

**Edexcel GCE
Core Mathematics C3
Gold Level G3
(Mark Scheme)**

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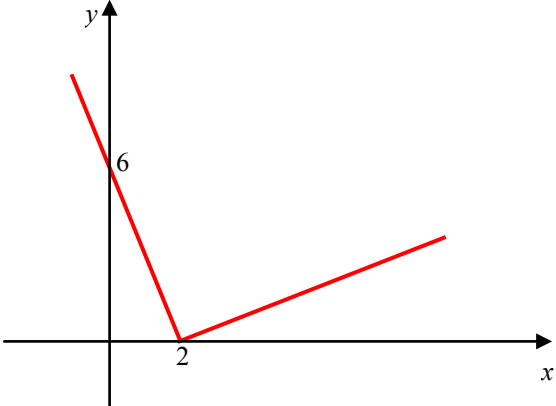
| Question Number | Scheme | Marks |
|-----------------|---|--|
| 1. | $x^2 - 1 \begin{array}{r} \frac{2x^2 \quad -1}{2x^4 \quad -3x^2 + x + 1} \\ \frac{2x^4 \quad -2x^2}{-x^2 + x + 1} \\ \frac{-x^2 \quad +1}{-x^2 \quad +1} \\ \hline x \end{array}$ <p style="text-align: right;">$a = 2$ stated or implied $c = -1$ stated or implied</p> $2x^2 - 1 + \frac{x}{x^2 - 1}$ <p style="text-align: center;">$a = 2, b = 0, c = -1, d = 1, e = 0$ $d = 1$ and $b = 0, e = 0$ stated or implied</p> | M1 A1 A1 A1 [4] |

| | | |
|--------|--|-------------------------------------|
| 2. (a) | $R^2 = 5^2 + 12^2$ $R = 13$ $\tan \alpha = \frac{12}{5}$ $\alpha \approx 1.176$ | M1 A1 M1 A1 cao (4) |
| (b) | $\cos(x - \alpha) = \frac{6}{13}$ $x - \alpha = \arccos \frac{6}{13} = 1.091 \dots$ $x = 1.091 \dots + 1.176 \dots \approx 2.267 \dots$ awrt 2.3 $x - \alpha = -1.091 \dots$ accept $\dots = 5.19 \dots$ for M $x = -1.091 \dots + 1.176 \dots \approx 0.0849 \dots$ awrt 0.084 or 0.085 | M1 A1 A1 M1 A1 (5) |
| (c)(i) | $R_{\max} = 13$ ft their R | B1 ft |
| (ii) | At the maximum, $\cos(x - \alpha) = 1$ or $x - \alpha = 0$ $x = \alpha = 1.176 \dots$ awrt 1.2, ft their α | M1 A1ft (3) (12 marks) |

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|-----------------|---|--|---|
| 3. | $2\cos 2\theta = 1 - 2\sin \theta$ $2(1 - 2\sin^2 \theta) = 1 - 2\sin \theta$ $2 - 4\sin^2 \theta = 1 - 2\sin \theta$ $4\sin^2 \theta - 2\sin \theta - 1 = 0$ $\sin \theta = \frac{2 \pm \sqrt{4 - 4(4)(-1)}}{8}$ PVs: $\alpha_1 = 54^\circ$ or $\alpha_2 = -18^\circ$ $\theta = \{54, 126, 198, 342\}$ | Substitutes either $1 - 2\sin^2 \theta$ or $2\cos^2 \theta - 1$ or $\cos^2 \theta - \sin^2 \theta$ for $\cos 2\theta$. Forms a “quadratic in sine” = 0 Applies the quadratic formula See notes for alternative methods. Any one correct answer 180-their pv All four solutions correct. | M1 M1(*) M1 A1 dM1(*) A1 [6] |

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|-----------------|--|---|
| 4. | (a) $R^2 = 6^2 + 8^2 \Rightarrow R = 10$ $\tan \alpha = \frac{8}{6} \Rightarrow \alpha = \text{awrt } 0.927$ (b)(i) $p(x) = \frac{4}{12 + 10\cos(\theta - 0.927)}$ $p(x) = \frac{4}{12 - 10}$ Maximum = 2 (b)(ii) $\theta - \text{'their } \alpha' = \pi$ $\theta = \text{awrt } 4.07$ | M1A1 M1A1 (4) M1 A1 (2) M1 A1 (2) (8 marks) |

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|-----------------|---|--|
| 5 (a) | $g(x) \geq 1$ | B1 (1) |
| 5 (b) | $fg(x) = f(e^{x^2}) = 3e^{x^2} + \ln e^{x^2}$ $= x^2 + 3e^{x^2} \quad *$ $(fg : x \mapsto x^2 + 3e^{x^2})$ | M1 A1 (2) |
| 5 (c) | $fg(x) \geq 3$ | B1 (1) |
| 5 (d) | $\frac{d}{dx}(x^2 + 3e^{x^2}) = 2x + 6xe^{x^2}$ $2x + 6xe^{x^2} = x^2 e^{x^2} + 2x$ $e^{x^2}(6x - x^2) = 0$ $e^{x^2} \neq 0, \quad 6x - x^2 = 0$ $x = 0, 6$ | M1 A1 M1 A1 A1 A1 (6) [10] |

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|----------------------|---|---|
| 6. (a) | $y = \frac{3-2x}{x-5} \Rightarrow y(x-5) = 3-2x$ <p style="text-align: right;">Attempt to make x (or swapped y) the subject</p> $xy - 5y = 3 - 2x$ $\Rightarrow xy + 2x = 3 + 5y \Rightarrow x(y+2) = 3 + 5y$ <p style="text-align: right;">Collect x terms together and factorise.</p> $\Rightarrow x = \frac{3+5y}{y+2} \quad \therefore f^{-1}(x) = \frac{3+5x}{x+2}$ | <p style="text-align: right;">M1</p> <p style="text-align: right;">M1</p> <p style="text-align: right;">A1 oe (3)</p> |
| (b) | Range of g is $-9 \leq g(x) \leq 4$ or $-9 \leq y \leq 4$ <p style="text-align: right;"><u>Correct Range</u></p> | <p style="text-align: right;">B1 (1)</p> |
| (c) | $g(g(2)) = g(0) = -6$, from sketch. | <p style="text-align: right;">Deduces that $g(2)$ is 0. Seen or implied.</p> <p style="text-align: right;">-6</p> <p style="text-align: right;">M1</p> <p style="text-align: right;">A1 (2)</p> |
| (d) | $fg(8) = f(4)$ $= \frac{3-4(2)}{4-5} = \frac{-5}{-1} = 5$ | <p style="text-align: right;">Correct order g followed by f</p> <p style="text-align: right;">5</p> <p style="text-align: right;">M1</p> <p style="text-align: right;">A1 (2)</p> |
| (e)(i) |  | <p style="text-align: right;">Correct shape</p> <p style="text-align: right;">(2, {0}), ({0}, 6)</p> <p style="text-align: right;">B1</p> <p style="text-align: right;">B1</p> |

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| <p>8.</p> | <p>(a) (£) 19500</p> | <p>B1</p> |
| | <p>(b)</p> $9500 = 17000e^{-0.25t} + 2000e^{-0.5t} + 500$ $17e^{-0.25t} + 2e^{-0.5t} = 9$ $(\times e^{0.5t}) \Rightarrow 17e^{0.25t} + 2 = 9e^{0.5t}$ $0 = 9e^{0.5t} - 17e^{0.25t} - 2$ $0 = (9e^{0.25t} + 1)(e^{0.25t} - 2)$ $e^{0.25t} = 2$ $t = 4 \ln(2) \text{ oe}$ | <p>(1)</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>(4)</p> |
| | <p>(c)</p> $\left(\frac{dV}{dt}\right) = -4250e^{-0.25t} - 1000e^{-0.5t}$ <p>When $t=8$ Decrease = 593 (£/year)</p> | <p>M1A1</p> <p>M1A1</p> <p>(4)</p> <p>(9 marks)</p> |