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# Mark Scheme (Results)

# January 2010

GCE

## GCE Core Mathematics C4 (6666/01)

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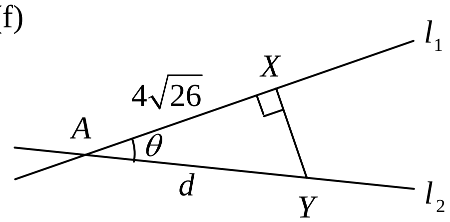
# 6666 Core Mathematics C4
# Mark Scheme

| Question Number | Scheme | | Marks | |
|---|---|---|---|---|
| Q1 | (a) $(1-8x)^{\frac{1}{2}} = 1+\left(\tfrac{1}{2}\right)(-8x)+\dfrac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2}(-8x)^2+\dfrac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}(-8x)^3+\ldots$ | | M1 A1 | |
| | $= 1-4x-8x^2; -32x^3- \ldots$ | | A1; A1 | (4) |
| | (b) $\sqrt{(1-8x)} = \sqrt{\left(1-\dfrac{8}{100}\right)}$ | | M1 | |
| | $= \sqrt{\dfrac{92}{100}} = \sqrt{\dfrac{23}{25}} = \dfrac{\sqrt{23}}{5}$ * | 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) $A \approx \frac{1}{2} \times 0.5( \ \dots \ )$ | B1 |
| | $= \ \dots \ \left(0+2\left(0.608+1.386+2.291+3.296+4.385\right)+5.545\right)$ | 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 |
| | $= 0.25 \times 29.477 \ \dots \ \approx 7.37$    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) $-2\sin 2x - 3\sin 3y\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ | M1 A1 |
| | $\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{2\sin 2x}{3\sin 3y}$ Accept $\frac{2\sin 2x}{-3\sin 3y}, \frac{-2\sin 2x}{3\sin 3y}$ | A1 (3) |
| | (b) At $x = \frac{\pi}{6}$, $\cos\left(\frac{2\pi}{6}\right) + \cos 3y = 1$ | M1 |
| | $\cos 3y = \frac{1}{2}$ | A1 |
| | $3y = \frac{\pi}{3} \Rightarrow y = \frac{\pi}{9}$ awrt 0.349 | A1 (3) |
| | (c) At $\left(\frac{\pi}{6}, \frac{\pi}{9}\right)$, $\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{2\sin 2\left(\frac{\pi}{6}\right)}{3\sin 3\left(\frac{\pi}{9}\right)} = -\frac{2\sin\frac{\pi}{3}}{3\sin\frac{\pi}{3}} = -\frac{2}{3}$ | M1 |
| | $y - \frac{\pi}{9} = -\frac{2}{3}\left(x - \frac{\pi}{6}\right)$ | 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) $\begin{pmatrix} 4 \\ -1 \\ 3 \end{pmatrix} \cdot \begin{pmatrix} 3 \\ -4 \\ 1 \end{pmatrix} = 12 + 4 + 3 = \sqrt{4^2 + (-1)^2 + 3^2}\sqrt{3^2 + (-4)^2 + 1^2}\cos\theta$ | | 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) $\int \frac{9x+6}{x}\,\mathrm{d}x = \int \left(9+\frac{6}{x}\right)\mathrm{d}x$ | | M1 | |
| | $= 9x + 6\ln x \ (+C)$ | | A1 | (2) |
| | (b) $\int \frac{1}{y^{\frac{1}{3}}}\,\mathrm{d}y = \int \frac{9x+6}{x}\,\mathrm{d}x$ | Integral signs not necessary | B1 | |
| | $\int y^{-\frac{1}{3}}\,\mathrm{d}y = \int \frac{9x+6}{x}\,\mathrm{d}x$ | | | |
| | $\frac{y^{\frac{2}{3}}}{\frac{2}{3}} = 9x + 6\ln x \ (+C)$ | $\pm k y^{\frac{2}{3}} =$ their $(\mathrm{a})$ | M1 | |
| | $\frac{3}{2}y^{\frac{2}{3}} = 9x + 6\ln x \ (+C)$ | ft their $(\mathrm{a})$ | 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 | $\dfrac{\mathrm{d}A}{\mathrm{d}t} = 1.5$ | B1 |
| | $A = \pi r^2 \Rightarrow \dfrac{\mathrm{d}A}{\mathrm{d}r} = 2\pi r$ | B1 |
| | When $A = 2$ | |
| | $2 = \pi r^2 \Rightarrow r = \sqrt{\dfrac{2}{\pi}} \quad (= 0.797\,884\ \ldots)$ | M1 |
| | $\dfrac{\mathrm{d}A}{\mathrm{d}t} = \dfrac{\mathrm{d}A}{\mathrm{d}r} \times \dfrac{\mathrm{d}r}{\mathrm{d}t}$ | |
| | $1.5 = 2\pi r \dfrac{\mathrm{d}r}{\mathrm{d}t}$ | M1 |
| | $\dfrac{\mathrm{d}r}{\mathrm{d}t} = \dfrac{1.5}{2\pi\sqrt{\frac{2}{\pi}}} \approx 0.299$ 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 | |
| | $\displaystyle\int y\,\mathrm{d}x=\int y\frac{\mathrm{d}x}{\mathrm{d}t}\,\mathrm{d}t=\int t\left(9-t^2\right)10t\,\mathrm{d}t$ | | M1 A1 | |
| | $=\displaystyle\int\left(90t^2-10t^4\right)\mathrm{d}t$ | | | |
| | $=\dfrac{90t^3}{3}-\dfrac{10t^5}{5}\ (+C)\quad\left(=30t^3-2t^5\ (+C)\right)$ | | A1 | |
| | $\left[\dfrac{90t^3}{3}-\dfrac{10t^5}{5}\right]_0^3=30\times3^3-2\times3^5\quad(=324)$ | | M1 | |
| | $A=2\displaystyle\int y\,\mathrm{d}x=648\quad\left(\text{units}^2\right)$ | | A1 | (6) |
| | | | | **[9]** |

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

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