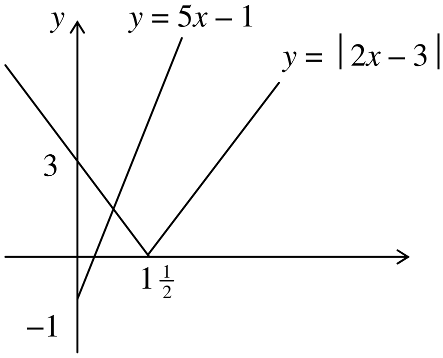
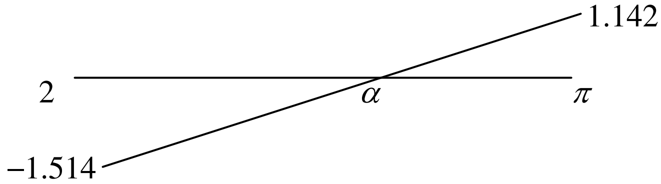
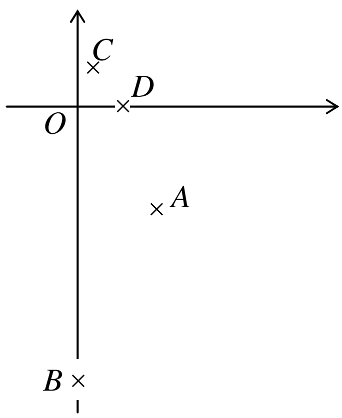
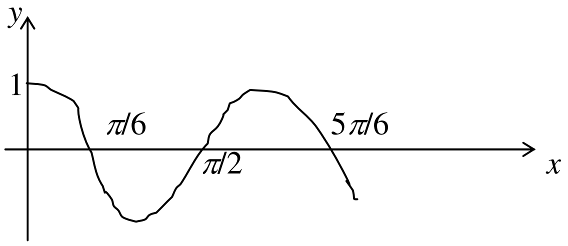
Question Number	Scheme	Marks
1.	$zw =$ $12\left(\cos\frac{\pi}{4}\cos\frac{2\pi}{3} - \sin\frac{\pi}{4}\sin\frac{2\pi}{3}\right) + 12\mathrm{i}\left(\sin\frac{\pi}{4}\cos\frac{2\pi}{3} + \cos\frac{\pi}{4}\sin\frac{2\pi}{3}\right)$ $= 12\left[\cos\frac{11\pi}{12} + \mathrm{i}\sin\frac{11\pi}{12}\right]$	B1 for 12 M1 A1 **(3 marks)**
2. (*a*)	 shape points on axes	 B1 B1 **(2)**
(*b*)	$-2x + 3 = 5x - 1$ $x = \frac{4}{7}$ $x > \frac{4}{7}$	M1 A1 A1 ft **(3)** **(5 marks)**

Question Number	Scheme	Marks
3. (*a*)	$\frac{1}{r+1}-\frac{1}{r+3}$	B1 B1 **(2)**
(*b*)	$\sum_{1}^{n} \frac{1}{r+1}-\frac{1}{r+3} = \frac{1}{2} - \not{\frac{1}{4}}$	
	$+ \frac{1}{3} - \frac{1}{5}$	
	$+ \not{\frac{1}{4}} - \not{\frac{1}{6}}$	M1
	$\vdots$	
	$+ \not{\frac{1}{n}} - \frac{1}{n+2}$	
	$+ \not{\frac{1}{n+1}} - \frac{1}{n+3}$	
	$= \left(\frac{1}{2}+\frac{1}{3}\right)+\left(-\frac{1}{n+2}-\frac{1}{n+3}\right)$	A1 A1
	$= \frac{5}{6}-\left(\frac{5n^2+25n+\not{30}-12n-\not{30}}{6(n+2)(n+3)}\right)$	M1
	$= \frac{n(5n+13)}{6(n+2)(n+3)}$ *	A1 cso
		(5)
		(7 marks)

Question Number	Scheme	Marks
4. (*a*)	$f(2) = -1.514$	B1
	$f(\pi) = 1.142$	B1
		
	$\dfrac{\pi - \alpha}{\alpha - 2} = \dfrac{1.142}{1.514}$	M1
	$\pi \times 1.514 + 2 \times 1.142 = (1.142 + 1.514)\alpha$	
	$\alpha = 2.65$	A1 **(4)**
(*b*)	$f'(x) = 4\cos 2x + 1$ $k\cos 2x + c$	M1
	$f(2.8) = -0.4625$	B1
	$f'(2.8) = 4.1023$	A1
	$x_2 = 2.8 - \dfrac{(-0.4625)}{4.1023}$	M1
	$= 2.91$ only	A1
		(9 marks)

Question Number	Scheme	Marks
5. (*a*)	$v + x\dfrac{dv}{dx}$,= $(4 + v)(1 + v)$	M1, M1
	$x\dfrac{dv}{dx} = v^2 + 5v + 4 - v$	A1
	$x\dfrac{dv}{dx} = (v + 2)^2$ *	A1 **(4)**
(*b*)	$\int \dfrac{1}{(v+2)^2}\,dv = \int \dfrac{1}{x}\,dx$	B1, M1
	$-\dfrac{1}{2+v} = \ln x + c$ must have + *c*	M1 A1
	$2 + v = -\dfrac{1}{\ln x + c}$	M1
	$v = -\dfrac{1}{\ln x + c} - 2$	A1 **(5)**
(*c*)	$y = -2x - \dfrac{x}{\ln x + c}$	B1 **(1)**
		(10 marks)

Question Number	Scheme	Marks
6. (*a*)	$z^2 = (3 - 3\text{i})(3 - 3\text{i}) = -18\text{i}$	M1 A1 **(2)**
(*b*)	$\frac{1}{z} = \frac{(3+3\text{i})}{(3-3\text{i})(3+3\text{i})} = \frac{3+3\text{i}}{18} = \frac{1+\text{i}}{6}$	M1 A1 **(2)**
(*c*)	$\lvert z \rvert = \sqrt{(9+9)} = \sqrt{18} = 3\sqrt{2}$	
	$\lvert z \rvert = 18$ two correct	M1
	$\left\lvert \frac{1}{z} \right\rvert = \sqrt{\frac{1}{18}} = \frac{1}{3\sqrt{2}} = \frac{\sqrt{2}}{6}$ all three correct	A1 **(2)**
(*d*)	 two correct	B1
	four correct	B1 **(2)**
(*e*)	$\frac{OB}{OD} = 18, \quad \frac{OA}{OC} = \frac{3\sqrt{2}}{\sqrt{2}/6} = 18$	M1 A1
	$\angle AOB = \angle COD = 45 \quad \therefore$ similar	B1 **(3)**
		(11 marks)

Question Number	Scheme	Marks
7. (*a*)	$y = \lambda x \cos 3x$	
	$\frac{dy}{dx} = \lambda \cos 3x - 3\lambda x \sin 3x$	M1 A1
	$\frac{d^2 y}{dx^2} = -3\lambda \sin 3x - 3\lambda \sin 3x - 9\lambda x \cos 3x$	A1
	$\therefore\ -6\lambda \sin 3x - 9\lambda x \cos 3x + 9\lambda x \cos 3x = -12 \sin 3x$	
	$\lambda = 2$ cso	A1 **(4)**
(*b*)	$\lambda^2 - 9 = 0$	M1
	$\lambda = (\pm)3\mathrm{i}$	A1
	$\therefore\ y = A \sin 3x + B \cos 3x$ form	M1
	$\therefore\ y = A \sin 3x + B \cos 3x + 2x \cos 3x$	A1 ft on λ's **(4)**
(*c*)	$y = 1, x = 0 \Rightarrow B = 1$	B1
	$\frac{dy}{dx} = 3A \cos 3x - 3B \sin 3x + 2 \cos 3x - 6x \sin 3x$	M1 A1ft on λ's
	$2 = 3A + 2 \Rightarrow A = 0$	
	$\therefore\ y = \cos 3x + 2x \cos 3x$	A1 **(4)**
(*d*)		
	axes	B1
	shape	B1 **(2)**
		(14 marks)

Question Number	Scheme	Marks
8. (*a*)	$\frac{1}{2}a^2\int 1+\cos^2\theta+2\cos\theta \ \ \mathrm{d}\theta$	M1 A1correct with limits
	$=\frac{1}{2}a^2\int 1+\frac{\cos 2\theta+1}{2}+2\cos\theta \ \mathrm{d}\theta$	M1 A1
	$=2\times\frac{1}{2}a^2\left[\theta+\frac{\sin 2\theta}{4}+\frac{\theta}{2}+2\sin\theta\right]_0^{\pi}$	A1
	$=a^2\left[\frac{3\pi}{2}\right]=\frac{3\pi a^2}{2}$	A1 **(6)**
(*b*)	$x=a\cos\theta+a\cos^2\theta$ $r\cos\theta$	M1
	$\frac{\mathrm{d}x}{\mathrm{d}\theta}=-a\sin\theta-2a\cos\theta\sin\theta$	A1
	$\frac{\mathrm{d}x}{\mathrm{d}\theta}=0\Rightarrow\cos\theta=-\frac{1}{2}$ finding θ	M1
	$\theta=\frac{2\pi}{3}$ or $\theta=\frac{4\pi}{3}$	
	$r=\frac{a}{2}$ or $r=\frac{a}{2}$ finding r	M1
	A: $r=\frac{a}{2}$, $\theta=\frac{2\pi}{3}$	
	B: $r=\frac{a}{2}$, $\theta=\frac{-2\pi}{3}$ both A and B	A1 **(5)**
(*c*)	$x=-\frac{1}{4}a \quad \therefore\ WX=2a+\frac{1}{4}a=2\frac{1}{4}a$	M1 A1
(*d*)	$WXYZ=\frac{27\sqrt{3}a^2}{8}$	B1 ft **(1)**
(*e*)	Area $=\frac{27\sqrt{3}}{8}\times 100-\frac{3\pi\times 100}{2}=113.3\text{ cm}^2$	M1 A1 **(2)**
		(16 marks)