$x=0 \Rightarrow \tan\theta = 0 \Rightarrow \theta = 0, \quad x = \frac{1}{\sqrt{3}} \Rightarrow \tan\theta = \frac{1}{\sqrt{3}} \Rightarrow \theta = \frac{\pi}{6}$	B1 (5)
(c)	$\left(V = 16\pi\int_0^{\frac{\pi}{6}} \sin^2\theta\,d\theta\right)$	
	$V = 16\pi\left[\frac{1}{2}\theta - \frac{\sin 2\theta}{4}\right]_0^{\frac{\pi}{6}}$	M1
	$= 16\pi\left[\left(\frac{\pi}{12} - \frac{1}{4}\sin\frac{\pi}{3}\right) - \; 0 - 0\;\right]$ Use of correct limits	M1
	$= 16\pi\left(\frac{\pi}{12} - \frac{\sqrt{3}}{8}\right) = \frac{4}{3}\pi^2 - 2\pi\sqrt{3} \qquad p = \frac{4}{3},\ q = -2$	A1 (3)
		(10 marks)