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January 2010

GCE

GCE Core Mathematics C4 (6666/01)

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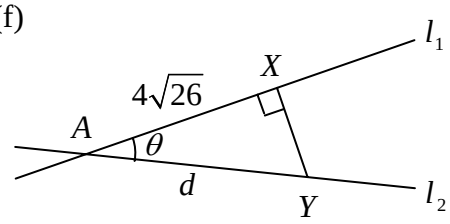
Question Number	Scheme	Marks
Q1	(a) $(1-8x)^{\frac{1}{2}} = 1+\left(\frac{1}{2}\right)(-8x)+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2}(-8x)^2+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}(-8x)^3+\ldots$	M1 A1
	$=1-4x-8x^2; -32x^3 - \ldots$	A1; A1 (4)
	(b) $\sqrt{(1-8x)} = \sqrt{\left(1-\frac{8}{100}\right)}$	M1
	$=\sqrt{\frac{92}{100}} = \sqrt{\frac{23}{25}} = \frac{\sqrt{23}}{5}$ * cso	A1 (2)
	(c) $1-4x-8x^2-32x^3 = 1-4(0.01)-8(0.01)^2-32(0.01)^3$	
	$=1-0.04-0.0008-0.000\,032 = 0.959\,168$	M1
	$\sqrt{23} = 5\times 0.959\,168$	M1
	$= 4.795\,84$ cao	A1 (3)
		[9]

Question Number	Scheme	Marks
Q2	(a) 1.386, 2.291 awrt 1.386, 2.291	B1 B1 (2)
	(b) $A \approx \frac{1}{2} \times 0.5(\ ... \ )$	B1
	$= \ ... \ \left(0 + 2\left(0.608 + 1.386 + 2.291 + 3.296 + 4.385\right) + 5.545\right)$	M1
	$= \ 0.25\left(0 + 2\left(0.608 + 1.386 + 2.291 + 3.296 + 4.385\right) + 5.545\right)$ ft their (a)	A1ft
	$= 0.25 \times 29.477 \ ... \ \approx 7.37$ cao	A1 (4)
	(c)(i) $\int x \ln x \, dx = \frac{x^2}{2} \ln x - \int \frac{x^2}{2} \times \frac{1}{x} dx$	M1 A1
	$= \frac{x^2}{2} \ln x - \int \frac{x}{2} dx$	
	$= \frac{x^2}{2} \ln x - \frac{x^2}{4} \ (+C)$	M1 A1
	(ii) $\left[\frac{x^2}{2} \ln x - \frac{x^2}{4}\right]_1^4 = \left(8 \ln 4 - 4\right) - \left(-\frac{1}{4}\right)$	M1
	$= 8 \ln 4 - \frac{15}{4}$	
	$= 8\left(2 \ln 2\right) - \frac{15}{4}$ $\ln 4 = 2 \ln 2$ seen or implied	M1
	$= \frac{1}{4}\left(64 \ln 2 - 15\right)$ $a = 64, b = -15$	A1 (7)
		[13]

Question Number	Scheme	Marks
Q3	(a) $-2\sin 2x - 3\sin 3y\dfrac{dy}{dx} = 0$	M1 A1
	$\dfrac{dy}{dx} = -\dfrac{2\sin 2x}{3\sin 3y}$ Accept $\dfrac{2\sin 2x}{-3\sin 3y}$, $\dfrac{-2\sin 2x}{3\sin 3y}$	A1 (3)
	(b) At $x = \dfrac{\pi}{6}$, $\cos\left(\dfrac{2\pi}{6}\right) + \cos 3y = 1$	M1
	$\cos 3y = \dfrac{1}{2}$	A1
	$3y = \dfrac{\pi}{3} \Rightarrow y = \dfrac{\pi}{9}$ awrt 0.349	A1 (3)
	(c) At $\left(\dfrac{\pi}{6}, \dfrac{\pi}{9}\right)$, $\dfrac{dy}{dx} = -\dfrac{2\sin 2\left(\frac{\pi}{6}\right)}{3\sin 3\left(\frac{\pi}{9}\right)} = -\dfrac{2\sin\frac{\pi}{3}}{3\sin\frac{\pi}{3}} = -\dfrac{2}{3}$	M1
	$y - \dfrac{\pi}{9} = -\dfrac{2}{3}\left(x - \dfrac{\pi}{6}\right)$	M1
	Leading to $6x + 9y - 2\pi = 0$	A1 (3) **[9]**

Question Number	Scheme	Marks
Q4	(a) A: $(-6, 4, -1)$ Accept vector forms	B1 (1)
	(b) $\begin{pmatrix}4\\-1\\3\end{pmatrix}.\begin{pmatrix}3\\-4\\1\end{pmatrix} = 12+4+3 = \sqrt{4^2+(-1)^2+3^2}\sqrt{3^2+(-4)^2+1^2}\cos\theta$	M1 A1
	$\cos\theta = \frac{19}{26}$ awrt 0.73	A1 (3)
	(c) X: $(10, 0, 11)$ Accept vector forms	B1 (1)
	(d) $\overrightarrow{AX} = \begin{pmatrix}10\\0\\11\end{pmatrix} - \begin{pmatrix}-6\\4\\-1\end{pmatrix}$ Either order	M1
	$= \begin{pmatrix}16\\-4\\12\end{pmatrix}$ cao	A1 (2)
	(e) $\lvert\overrightarrow{AX}\rvert = \sqrt{16^2+(-4)^2+12^2}$	M1
	$= \sqrt{416} = \sqrt{16\times 26} = 4\sqrt{26}$ ∗ Do not penalise if consistent incorrect signs in (d)	A1 (2)
	(f)  Use of correct right angled triangle	M1
	$\frac{\lvert\overrightarrow{AX}\rvert}{d} = \cos\theta$	M1
	$d = \frac{4\sqrt{26}}{\frac{19}{26}} \approx 27.9$ awrt 27.9	A1 (3)
		[12]

Question Number	Scheme	Marks
Q5	(a) $\int \frac{9x+6}{x}\,dx = \int \left(9+\frac{6}{x}\right)dx$	M1
	$= 9x + 6\ln x \ (+C)$	A1 (2)
	(b) $\int \frac{1}{y^{\frac{1}{3}}}\,dy = \int \frac{9x+6}{x}\,dx$ Integral signs not necessary	B1
	$\int y^{-\frac{1}{3}}\,dy = \int \frac{9x+6}{x}\,dx$	
	$\frac{y^{\frac{2}{3}}}{\frac{2}{3}} = 9x + 6\ln x \ (+C)$ $\pm ky^{\frac{2}{3}} =$ their (a)	M1
	$\frac{3}{2}y^{\frac{2}{3}} = 9x + 6\ln x \ (+C)$ ft their (a)	A1ft
	$y = 8,\ x = 1$	
	$\frac{3}{2}8^{\frac{2}{3}} = 9 + 6\ln 1 + C$	M1
	$C = -3$	A1
	$y^{\frac{2}{3}} = \frac{2}{3}(9x + 6\ln x - 3)$	
	$y^2 = (6x + 4\ln x - 2)^3 \quad \left(= 8(3x + 2\ln x - 1)^3\right)$	A1 (6)
		[8]

Question Number	Scheme	Marks
Q6	$\frac{dA}{dt} = 1.5$	B1
	$A = \pi r^2 \Rightarrow \frac{dA}{dr} = 2\pi r$	B1
	When $A = 2$	
	$2 = \pi r^2 \Rightarrow r = \sqrt{\frac{2}{\pi}} \ (= 0.797\,884\ldots)$	M1
	$\frac{dA}{dt} = \frac{dA}{dr} \times \frac{dr}{dt}$	
	$1.5 = 2\pi r \frac{dr}{dt}$	M1
	$\frac{dr}{dt} = \frac{1.5}{2\pi\sqrt{\frac{2}{\pi}}} \approx 0.299$ awrt 0.299	A1
		[5]

Question Number	Scheme	Marks
Q7	(a) $y = 0 \Rightarrow t\left(9-t^2\right) = t(3-t)(3+t) = 0$	
	$t = 0, 3, -3$ Any one correct value	B1
	At $t = 0$, $x = 5(0)^2 - 4 = -4$ Method for finding one value of x	M1
	At $t = 3$, $x = 5(3)^2 - 4 = 41$	
	$\left(\text{At } t = -3,\ x = 5(-3)^2 - 4 = 41\right)$	
	At A, $x = -4$; at B, $x = 41$ Both	A1 (3)
	(b) $\dfrac{\mathrm{d}x}{\mathrm{d}t} = 10t$ Seen or implied	B1
	$\int y\,\mathrm{d}x = \int y\dfrac{\mathrm{d}x}{\mathrm{d}t}\mathrm{d}t = \int t\left(9-t^2\right)10t\,\mathrm{d}t$	M1 A1
	$= \int\left(90t^2 - 10t^4\right)\mathrm{d}t$	
	$= \dfrac{90t^3}{3} - \dfrac{10t^5}{5}\ (+C) \qquad \left(= 30t^3 - 2t^5\ (+C)\right)$	A1
	$\left[\dfrac{90t^3}{3} - \dfrac{10t^5}{5}\right]_0^3 = 30\times 3^3 - 2\times 3^5 \quad (= 324)$	M1
	$A = 2\int y\,\mathrm{d}x = 648 \quad \left(\text{units}^2\right)$	A1 (6)
		[9]

Question Number	Scheme	Marks
Q8	(a) $\dfrac{\mathrm{d}x}{\mathrm{d}u} = -2\sin u$	B1
	$\displaystyle\int \frac{1}{x^2\sqrt{4-x^2}}\,\mathrm{d}x = \int \frac{1}{(2\cos u)^2\sqrt{4-(2\cos u)^2}} \times -2\sin u\,\mathrm{d}u$	M1
	$\displaystyle= \int \frac{-2\sin u}{4\cos^2 u\sqrt{4\sin^2 u}}\,\mathrm{d}u$ Use of $1-\cos^2 u = \sin^2 u$	M1
	$\displaystyle= -\frac{1}{4}\int \frac{1}{\cos^2 u}\,\mathrm{d}u$ $\pm k\displaystyle\int \frac{1}{\cos^2 u}\,\mathrm{d}u$	M1
	$\displaystyle= -\frac{1}{4}\tan u\ (+C)$ $\pm k\tan u$	M1
	$x=\sqrt{2} \Rightarrow \sqrt{2} = 2\cos u \Rightarrow u = \dfrac{\pi}{4}$	
	$x=1 \Rightarrow 1 = 2\cos u \Rightarrow u = \dfrac{\pi}{3}$	M1
	$\displaystyle\left[-\frac{1}{4}\tan u\right]_{\frac{\pi}{3}}^{\frac{\pi}{4}} = -\frac{1}{4}\left(\tan\frac{\pi}{4} - \tan\frac{\pi}{3}\right)$	
	$\displaystyle= -\frac{1}{4}\left(1-\sqrt{3}\right)\ \left(= \frac{\sqrt{3}-1}{4}\right)$	A1 (7)
	(b) $\displaystyle V = \pi\int_1^{\sqrt{2}} \left(\frac{4}{x\left(4-x^2\right)^{\frac{1}{4}}}\right)^2 \mathrm{d}x$	M1
	$\displaystyle= 16\pi\int_1^{\sqrt{2}} \frac{1}{x^2\sqrt{4-x^2}}\,\mathrm{d}x$ $16\pi\times$ integral in (a)	M1
	$\displaystyle= 16\pi\left(\frac{\sqrt{3}-1}{4}\right)$ $16\pi\times$ their answer to part (a)	A1ft (3)
		[10]

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