FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C3

Paper G

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 G – Marking Guide

1.	*(a)*	$\frac{dy}{dx} = 3(3x-5)^2 \times 3 = 9(3x-5)^2$	M1	
		grad = 9	A1	
		$\therefore\ y - 1 = 9(x-2)$ $\quad [\,y = 9x - 17\,]$	M1 A1	
	(b)	$9(3x-5)^2 = 9$		
		$3x - 5 = \pm 1$	M1	
		$x = 2$ (at P), $\frac{4}{3}$	A1	
		$\therefore\ Q\,(\frac{4}{3}, -1)$	A1	**(7)**
2.	*(a)*	$\cos(A+B) \equiv \cos A \cos B - \sin A \sin B$		
		$\cos(A-B) \equiv \cos A \cos B + \sin A \sin B$		
		adding, $\quad 2\cos A \cos B \equiv \cos(A+B) + \cos(A-B)$	M1 A1	
	(b)	$2\cos(x + \frac{\pi}{2})\cos(x + \frac{\pi}{6}) = 1$	M1	
		$\cos(2x + \frac{2\pi}{3}) + \cos\frac{\pi}{3} = 1$	M1	
		$\cos(2x + \frac{2\pi}{3}) = 1 - \frac{1}{2} = \frac{1}{2}$	A1	
		$2x + \frac{2\pi}{3} = 2\pi - \frac{\pi}{3}, 2\pi + \frac{\pi}{3} = \frac{5\pi}{3}, \frac{7\pi}{3}$	B1	
		$2x = \pi, \frac{5\pi}{3}$	M1	
		$x = \frac{\pi}{2}, \frac{5\pi}{6}$	A2	**(9)**
3.	*(a)*	$= \frac{1}{\cos x} \times (-\sin x) = -\tan x$	M1 A2	
	(b)	$= 2x \times \sin 3x + x^2 \times 3\cos 3x = 2x \sin 3x + 3x^2 \cos 3x$	M1 A2	
	(c)	$= \frac{d}{dx}[\,6(2x-7)^{-\frac{1}{2}}\,]$	B1	
		$= -3(2x-7)^{-\frac{3}{2}} \times 2 = -\frac{6}{(2x-7)^{\frac{3}{2}}}$	M1 A2	**(10)**
4.	*(a)*	$2\sin x - 3\cos x = R\sin x\cos\alpha - R\cos x\sin\alpha$		
		$R\cos\alpha = 2,\ R\sin\alpha = 3$		
		$\therefore\ R = \sqrt{2^2 + 3^2} = \sqrt{13}$	M1 A1	
		$\tan\alpha = \frac{3}{2},\ \alpha = 56.3$ (3sf)	M1 A1	
		$\therefore\ 2\sin x° - 3\cos x° = \sqrt{13}\sin(x - 56.3)°$		
	(b)	$\operatorname{cosec} x° + 3\cot x° = 2 \ \Rightarrow\ \frac{1}{\sin x} + \frac{3\cos x}{\sin x} = 2$		
		$\Rightarrow\ 1 + 3\cos x = 2\sin x$		
		$\Rightarrow\ 2\sin x° - 3\cos x° = 1$	B1	
	(c)	$\sqrt{13}\sin(x - 56.31) = 1$		
		$\sin(x - 56.31) = \frac{1}{\sqrt{13}}$	M1	
		$x - 56.31 = 16.10,\ 180 - 16.10 = 16.10, 163.90$	B1 M1	
		$x = 72.4, 220.2$ (1dp)	A2	**(10)**

5. *(a)* let $f(x) = 2x^3 - x^2 + 4x + 15$

$f(-\frac{3}{2}) = -\frac{27}{4} - \frac{9}{4} - 6 + 15 = 0 \;\; \therefore \; (2x + 3)$ is a factor — M1 A1

(b)

$$\begin{array}{r|l} & x^2 - 2x + 5 \\ 2x+3 & 2x^3 - x^2 + 4x + 15 \\ & 2x^3 + 3x^2 \\ & \quad - 4x^2 + 4x \\ & \quad - 4x^2 - 6x \\ & \qquad\quad 10x + 15 \\ & \qquad\quad 10x + 15 \end{array}$$

M1 A1

$\therefore \; f(x) = (2x + 3)(x^2 - 2x + 5)$

$\therefore \; \dfrac{2x^2+x-3}{2x^3-x^2+4x+15} = \dfrac{(2x+3)(x-1)}{(2x+3)(x^2-2x+5)} = \dfrac{x-1}{x^2-2x+5}$ — M1 A1

(c) $\dfrac{dy}{dx} = \dfrac{1\times(x^2-2x+5)-(x-1)(2x-2)}{(x^2-2x+5)^2} = \dfrac{-x^2+2x+3}{(x^2-2x+5)^2}$ — M1 A2

SP: $\dfrac{-x^2+2x+3}{(x^2-2x+5)^2} = 0$

$-x^2 + 2x + 3 = 0, \quad -(x + 1)(x - 3) = 0$ — M1

$x = -1, 3 \quad \therefore \; (-1, -\frac{1}{4}), (3, \frac{1}{4})$ — A2 **(12)**

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6. *(a)* $P = 30 + 50e^{0.002 \times 30} = 83.1$ — M1

$\therefore$ population = 83 100 (3sf) — A1

(b) $30 + 50e^{0.002t} > 84$ — M1

$e^{0.002t} > \frac{54}{50}$ — A1

$t > \frac{1}{0.002} \ln \frac{54}{50}, \;\; t > 38.5 \;\; \therefore$ 2018 — M1 A1

(c) $30 + 50e^{0.002t} = 26 + 50e^{0.003t}, \quad 50e^{0.003t} - 50e^{0.002t} = 4$

$e^{0.003t} - e^{0.002t} = 0.08, \quad e^{0.002t}(e^{0.001t} - 1) = 0.08$ — M1

$e^{0.001t} - 1 = 0.08e^{-0.002t}$ — M1

$0.001t = \ln(1 + 0.08e^{-0.002t})$

$t = 1000 \ln(1 + 0.08e^{-0.002t})$ — A1

(d) $t_1 = 69.887, \;\; t_2 = 67.251, \;\; t_3 = 67.595$ — M1 A2

$\therefore$ 2047 — A1 **(13)**

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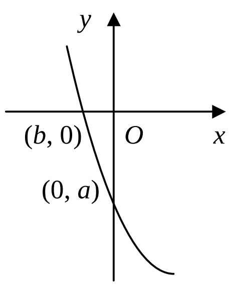
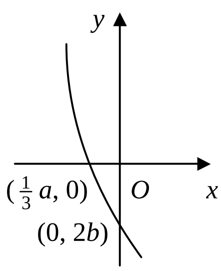
7. *(a)* *(i)*



M1 A2

(ii)



M1 A2

(b) $x = 0 \;\Rightarrow\; y = -1 \;\; \therefore \; b = -1$ — B1

$y = 0 \;\Rightarrow\; 2 - \sqrt{x+9} = 0$

$x = 2^2 - 9 = -5 \;\; \therefore \; a = -5$ — M1 A1

(c) $y = 2 - \sqrt{x+9}, \quad \sqrt{x+9} = 2 - y$

$x + 9 = (2 - y)^2$ — M1

$x = (2 - y)^2 - 9$

$\therefore \; f^{-1}(x) = (2 - x)^2 - 9$ — M1 A1

$f(-9) = 2 \;\; \therefore$ domain of $f^{-1}(x)$ is $x \in \mathbb{R}, \; x \leq 2$ — M1 A1 **(14)**

Total **(75)**

Performance Record – C3 Paper G

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	differentiation	trigonometry	differentiation	trigonometry	rational expressions, differentiation	exponentials and logarithms, numerical methods	functions	
Marks	7	9	10	10	12	13	14	75
Student								