

# Mark Scheme (Results) Summer 2010

GCE

## Core Mathematics C4 (6666)

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June 2010  
6666 Core Mathematics C4  
Mark Scheme

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

Question Number	Scheme	Marks
2.	$\frac{du}{dx} = -\sin x$ $\int \sin x e^{\cos x+1} dx = -\int e^u du$ $= -e^u$ $= -e^{\cos x+1}$ $\left[-e^{\cos x+1}\right]_0^{\frac{\pi}{2}} = -e^1 - (-e^2)$ $= e(e-1) *$	<p>B1</p> <p>M1 A1</p> <p>ft sign error A1ft</p> <p>or equivalent with <math>u</math> M1</p> <p>cso A1</p> <p><b>(6)</b> <b>[6]</b></p>

Question Number	Scheme	Marks
3.	$\frac{d}{dx}(2^x) = \ln 2 \cdot 2^x$ $\ln 2 \cdot 2^x + 2y \frac{dy}{dx} = 2y + 2x \frac{dy}{dx}$ <p>Substituting (3, 2)</p> $8 \ln 2 + 4 \frac{dy}{dx} = 4 + 6 \frac{dy}{dx}$ $\frac{dy}{dx} = 4 \ln 2 - 2$ <p>Accept exact equivalents</p>	<p>B1</p> <p>M1 A1= A1</p> <p>M1</p> <p>M1 A1 (7)</p> <p>[7]</p>

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

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

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



Question Number	Scheme	Marks
7.	<p>(a) <b>j</b> components <math>3 + 2\lambda = 9 \Rightarrow \lambda = 3</math> <span style="float: right;"><math>(\mu = 1)</math></span>  Leading to <math>C : (5, 9, -1)</math> <span style="float: right;">accept vector forms</span></p> <p>(b) <span style="float: right;">Choosing correct directions or finding <math>\overline{AC}</math> and <math>\overline{BC}</math></span>  <math display="block">\begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} 5 \\ 0 \\ 2 \end{pmatrix} = 5 + 2 = \sqrt{6}\sqrt{29} \cos \angle ACB</math> <span style="float: right;">use of scalar product</span>  <math>\angle ACB = 57.95^\circ</math> <span style="float: right;">awrt <math>57.95^\circ</math></span></p> <p>(c) <math>A : (2, 3, -4)</math> <math>B : (-5, 9, -5)</math>  <math display="block">\overline{AC} = \begin{pmatrix} 3 \\ 6 \\ 3 \end{pmatrix}, \quad \overline{BC} = \begin{pmatrix} 10 \\ 0 \\ 4 \end{pmatrix}</math> <math display="block">AC^2 = 3^2 + 6^2 + 3^2 \Rightarrow AC = 3\sqrt{6}</math> <math display="block">BC^2 = 10^2 + 4^2 \Rightarrow BC = 2\sqrt{29}</math> <math display="block">\Delta ABC = \frac{1}{2} AC \times BC \sin \angle ACB</math> <math display="block">= \frac{1}{2} 3\sqrt{6} \times 2\sqrt{29} \sin \angle ACB \approx 33.5</math> <span style="float: right;"><math>15\sqrt{5}</math>, awrt 34</span></p>	<p>M1 A1 A1 <b>(3)</b></p> <p>M1 M1 A1 A1 <b>(4)</b></p> <p>M1 A1 A1 M1 A1 <b>(5)</b> <b>[12]</b></p>
	<p><i>Alternative method for (b) and (c)</i></p> <p>(b) <math>A : (2, 3, -4)</math> <math>B : (-5, 9, -5)</math> <math>C : (5, 9, -1)</math>  <math display="block">AB^2 = 7^2 + 6^2 + 1^2 = 86</math> <math display="block">AC^2 = 3^2 + 6^2 + 3^2 = 54</math> <math display="block">BC^2 = 10^2 + 0^2 + 4^2 = 116</math> <span style="float: right;">Finding all three sides</span>  <math display="block">\cos \angle ACB = \frac{116 + 54 - 86}{2\sqrt{116}\sqrt{54}} \quad (= 0.53066 \dots)</math> <math display="block">\angle ACB = 57.95^\circ</math> <span style="float: right;">awrt <math>57.95^\circ</math></span></p> <p>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).</p>	<p>M1 M1 A1 A1 <b>(4)</b></p>

Question Number	Scheme	Marks
<p><b>8.</b></p>	<p>(a)</p> $\frac{dV}{dt} = 0.48\pi - 0.6\pi h$ $V = 9\pi h \Rightarrow \frac{dV}{dt} = 9\pi \frac{dh}{dt}$ $9\pi \frac{dh}{dt} = 0.48\pi - 0.6\pi h$ <p>Leading to <math>75 \frac{dh}{dt} = 4 - 5h</math> *</p> <p>(b)</p> $\int \frac{75}{4-5h} dh = \int 1 dt$ <p style="text-align: right;">separating variables</p> $-15 \ln(4-5h) = t (+C)$ $-15 \ln(4-5h) = t + C$ <p>When <math>t = 0, h = 0.2</math></p> $-15 \ln 3 = C$ $t = 15 \ln 3 - 15 \ln(4-5h)$ <p>When <math>h = 0.5</math></p> $t = 15 \ln 3 - 15 \ln 1.5 = 15 \ln \left( \frac{3}{1.5} \right) = 15 \ln 2$	<p>M1 A1</p> <p>B1</p> <p>M1</p> <p>cs0 A1 <b>(5)</b></p> <p>M1</p> <p>M1 A1</p> <p>M1</p> <p>M1 A1</p>
	<p><i>Alternative for last 3 marks</i></p> $t = \left[ -15 \ln(4-5h) \right]_{0.2}^{0.5}$ $= -15 \ln 1.5 + 15 \ln 3$ $= 15 \ln \left( \frac{3}{1.5} \right) = 15 \ln 2$	<p>awrt 10.4</p> <p>M1 M1</p> <p>awrt 10.4 A1 <b>(6)</b></p>



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