

Mark Scheme (Results)

June 2011

GCE Core Mathematics C3 (6665) Paper 1

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EDEXCEL GCE MATHEMATICS

General Instructions for Marking

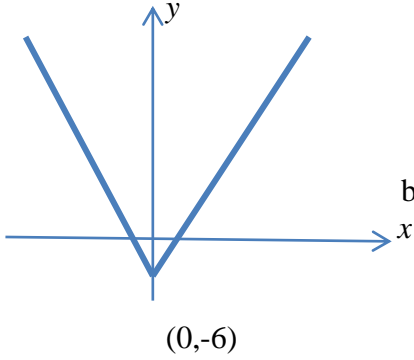
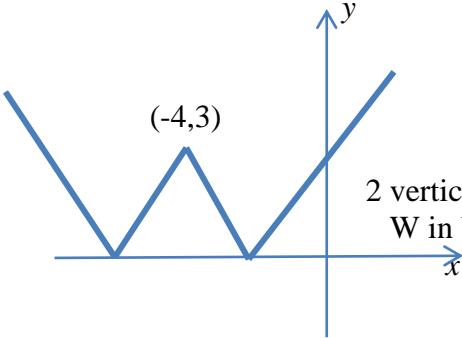
1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
 - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
 - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
 - **B** marks are unconditional accuracy marks (independent of M marks)
 - Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod – benefit of doubt
- ft – follow through
- the symbol \checkmark will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- \square The second mark is dependent on gaining the first mark

Question Number	Scheme	Marks
1 (a)	$\frac{1}{(x^2+3x+5)} \times \dots = \frac{2x+3}{(x^2+3x+5)}$	M1,A1 (2)
1 (b)	<p>Applying $\frac{vu'-uv'}{v^2}$</p> $\frac{x^2 \times -\sin x - \cos x \times 2x}{(x^2)^2} = \frac{-x^2 \sin x - 2x \cos x}{x^4} = \frac{-x \sin x - 2 \cos x}{x^3} \text{ oe}$	M1, A2,1,0 (3) 5 Marks
2 (a)	$f(0.75) = -0.18\dots$ $f(0.85) = 0.17\dots\dots$ <p>Change of sign, hence root between $x=0.75$ and $x=0.85$</p>	M1 A1 (2)
2 (b)	<p>Sub $x_0=0.8$ into $x_{n+1} = [\arcsin(1 - 0.5x_n)]^{\frac{1}{2}}$ to obtain x_1</p> <p>Awrt $x_1=0.80219$ and $x_2=0.80133$</p> <p>Awrt $x_3 = 0.80167$</p>	M1 A1 A1 (3)
2 (c)	$f(0.801565) = -2.7\dots \times 10^{-5}$ $f(0.801575) = +8.6\dots \times 10^{-6}$ <p>Change of sign and conclusion</p> <p>See Notes for continued iteration method</p>	M1A1 A1 (3) 8 Marks

Question Number	Scheme	Marks
3 (a)	 <p style="text-align: right;">V shape</p> <p style="text-align: right;">vertex on y axis & both branches of graph cross x axis</p> <p style="text-align: right;">'y' co-ordinate of R is -6</p> <p style="text-align: center;">(0,-6)</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p style="text-align: right;">(3)</p>
(b)	 <p style="text-align: right;">W shape</p> <p style="text-align: right;">2 vertices on the negative x axis. W in both quad 1 & quad 2.</p> <p style="text-align: right;">R' = (-4,3)</p> <p style="text-align: center;">(-4,3)</p>	<p>B1</p> <p>B1dep</p> <p>B1</p> <p style="text-align: right;">(3)</p> <p style="text-align: right;">6 Marks</p>
4 (a)	$y = 4 - \ln(x + 2)$ $\ln(x + 2) = 4 - y$ $x + 2 = e^{4-y}$ $x = e^{4-y} - 2$ $f^{-1}(x) = e^{4-x} - 2$	<p>oe</p> <p>M1</p> <p>M1A1</p> <p style="text-align: right;">(3)</p>
(b)	$x \leq 4$	<p>B1</p> <p style="text-align: right;">(1)</p>
(c)	$fg(x) = 4 - \ln(e^{x^2} - 2 + 2)$ $fg(x) = 4 - x^2$	<p>M1</p> <p>dM1A1</p> <p style="text-align: right;">(3)</p>
(d)	$fg(x) \leq 4$	<p>B1ft</p> <p style="text-align: right;">(1)</p> <p style="text-align: right;">8 Marks</p>

Question Number	Scheme	Marks
5 (a)	$p=7.5$	B1 (1)
(b)	$2.5 = 7.5e^{-4k}$ $e^{-4k} = \frac{1}{3}$ $-4k = \ln\left(\frac{1}{3}\right)$ $-4k = -\ln(3)$ $k = \frac{1}{4}\ln(3)$	M1 M1 dM1 A1*
	See notes for additional correct solutions and the last A1	(4)
(c)	$\frac{dm}{dt} = -kpe^{-kt}$ ft on their p and k $-\frac{1}{4}\ln 3 \times 7.5e^{-\frac{1}{4}(\ln 3)t} = -0.6\ln 3$ $e^{-\frac{1}{4}(\ln 3)t} = \frac{2.4}{7.5} = (0.32)$ $-\frac{1}{4}(\ln 3)t = \ln(0.32)$ $t=4.1486\dots$ 4.15 or awrt 4.1	M1A1ft M1A1 dM1 A1 (6)
		11Marks

Question Number	Scheme	Marks
6 (a)	$\frac{1}{\sin 2\theta} - \frac{\cos 2\theta}{\sin 2\theta} = \frac{1 - \cos 2\theta}{\sin 2\theta}$ $= \frac{2\sin^2 \theta}{2\sin \theta \cos \theta}$ $= \frac{\sin \theta}{\cos \theta} = \tan \theta$	M1 M1A1 cso A1* (4)
(b)(i)	$\tan 15^\circ = \frac{1}{\sin 30^\circ} - \frac{\cos 30^\circ}{\sin 30^\circ}$ $\tan 15^\circ = \frac{1}{\frac{1}{2}} - \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = 2 - \sqrt{3}$	M1 cso dM1 A1* (3)
(b)(ii)	$\tan 2x = 1$ $2x = 45^\circ$ $2x = 45^\circ + 180^\circ$ $x = 22.5^\circ, 112.5^\circ, 202.5^\circ, 292.5^\circ$	M1 A1 M1 A1(any two) A1 (5)
	<p>Alt for (b)(i)</p> $\tan 15^\circ = \tan(60^\circ - 45^\circ) \text{ or } \tan(45^\circ - 30^\circ)$ $\tan 15^\circ = \frac{\tan 60^\circ - \tan 45^\circ}{1 + \tan 60^\circ \tan 45^\circ} \text{ or } \frac{\tan 45^\circ - \tan 30^\circ}{1 + \tan 45^\circ \tan 30^\circ}$ $\tan 15^\circ = \frac{\sqrt{3} - 1}{1 + \sqrt{3}} \text{ or } \frac{1 - \frac{\sqrt{3}}{3}}{1 + \frac{\sqrt{3}}{3}}$ <p>Rationalises to produce</p> $\tan 15^\circ = 2 - \sqrt{3}$	12 Marks M1 M1 A1*

Question Number	Scheme	Marks
7 (a)	$x^2 - 9 = (x + 3)(x - 3)$ $\frac{4x - 5}{(2x + 1)(x - 3)} - \frac{2x}{(x + 3)(x - 3)}$ $= \frac{(4x - 5)(x + 3)}{(2x + 1)(x - 3)(x + 3)} - \frac{2x(2x + 1)}{(2x + 1)(x + 3)(x - 3)}$ $= \frac{5x - 15}{(2x + 1)(x - 3)(x + 3)}$ $= \frac{5(x - 3)}{(2x + 1)(x - 3)(x + 3)} = \frac{5}{(2x + 1)(x + 3)}$	B1 M1 M1A1 A1* (5)
(b)	$f(x) = \frac{5}{2x^2 + 7x + 3}$ $f'(x) = \frac{-5(4x + 7)}{(2x^2 + 7x + 3)^2}$ $f'(-1) = -\frac{15}{4}$ <p>Uses $m_1 m_2 = -1$ to give gradient of normal = $\frac{4}{15}$</p> $\frac{y - (-\frac{5}{2})}{(x - -1)} = \text{their } \frac{4}{15}$ $y + \frac{5}{2} = \frac{4}{15}(x + 1) \text{ or any equivalent form}$	M1M1A1 M1A1 M1 M1 A1 (8) 13 Marks

Question Number	Scheme	Marks
<p>8</p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	$R^2 = 2^2 + 3^2$ $R = \sqrt{13} \text{ or } 3.61 \dots$ $\tan \alpha = \frac{3}{2}$ $\alpha = 0.983 \dots$ $f'(x) = 2e^{2x} \cos 3x - 3e^{2x} \sin 3x$ $= e^{2x} (2 \cos 3x - 3 \sin 3x)$ $= e^{2x} (R \cos(3x + \alpha))$ $= R e^{2x} \cos(3x + \alpha)$ $f'(x) = 0 \Rightarrow \cos(3x + \alpha) = 0$ $3x + \alpha = \frac{\pi}{2}$ $x = 0.196 \dots \quad \text{awrt } 0.20$	<p>M1 A1</p> <p>M1 A1</p> <p>(4)</p> <p>M1A1A1</p> <p>M1</p> <p>A1* cso</p> <p>(5)</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>(3)</p> <p>12 Marks</p>
	<p>Alternative to part (c) \Rightarrow</p> $f'(x) = 0 \Rightarrow 2 \cos 3x - 3 \sin 3x = 0$ $\tan 3x = \frac{2}{3}$ $x = 0.196 \dots \quad \text{awrt } 0.20$	<p>M1</p> <p>M1</p> <p>A1</p> <p>(3)</p>

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