Solomon Press
Core Mathematics C3
Paper D

(Mark Scheme)

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FOR EDEXCEL

GCE Examinations

Advanced Subsidiary

Core Mathematics C3

Paper D

MARKING GUIDE

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks could be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.

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C3 Paper D – Marking Guide

1. *(a)* $= f(2) = 2 + \ln 4$ — M1 A1

(b) $y = 2 + \ln(3x - 2)$, $\quad 3x - 2 = e^{y-2}$ — M1

$x = \frac{1}{3}(2 + e^{y-2})$

$f^{-1}(x) = \frac{1}{3}(2 + e^{x-2})$ — M1 A1 **(5)**

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2. $3(\operatorname{cosec}^2 x - 1) - 4 \operatorname{cosec} x + \operatorname{cosec}^2 x = 0$ — M1

$4 \operatorname{cosec}^2 x - 4 \operatorname{cosec} x - 3 = 0$

$(2 \operatorname{cosec} x + 1)(2 \operatorname{cosec} x - 3) = 0$ — M1

$\operatorname{cosec} x = -\frac{1}{2}$ or $\frac{3}{2}$ — A1

$\sin x = -2$ (no solutions) or $\frac{2}{3}$ — M1

$x = 0.73, \pi - 0.7297$

$x = 0.73, 2.41$ (2dp) — A2 **(6)**

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3. *(a)* *(i)* $= \frac{\ln x}{\ln 2} = \frac{y}{\ln 2}$ — M1 A1

(ii) $= \ln x^2 - \ln e = 2 \ln x - 1 = 2y - 1$ — M1 A1

(b) $\frac{y}{\ln 2} = 4 - (2y - 1)$ — M1

$y = (5 - 2y)\ln 2$

$y(2 \ln 2 + 1) = 5 \ln 2$ — M1

$y = \frac{5 \ln 2}{2 \ln 2 + 1}$ — A1

$x = e^y = 4.27$ (2dp) — A1 **(8)**

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4. *(a)* $\text{LHS} \equiv \frac{2\sin(x+y)\cos(x-y)}{2\cos(x+y)\cos(x-y)}$ — M1 A1

$\equiv \frac{\sin(x+y)}{\cos(x+y)} \equiv \tan(x + y) \equiv \text{RHS}$ — M1 A1

(b) let $x = 30°$, $y = 22.5°$ $\therefore \tan(30 + 22.5) = \frac{\sin 60 + \sin 45}{\cos 60 + \cos 45}$ — M1

$\tan 52.5 = \frac{\frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}}}{\frac{1}{2} + \frac{1}{\sqrt{2}}} = \frac{\sqrt{3} + \sqrt{2}}{1 + \sqrt{2}}$ — B1 A1

$= \frac{\sqrt{3} + \sqrt{2}}{1 + \sqrt{2}} \times \frac{1 - \sqrt{2}}{1 - \sqrt{2}}$ — M1

$= \frac{\sqrt{3} - \sqrt{6} + \sqrt{2} - 2}{1 - 2} = \sqrt{6} - \sqrt{3} - \sqrt{2} + 2$ — A1 **(9)**

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5. *(a)* $f(x) = 3 - \frac{x-1}{x-3} + \frac{x+11}{(2x+1)(x-3)}$ — B1

$= \frac{3(2x^2 - 5x - 3) - (x-1)(2x+1) + (x+11)}{(2x+1)(x-3)}$ — M1 A1

$= \frac{4x^2 - 13x + 3}{(2x+1)(x-3)} = \frac{(4x-1)(x-3)}{(2x+1)(x-3)} = \frac{4x-1}{2x+1}$ — M1 A1

(b) $f'(x) = \frac{4 \times (2x+1) - (4x-1) \times 2}{(2x+1)^2} = \frac{6}{(2x+1)^2}$ — M1 A1

$x = -2 \Rightarrow y = 3$, grad $= \frac{2}{3}$ — A1

$\therefore \; y - 3 = \frac{2}{3}(x + 2)$ — M1

$3y - 9 = 2x + 4$

$2x - 3y + 13 = 0$ — A1 **(10)**

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6. *(a)* $\dfrac{dy}{dx} = 3e^{3x} \times \cos 2x + e^{3x} \times (-2 \sin 2x) = e^{3x}(3 \cos 2x - 2 \sin 2x)$ M1 A1

(b) $\dfrac{d^2y}{dx^2} = 3e^{3x} \times (3 \cos 2x - 2 \sin 2x) + e^{3x}(-6 \sin 2x - 4 \cos 2x)$ M1 A1

$= e^{3x}(5 \cos 2x - 12 \sin 2x)$ A1

(c) SP: $e^{3x}(3 \cos 2x - 2 \sin 2x) = 0$

$3 \cos 2x = 2 \sin 2x$ M1

$\tan 2x = \frac{3}{2}$ M1

$2x = 0.98279, \quad x = 0.491$ (3sf) M1 A1

(d) when $x = 0.491$, $\dfrac{d^2y}{dx^2} = -31.5$, $\dfrac{d^2y}{dx^2} < 0$ $\therefore$ maximum M1 A1 **(11)**

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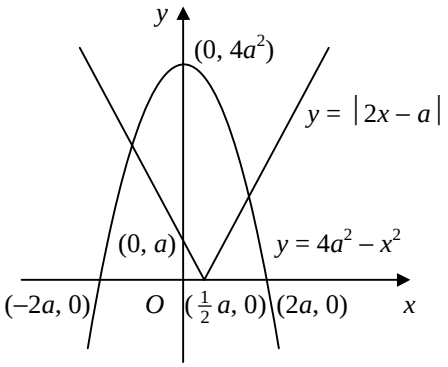
7. *(a)*



B3

B3

(b) $4 - x^2 = 2x - 1$ M1

$x^2 + 2x - 5 = 0, \quad x = \dfrac{-2 \pm \sqrt{4+20}}{2} = \dfrac{-2 \pm 2\sqrt{6}}{2}$ M1

$x > \frac{1}{2} \quad \therefore x = -1 + \sqrt{6}$ A1

$4 - x^2 = -(2x - 1)$ M1

$x^2 - 2x - 3 = 0$

$(x + 1)(x - 3) = 0$ M1

$x < \frac{1}{2} \quad \therefore x = -1, \qquad x = -1, -1 + \sqrt{6}$ A1 **(12)**

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8. *(a)* $\dfrac{dy}{dx} = 2 - \dfrac{3}{2x+5} \times 2 = 2 - \dfrac{6}{2x+5}$ M1

grad $= -4$, grad of normal $= \frac{1}{4}$ A1

$\therefore \quad y + 4 = \frac{1}{4}(x + 2) \qquad [\, y = \frac{1}{4}x - \frac{7}{2} \,]$ M1 A1

(b) $\frac{1}{4}x - \frac{7}{2} = 2x - 3 \ln (2x + 5)$ M1

$\frac{7}{4}x + \frac{7}{2} - 3 \ln (2x + 5) = 0, \quad$ let $f(x) = \frac{7}{4}x + \frac{7}{2} - 3 \ln (2x + 5)$

$f(1) = -0.59, \ f(2) = 0.41$ M1

sign change, $f(x)$ continuous $\therefore$ root A1

(c) $\frac{7}{4}x + \frac{7}{2} - 3 \ln (2x + 5) = 0$

$7x + 14 - 12 \ln (2x + 5) = 0$

$7x = 12 \ln (2x + 5) - 14$ M1

$x = \frac{12}{7} \ln (2x + 5) - 2$ A1

(d) $x_1 = 1.5648, x_2 = 1.5923, x_3 = 1.6039, x_4 = 1.6087, x_5 = 1.6107$ M1 A1

$q = 1.61$ (3sf) A1

$f(1.605) = -0.0073, \ f(1.615) = 0.0029$ M1

sign change, $f(x)$ continuous $\therefore$ root $\therefore q = 1.61$ (3sf) A1 **(14)**

Total **(75)**

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