

# Mark Scheme (Results)

June 2011

GCE Core Mathematics C3 (6665) Paper 1

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## EDEXCEL GCE MATHEMATICS

### General Instructions for Marking

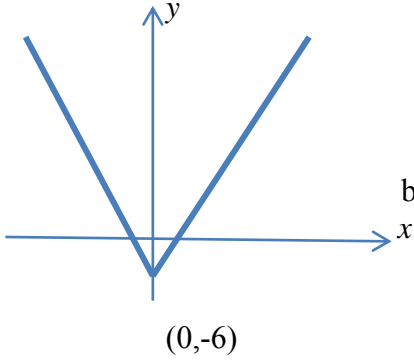
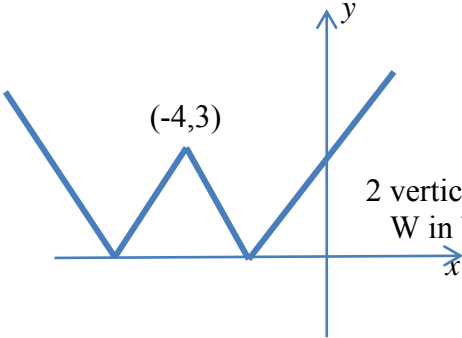
1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
  - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
  - **A** marks: Accuracy marks can only be awarded if the 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)
(b)	<p>Applying <math>\frac{vu'-uv'}{v^2}</math></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 <math>x=0.75</math> and <math>x=0.85</math></p>	M1 A1 (2)
(b)	<p>Sub <math>x_0=0.8</math> into <math>x_{n+1} = [\arcsin(1 - 0.5x_n)]^{\frac{1}{2}}</math> to obtain <math>x_1</math></p> <p>Awrt <math>x_1=0.80219</math> and <math>x_2=0.80133</math></p> <p>Awrt <math>x_3 = 0.80167</math></p>	M1 A1 A1 (3)
(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>V shape</p> <p>vertex on y axis &amp; both branches of graph cross x axis</p> <p>∴ y<sup>co</sup> co-ordinate of R is -6</p> <p>(0,-6)</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>(3)</p>
(b)	 <p>W shape</p> <p>2 vertices on the negative x axis.</p> <p>W in both quad 1 &amp; quad 2.</p> <p>R<sup>co</sup> = (-4,3)</p>	<p>B1</p> <p>B1dep</p> <p>B1</p> <p>(3)</p> <p>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>(3)</p>
(b)	$x \leq 4$	<p>B1</p> <p>(1)</p>
(c)	$fg(x) = 4 - \ln(e^{x^2} - 2 + 2)$ $fg(x) = 4 - x^2$	<p>M1</p> <p>dM1A1</p> <p>(3)</p>
(d)	$fg(x) \leq 4$	<p>B1ft</p> <p>(1)</p> <p>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 cs0 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 cs0 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 <math>m_1 m_2 = -1</math> to give gradient of normal = <math>\frac{4}{15}</math></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><b>8</b></p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	$R^2 = 2^2 + 3^2$ $R = \sqrt{13} \text{ or } 3.61 \dots$ $\tan \alpha = \frac{3}{2}$ $\alpha = 0.983 \dots$ $f'(x) = 2e^{2x} \cos 3x - 3e^{2x} \sin 3x$ $= e^{2x} (2 \cos 3x - 3 \sin 3x)$ $= e^{2x} (R \cos(3x + \alpha))$ $= R e^{2x} \cos(3x + \alpha)$ $f'(x) = 0 \quad \cos(3x + \alpha) = 0$ $3x + \alpha = \frac{\pi}{2}$ $x = 0.196 \dots \quad \text{awrt } 0.20$	<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)</p> $f'(x) = 0 \quad 2 \cos 3x - 3 \sin 3x = 0$ $\tan 3x = \frac{2}{3}$ $x = 0.196 \dots \quad \text{awrt } 0.20$	<p>M1</p> <p>M1</p> <p>A1</p> <p>(3)</p>

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