# Mark Scheme (Results)

# June 2011

GCE Core Mathematics C3 (6665) Paper 1

PEARSON

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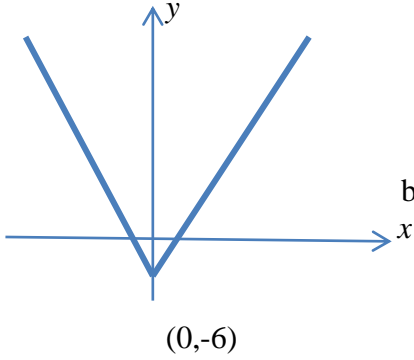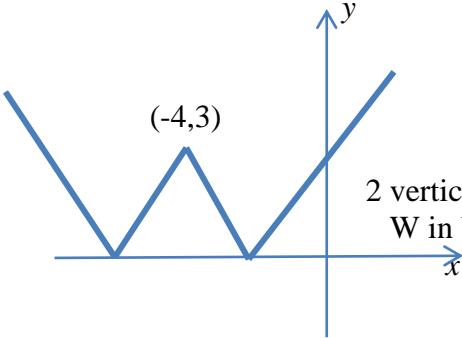
# General Instructions for Marking

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    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

   - ⌐The second mark is dependent on gaining the first mark

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

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

| Question Number | Scheme | Marks |
|---|---|---|
| 5 (a) | $p=7.5$ | B1 |
| | | (1) |
| (b) | $2.5 = 7.5e^{-4k}$ | M1 |
| | $e^{-4k} = \dfrac{1}{3}$ | M1 |
| | $-4k = \ln(\dfrac{1}{3})$ | dM1 |
| | $-4k = -\ln(3)$ | |
| | $k = \dfrac{1}{4}\ln(3)$ | A1* |
| | See notes for additional correct solutions and the last A1 | |
| | | (4) |
| (c ) | $\dfrac{dm}{dt} = -kpe^{-kt}$     ft on their $p$ and $k$ | M1A1ft |
| | $-\dfrac{1}{4}ln3 \times 7.5e^{-\frac{1}{4}(ln3)t} = -0.6ln3$ | |
| | $e^{-\frac{1}{4}(ln3)t} = \dfrac{2.4}{7.5}$   $= (0.32)$ | M1A1 |
| | $-\dfrac{1}{4}(ln3)t = \ln(0.32)$ | dM1 |
| | $t=4.1486\ldots$    4.15 or awrt 4.1 | A1 |
| | | (6) |
| | | 11Marks |

| Question Number | Scheme | Marks |
|---|---|---|
| 6 (a) | $$\frac{1}{\sin2\theta} - \frac{\cos2\theta}{\sin2\theta} = \frac{1-\cos2\theta}{\sin2\theta}$$ | M1 |
| | $$= \frac{2\sin^2\theta}{2\sin\theta\cos\theta}$$ | M1A1 |
| | $$= \frac{\sin\theta}{\cos\theta} = \tan\theta \qquad \text{cso}$$ | A1* (4) |
| (b)(i) | $$\tan15° = \frac{1}{\sin30°} - \frac{\cos30°}{sin30°}$$ | M1 |
| | $$\tan15° = \frac{1}{\frac{1}{2}} - \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = 2 - \sqrt{3} \qquad \text{cso}$$ | dM1 A1* (3) |
| (b)(ii) | $$\tan2x = 1$$ | M1 |
| | $$2x = 45°$$ | A1 |
| | $$2x = 45° + 180°$$ | M1 |
| | $$x = 22.5°, 112.5°, 202.5°, 292.5°$$ | A1(any two) A1 (5) |
| | Alt for (b)(i)  $\tan15° = \tan(60° - 45°) \quad or \quad \tan(45° - 30°)$ | 12 Marks |
| | $$\tan15° = \frac{\tan60 - \tan45}{1 + \tan60 tan45} \quad or \quad \frac{\tan45 - \tan30}{1 + \tan45\tan30}$$ | M1 |
| | $$\tan15° = \frac{\sqrt{3}-1}{1+\sqrt{3}} \quad or \quad \frac{1 - \frac{\sqrt{3}}{3}}{1 + \frac{\sqrt{3}}{3}}$$ | M1 |
| | Rationalises to produce $\tan15° = 2 - \sqrt{3}$ | A1* |

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

| Question Number | Scheme | Marks |
|---|---|---|
| **8** **(a)** | $$R^2 = 2^2 + 3^2$$ $$R = \sqrt{13} \text{ or } 3.61 \ldots..$$ $$\tan\alpha = \frac{3}{2}$$ $$\alpha = 0.983 \ldots$$ | M1 A1 M1 A1 (4) |
| **(b)** | $$f'(x) = 2e^{2x}\cos3x - 3e^{2x}\sin3x$$ $$= e^{2x}(2\cos3x - 3\sin3x)$$ $$= e^{2x}(R\cos(3x + \alpha)$$ $$= Re^{2x}\cos(3x + \alpha)$$ | M1A1A1 M1 A1* cso (5) |
| **(c )** | $$f'(x) = 0 \Rightarrow \cos(3x + \alpha) = 0$$ $$3x + \alpha = \frac{\pi}{2}$$ $x$=0.196…     awrt 0.20 | M1 M1 A1 (3) |
| | | 12 Marks |
| | Alternative to part (c )$\Rightarrow$ $$f'(x) = 0 \Rightarrow 2\cos3x - 3\sin3x = 0$$ $$\tan3x = \frac{2}{3}$$ $x$=0.196…     awrt 0.20 | M1 M1 A1 (3) |