

# Mark Scheme (Results)

## January 2010

GCE

GCE Core Mathematics C4 (6666/01)

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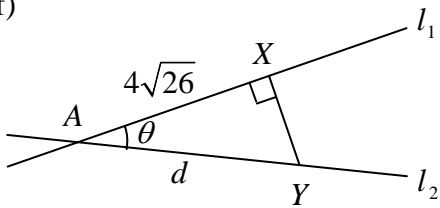
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January 2010  
6666 Core Mathematics C4  
Mark Scheme

| Question Number | Scheme   | Marks               |
|-----------------|--|---------------------|
| Q1              | $(a) (1-8x)^{\frac{1}{2}} = 1 + \left(\frac{1}{2}\right)(-8x) + \frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2}(-8x)^2 + \frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}(-8x)^3 + \dots$ $= 1 - 4x - 8x^2; -32x^3 - \dots$ | M1 A1<br>A1; A1 (4) |
|                 | $(b) \sqrt{(1-8x)} = \sqrt{\left(1 - \frac{8}{100}\right)}$ $= \sqrt{\frac{92}{100}} = \sqrt{\frac{23}{25}} = \frac{\sqrt{23}}{5} *$   | M1<br>cs0 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                  |
|                 | $\sqrt{23} = 5 \times 0.959 168$ $= 4.795 84$  | M1<br>cao A1 (3)    |
|                 |  | [9]                 |

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

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

| 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) $\vec{AX} = \begin{pmatrix} 10 \\ 0 \\ 11 \end{pmatrix} - \begin{pmatrix} -6 \\ 4 \\ -1 \end{pmatrix}$ Either order  | M1                                   |
|                 | $= \begin{pmatrix} 16 \\ -4 \\ 12 \end{pmatrix}$ cao   | A1 (2)                               |
|                 | (e) $ \vec{AX}  = \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 |
|                 | $\frac{ \vec{AX} }{d} = \cos \theta$   | M1                                   |
|                 | $d = \frac{4\sqrt{26}}{\frac{19}{26}} \approx 27.9$ awrt 27.9  | A1 (3)                               |
|                 |  | [12]                                 |

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

| Question Number | Scheme  | Marks  |
|-----------------|---|--|
| Q6              | $\frac{dA}{dt} = 1.5$ $A = \pi r^2 \Rightarrow \frac{dA}{dr} = 2\pi r$ <p>When <math>A = 2</math></p> $2 = \pi r^2 \Rightarrow r = \sqrt{\frac{2}{\pi}} (= 0.797\,884 \dots)$ $\frac{dA}{dt} = \frac{dA}{dr} \times \frac{dr}{dt}$ $1.5 = 2\pi r \frac{dr}{dt}$ $\frac{dr}{dt} = \frac{1.5}{2\pi\sqrt{\frac{2}{\pi}}} \approx 0.299$ <p style="text-align: right;">awrt 0.299</p> | <p>B1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>[5]</p> |



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

| Question Number | Scheme  | Marks   |
|-----------------|---|---|
| Q8              | <p>(a) <math>\frac{dx}{du} = -2 \sin u</math></p> <p><math>\int \frac{1}{x^2 \sqrt{4-x^2}} dx = \int \frac{1}{(2 \cos u)^2 \sqrt{4-(2 \cos u)^2}} \times -2 \sin u du</math></p> <p><math>= \int \frac{-2 \sin u}{4 \cos^2 u \sqrt{4 \sin^2 u}} du</math> Use of <math>1 - \cos^2 u = \sin^2 u</math></p> <p><math>= -\frac{1}{4} \int \frac{1}{\cos^2 u} du</math> <math>\pm k \int \frac{1}{\cos^2 u} du</math></p> <p><math>= -\frac{1}{4} \tan u (+C)</math> <math>\pm k \tan u</math></p> <p><math>x = \sqrt{2} \Rightarrow \sqrt{2} = 2 \cos u \Rightarrow u = \frac{\pi}{4}</math></p> <p><math>x = 1 \Rightarrow 1 = 2 \cos u \Rightarrow u = \frac{\pi}{3}</math></p> <p><math>\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)</math></p> <p><math>= -\frac{1}{4} (1 - \sqrt{3}) \left( = \frac{\sqrt{3}-1}{4} \right)</math></p> <p>(b) <math>V = \pi \int_1^{\sqrt{2}} \left( \frac{4}{x(4-x^2)^{\frac{1}{4}}} \right)^2 dx</math></p> <p><math>= 16\pi \int_1^{\sqrt{2}} \frac{1}{x^2 \sqrt{4-x^2}} dx</math> <math>16\pi \times \text{integral in (a)}</math></p> <p><math>= 16\pi \left( \frac{\sqrt{3}-1}{4} \right)</math> <math>16\pi \times \text{their answer to part (a)}</math></p> | <p>B1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1 (7)</p> <p>M1</p> <p>M1</p> <p>A1ft (3)</p> <p>[10]</p> |



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