Mark Scheme (Results)
Summer 2010

GCE

Core Mathematics C4 (6666)

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Question Number	Scheme		Marks	
1.	(a) $y\left(\frac{\pi}{6}\right) \approx 1.2247, \ y\left(\frac{\pi}{4}\right) = 1.1180$	accept awrt 4 d.p.	B1 B1	**(2)**
	(b)(i) $I \approx \left(\frac{\pi}{12}\right)(1.3229 + 2 \times 1.2247 + 1)$	B1 for $\frac{\pi}{12}$	B1 M1	
	≈ 1.249	cao	A1	
	(ii) $I \approx \left(\frac{\pi}{24}\right)(1.3229 + 2 \times (1.2973 + 1.2247 + 1.1180) + 1)$	B1 for $\frac{\pi}{24}$	B1 M1	
	≈ 1.257	cao	A1	**(6)** **[8]**

Question Number	Scheme		Marks
2.	$\dfrac{\mathrm{d}u}{\mathrm{d}x} = -\sin x$		B1
	$\int \sin x\, \mathrm{e}^{\cos x+1} \mathrm{d}x = -\int \mathrm{e}^{u} \mathrm{d}u$		M1 A1
	$= -\mathrm{e}^{u}$	ft sign error	A1ft
	$= -\mathrm{e}^{\cos x+1}$		
	$\left[-\mathrm{e}^{\cos x+1}\right]_0^{\frac{\pi}{2}} = -\mathrm{e}^{1} - \left(-\mathrm{e}^{2}\right)$	or equivalent with u	M1
	$= \mathrm{e}(\mathrm{e}-1)$ ∗	cso	A1 **(6)**
			[6]

Question Number	Scheme	Marks
3.	$\frac{\mathrm{d}}{\mathrm{d}x}\left(2^x\right) = \ln 2.2^x$	B1
	$\ln 2.2^x + 2y\frac{\mathrm{d}y}{\mathrm{d}x} = 2y + 2x\frac{\mathrm{d}y}{\mathrm{d}x}$	M1 A1= A1
	Substituting $(3, 2)$	
	$8\ln 2 + 4\frac{\mathrm{d}y}{\mathrm{d}x} = 4 + 6\frac{\mathrm{d}y}{\mathrm{d}x}$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = 4\ln 2 - 2$ Accept exact equivalents	M1 A1 **(7)**
		[7]

Question Number	Scheme		Marks
4.	(a) $\frac{dx}{dt} = 2\sin t\cos t,\ \frac{dy}{dt} = 2\sec^2 t$		B1 B1
	$\frac{dy}{dx} = \frac{\sec^2 t}{\sin t\cos t}\left(= \frac{1}{\sin t\cos^3 t}\right)$	or equivalent	M1 A1 **(4)**
	(b) At $t = \frac{\pi}{3},\ x = \frac{3}{4},\ y = 2\sqrt{3}$		B1
	$\frac{dy}{dx} = \frac{\sec^2 \frac{\pi}{3}}{\sin\frac{\pi}{3}\cos\frac{\pi}{3}} = \frac{16}{\sqrt{3}}$		M1 A1
	$y - 2\sqrt{3} = \frac{16}{\sqrt{3}}\left(x - \frac{3}{4}\right)$		M1
	$y = 0 \quad \Rightarrow \quad x = \frac{3}{8}$		M1 A1 **(6)**
			[10]

Question Number	Scheme	Marks
5.	(a) $A = 2$	B1
	$2x^2 + 5x - 10 = A(x-1)(x+2) + B(x+2) + C(x-1)$	
	$x \to 1$ $\quad -3 = 3B \Rightarrow B = -1$	M1 A1
	$x \to -2$ $\quad -12 = -3C \Rightarrow C = 4$	A1 **(4)**
	(b) $\dfrac{2x^2 + 5x - 10}{(x-1)(x+2)} = 2 + (1-x)^{-1} + 2\left(1 + \dfrac{x}{2}\right)^{-1}$	M1
	$(1-x)^{-1} = 1 + x + x^2 + \ ...$	B1
	$\left(1 + \dfrac{x}{2}\right)^{-1} = 1 - \dfrac{x}{2} + \dfrac{x^2}{4} + \ ...$	B1
	$\dfrac{2x^2 + 5x - 10}{(x-1)(x+2)} = (2+1+2) + (1-1)x + \left(1 + \dfrac{1}{2}\right)x^2 + \ ...$	M1
	$= 5 + \ ...$ $\quad$ ft their $A - B + \frac{1}{2}C$	A1 ft
	$= \ ... + \dfrac{3}{2}x^2 + \ ...$ $\quad$ $0x$ stated or implied	A1 A1 **(7)**
		[11]

Question Number	Scheme		Marks
6.	(a) $\mathrm{f}(\theta) = 4\cos^2\theta - 3\sin^2\theta$		
	$= 4\left(\frac{1}{2}+\frac{1}{2}\cos 2\theta\right) - 3\left(\frac{1}{2}-\frac{1}{2}\cos 2\theta\right)$		M1 M1
	$= \frac{1}{2}+\frac{7}{2}\cos 2\theta$ ∗	cso	A1 **(3)**
	(b) $\int \theta\cos 2\theta \, \mathrm{d}\theta = \frac{1}{2}\theta\sin 2\theta - \frac{1}{2}\int \sin 2\theta \, \mathrm{d}\theta$		M1 A1
	$= \frac{1}{2}\theta\sin 2\theta + \frac{1}{4}\cos 2\theta$		A1
	$\int \theta \, \mathrm{f}(\theta) \, \mathrm{d}\theta = \frac{1}{4}\theta^2 + \frac{7}{4}\theta\sin 2\theta + \frac{7}{8}\cos 2\theta$		M1 A1
	$\left[\ \ldots\ \right]_0^{\frac{\pi}{2}} = \left[\frac{\pi^2}{16}+0-\frac{7}{8}\right] - \left[0+0+\frac{7}{8}\right]$		M1
	$= \frac{\pi^2}{16} - \frac{7}{4}$		A1 **(7)**
			[10]

Question Number	Scheme	Marks
7.	(a) **j** components $3+2\lambda=9 \Rightarrow \lambda=3$ $(\mu=1)$	M1 A1
	Leading to $C:(5, 9, -1)$ accept vector forms	A1 **(3)**
	(b) Choosing correct directions or finding $\overrightarrow{AC}$ and $\overrightarrow{BC}$	M1
	$\begin{pmatrix}1\\2\\1\end{pmatrix}.\begin{pmatrix}5\\0\\2\end{pmatrix}=5+2=\sqrt{6}\sqrt{29}\cos\angle ACB$ use of scalar product	M1 A1
	$\angle ACB = 57.95°$ awrt $57.95°$	A1 **(4)**
	(c) $A:(2, 3, -4)$ $B:(-5, 9, -5)$	
	$\overrightarrow{AC}=\begin{pmatrix}3\\6\\3\end{pmatrix}$, $\overrightarrow{BC}=\begin{pmatrix}10\\0\\4\end{pmatrix}$	
	$AC^2=3^2+6^2+3^2 \Rightarrow AC=3\sqrt{6}$	M1 A1
	$BC^2=10^2+4^2 \Rightarrow BC=2\sqrt{29}$	A1
	$\triangle ABC=\frac{1}{2}AC\times BC\sin\angle ACB$	
	$=\frac{1}{2}3\sqrt{6}\times 2\sqrt{29}\sin\angle ACB \approx 33.5$ $15\sqrt{5}$, awrt 34	M1 A1 **(5)**
		[12]
	Alternative method for (b) *and* (c)	
	(b) $A:(2, 3, -4)$ $B:(-5, 9, -5)$ $C:(5, 9, -1)$	
	$AB^2=7^2+6^2+1^2=86$	
	$AC^2=3^2+6^2+3^2=54$	
	$BC^2=10^2+0^2+4^2=116$ Finding all three sides	M1
	$\cos\angle ACB=\frac{116+54-86}{2\sqrt{116}\sqrt{54}}$ $(=0.53066\ ...)$	M1 A1
	$\angle ACB=57.95°$ awrt $57.95°$	A1 **(4)**
	If this method is used some of the working may gain credit in part (c) and appropriate marks may be awarded if there is an attempt at part (c).	

Question Number	Scheme		Marks
8.	(a) $\dfrac{\mathrm{d}V}{\mathrm{d}t} = 0.48\pi - 0.6\pi h$		M1 A1
	$V = 9\pi h \quad \Rightarrow \dfrac{\mathrm{d}V}{\mathrm{d}t} = 9\pi \dfrac{\mathrm{d}h}{\mathrm{d}t}$		B1
	$9\pi \dfrac{\mathrm{d}h}{\mathrm{d}t} = 0.48\pi - 0.6\pi h$		M1
	Leading to $75\dfrac{\mathrm{d}h}{\mathrm{d}t} = 4 - 5h$ *	cso	A1 **(5)**
	(b) $\displaystyle\int \frac{75}{4-5h}\,\mathrm{d}h = \int 1\,\mathrm{d}t$	separating variables	M1
	$-15\ln(4-5h) = t \quad (+C)$		M1 A1
	$-15\ln(4-5h) = t + C$		
	When $t = 0$, $h = 0.2$		
	$-15\ln 3 = C$		M1
	$t = 15\ln 3 - 15\ln(4-5h)$		
	When $h = 0.5$		
	$t = 15\ln 3 - 15\ln 1.5 = 15\ln\left(\dfrac{3}{1.5}\right) = 15\ln 2$	awrt 10.4	M1 A1
	Alternative for last 3 *marks*		
	$t = \left[-15\ln(4-5h)\right]_{0.2}^{0.5}$		
	$= -15\ln 1.5 + 15\ln 3$		M1 M1
	$= 15\ln\left(\dfrac{3}{1.5}\right) = 15\ln 2$	awrt 10.4	A1 **(6)**

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