FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper A

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.

Written by Shaun Armstrong

C2 Paper A – Marking Guide

1. *(a)* $f(-2) = -35 \quad \therefore \quad -24 - 8 - 2k + 9 = -35$ M1

$k = 6$ A1

(b) $= f(\tfrac{2}{3})$ B1

$= 3(\tfrac{8}{27}) - 2(\tfrac{4}{9}) + 6(\tfrac{2}{3}) + 9 = \tfrac{8}{9} - \tfrac{8}{9} + 4 + 9 = 13$ M1 A1 **(5)**

2.

x	-2	-1	0	1	2	
2^x	$\tfrac{1}{4}$	$\tfrac{1}{2}$	1	2	4	B1

area $\approx \tfrac{1}{2} \times 1 \times [\tfrac{1}{4} + 4 + 2(\tfrac{1}{2} + 1 + 2)]$ B1 M1 A1

$= 5\tfrac{5}{8}$ or 5.63 (3sf) A1 **(5)**

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3. $\tan^2 \theta = \tfrac{1}{3}$ M1

$\tan \theta = \pm \tfrac{1}{\sqrt{3}}$ A1

$\theta = \tfrac{\pi}{6}, \tfrac{\pi}{6} - \pi$ or $\pi - \tfrac{\pi}{6}, -\tfrac{\pi}{6}$ B1 M1

$\theta = -\tfrac{5\pi}{6}, -\tfrac{\pi}{6}, \tfrac{\pi}{6}, \tfrac{5\pi}{6}$ A2 **(6)**

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4. *(a)* $= 1 + 8(3x) + \binom{8}{2}(3x)^2 + \binom{8}{3}(3x)^3 + \ldots$ M1 A1

$= 1 + 24x + 252x^2 + 1512x^3 + \ldots$ M1 A1

(b) $x = 0.001$ B1

$(1.003)^8 \approx 1 + 0.024 + 0.000\,252 + 0.000\,001\,512$ M1

$= 1.024\,253\,5$ (8sf) A1 **(7)**

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5. *(a)* *(i)* $= 2 \log_3 x = 2t$ M1 A1

(ii) $= \dfrac{\log_3 x}{\log_3 9} = \dfrac{\log_3 x}{2} = \tfrac{1}{2}t$ M1 A1

(b) $2t - \tfrac{1}{2}t = 4$

$t = \tfrac{8}{3}$ M1

$\log_3 x = \tfrac{8}{3}, \quad x = 3^{\frac{8}{3}} = 18.7$ M1 A1 **(7)**

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6. *(a)* radius $= \sqrt{25+1} = \sqrt{26}$ M1 A1

$\therefore \quad (x + 3)^2 + (y - 2)^2 = (\sqrt{26})^2$ M1

$(x + 3)^2 + (y - 2)^2 = 26$ A1

(b) $(-4, 7)$, LHS $= (-4 + 3)^2 + (7 - 2)^2 = 1 + 25 = 26 \quad \therefore$ lies on circle B1

(c) grad of radius $= \dfrac{7-2}{-4-(-3)} = -5$ M1

$\therefore$ grad of tangent $= \dfrac{-1}{-5} = \tfrac{1}{5}$ M1 A1

$\therefore \quad y - 7 = \tfrac{1}{5}(x + 4)$ M1

$5y - 35 = x + 4$

$x - 5y + 39 = 0$ A1 **(10)**

7.	*(a)*	$2x^2 + 6x + 7 = 2x + 13$		
		$x^2 + 2x - 3 = 0$	M1	
		$(x + 3)(x - 1) = 0$	M1	
		$x = -3, 1$	A1	
		$\therefore\ (-3, 7), (1, 15)$	A1	
	(b)	area under curve $= \int_{-3}^{1} (2x^2 + 6x + 7)\ \mathrm{d}x$		
		$= [\frac{2}{3}x^3 + 3x^2 + 7x]_{-3}^{1}$	M1 A2	
		$= (\frac{2}{3} + 3 + 7) - (-18 + 27 - 21) = 22\frac{2}{3}$	M1	
		area of trapezium $= \frac{1}{2} \times (7 + 15) \times 4 = 44$	B1	
		shaded area $= 44 - 22\frac{2}{3} = 21\frac{1}{3}$	M1 A1	**(11)**
8.	*(a)*	$\frac{a(r^4 - 1)}{r - 1} = 10 \times \frac{a(r^2 - 1)}{r - 1}$	B1 M1	
		$r^4 - 1 = 10(r^2 - 1)$		
		$r^4 - 10r^2 + 9 = 0$	A1	
		$(r^2 - 1)(r^2 - 9) = 0$	M1	
		$r^2 = 1, 9$		
		$r = \pm 1, \pm 3$	M1	
		$r > 1\ \ \therefore\ r = 3$	A1	
	(b)	$\frac{a(3^3 - 1)}{3 - 1} = 26$	M1 A1	
		$a = \frac{26}{13} = 2$	A1	
	(c)	$S_6 = \frac{2(3^6 - 1)}{3 - 1} = 728$	M1 A1	**(11)**
9.	*(a)*	area $= 2xy + (\frac{1}{2} \times x^2 \times 0.5) = 2xy + \frac{1}{4}x^2 = 50$	M1	
		$\therefore\ y = \frac{50 - \frac{1}{4}x^2}{2x} = \frac{25}{x} - \frac{1}{8}x$	A1	
		$P = 2x + 4y + (x \times 0.5) = \frac{5}{2}x + 4y$	M1	
		$= \frac{5}{2}x + 4(\frac{25}{x} - \frac{1}{8}x)$	M1	
		$= \frac{5}{2}x + \frac{100}{x} - \frac{1}{2}x = 2x + \frac{100}{x}$	A1	
	(b)	$\frac{\mathrm{d}P}{\mathrm{d}x} = 2 - 100x^{-2}$	M1 A1	
		for minimum, $2 - 100x^{-2} = 0$	M1	
		$x^2 = 50$		
		$x = \sqrt{50}$ or $5\sqrt{2}$	A1	
	(c)	$\frac{\mathrm{d}^2P}{\mathrm{d}x^2} = 200x^{-3}$	M1	
		when $x = 5\sqrt{2}$, $\frac{\mathrm{d}^2P}{\mathrm{d}x^2} = \frac{2}{5}\sqrt{2}$, $\frac{\mathrm{d}^2P}{\mathrm{d}x^2} > 0\ \therefore$ minimum	A1	
	(d)	$= 2(5\sqrt{2}) + \frac{100}{5\sqrt{2}} = 10\sqrt{2} + 10\sqrt{2} = 20\sqrt{2}$	M1 A1	**(13)**
			Total	**(75)**

Performance Record – C2 Paper A

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	remain. theorem	trapezium rule	trig. eqn	binomial	logs	circle	area by integr.	GP	circular sector, max./min. problem	
Marks	5	5	6	7	7	10	11	11	13	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper B

MARKING GUIDE

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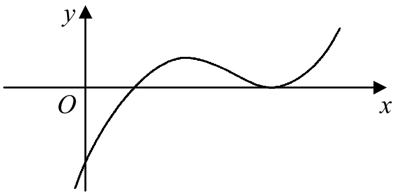
C2 Paper B – Marking Guide

1.		$\log_5 \frac{4x+3}{x-1} = 2$	M1	
		$\frac{4x+3}{x-1} = 5^2 = 25$	M1	
		$4x + 3 = 25(x - 1)$	M1	
		$21x = 28, \quad x = \frac{4}{3}$	A1	**(4)**
2.		$\int_1^3 (x^2 - 2x + k)\ \mathrm{d}x = [\frac{1}{3}x^3 - x^2 + kx]_1^3$	M1 A2	
		$= (9 - 9 + 3k) - (\frac{1}{3} - 1 + k) = 2k + \frac{2}{3}$	M1	
		$\therefore\ 2k + \frac{2}{3} = 8\frac{2}{3}, \quad k = 4$	M1 A1	**(6)**
3.	*(a)*	$= 1 + n(\frac{1}{4}x) + \frac{n(n-1)}{2}(\frac{1}{4}x)^2 + \ldots$	B1 M1	
		$= 1 + \frac{1}{4}nx + \frac{1}{32}n(n - 1)x^2 + \ldots$	A1	
	(b)	$\frac{1}{4}n = \frac{1}{32}n(n - 1)$	M1	
		$8n = n(n - 1)$		
		$n[8 - (n - 1)] = 0$	M1	
		$n \neq 0 \ \therefore\ n = 9$	A1	**(6)**
4.		$3(1 - \sin^2 x) + \sin^2 x + 5 \sin x = 0$	M1	
		$2 \sin^2 x - 5 \sin x - 3 = 0$	A1	
		$(2 \sin x + 1)(\sin x - 3) = 0$	M1	
		$\sin x = 3$ (no solutions) or $-\frac{1}{2}$	A1	
		$x = 180 + 30, 360 - 30$	B1 M1	
		$x = 210, 330$	A1	**(7)**
5.	*(a)*	$(x + 1)^2 + (y - 6)^2 = (2\sqrt{5})^2$	M1	
		$(x + 1)^2 + (y - 6)^2 = 20$	A1	
	(b)	sub. $y = 3x - 1$ into eqn of C:		
		$(x + 1)^2 + [(3x - 1) - 6]^2 = 20$	M1	
		$(x + 1)^2 + (3x - 7)^2 = 20$	A1	
		$x^2 - 4x + 3 = 0$		
		$(x - 1)(x - 3) = 0$	M1	
		$x = 1, 3$	A1	
	(c)	$x = 1 \Rightarrow y = 2 \quad \therefore (1, 2), \qquad x = 3 \Rightarrow y = 8 \quad \therefore (3, 8)$	B1	
		$AB = \sqrt{(3-1)^2 + (8-2)^2} = \sqrt{4+36} = \sqrt{40} = \sqrt{4 \times 10} = 2\sqrt{10}$	M1 A1	**(9)**
6.	*(a)*	$\frac{\mathrm{d}y}{\mathrm{d}x} = 4 - x^{-2}$	M1 A1	
		for minimum, $\quad 4 - x^{-2} = 0$	M1	
		$x^2 = \frac{1}{4}$		
		$x > 0 \ \therefore\ x = \frac{1}{2} \quad \therefore\ (\frac{1}{2}, 4)$	A2	
	(b)	$\begin{array}{ccccc} x & 1 & 2 & 3 & 4 \\ 4x + x^{-1} & 5 & 8\frac{1}{2} & 12\frac{1}{3} & 16\frac{1}{4} \end{array}$	B1	
		area $\approx \frac{1}{2} \times 1 \times [5 + 16\frac{1}{4} + 2(8\frac{1}{2} + 12\frac{1}{3})]$	B1 M1 A1	
		$= 31.5$ (3sf)	A1	**(10)**

7.	*(a)*	$r = \frac{114}{120} = 0.95$	M1	
		$u_5 = 120 \times (0.95)^4 = 97.74$	M1	
		$\therefore$ 1 hour 38 minutes	A1	
	(b)	$S_8 = \frac{120[1-(0.95)^8]}{1-0.95}$	M1 A1	
		= 807.79... minutes ≈ 13 hours 28 minutes	A1	
	(c)	$120 \times (0.95)^{n-1} < 60$	M1	
		$(n - 1) \lg 0.95 < \lg 0.5$	M1	
		$n > \frac{\lg 0.5}{\lg 0.95} + 1$	A1	
		$n > 14.51$ $\therefore$ 15 papers	A1	**(10)**
8.	*(a)*	$BD^2 = 6^2 + 9^2 - (2 \times 6 \times 9 \times \cos 60)$	M1 A1	
		$BD^2 = 36 + 81 - 54 = 63$		
		$BD = \sqrt{63} = \sqrt{9 \times 7} = 3\sqrt{7}$ cm	M1 A1	
	(b)	$(3\sqrt{7})^2 = 3^2 + 8^2 - (2 \times 3 \times 8 \times \cos C)$	M1	
		$\cos C = \frac{9+64-63}{48} = \frac{5}{24}$		
		$\angle BCD = 78.0°$ (1dp)	M1 A1	
	(c)	$= (\frac{1}{2} \times 6 \times 9 \times \sin 60) + (\frac{1}{2} \times 3 \times 8 \times \sin 77.975)$	M2	
		$= 35.1$ cm^2 (3sf)	A1	**(10)**
9.	*(a)*	$f(1) = 1 - 9 + 24 - 16 = 0$	B1	
		$\therefore$ $(x - 1)$ is a factor of $f(x)$	B1	
	(b)	$\begin{array}{rrrrr} & x^2 & -\ 8x & +\ 16 & \\ \cline{2-5} x-1\,) & x^3 & -\ 9x^2 & +\ 24x & -\ 16 \\ & x^3 & -\ x^2 & & \\ \cline{2-3} & & -\ 8x^2 & +\ 24x & \\ & & -\ 8x^2 & +\ 8x & \\ \cline{3-4} & & & 16x & -\ 16 \\ & & & 16x & -\ 16 \\ \cline{4-5} \end{array}$	M1 A1	
		$f(x) = (x - 1)(x^2 - 8x + 16)$		
		$f(x) = (x - 1)(x - 4)^2$ $[\,p = -1, q = -4\,]$	M1 A1	
	(c)		B2	
	(d)	$= \int_1^4 (x^3 - 9x^2 + 24x - 16)\ dx$		
		$= [\frac{1}{4}x^4 - 3x^3 + 12x^2 - 16x]_1^4$	M1 A2	
		$= [(64 - 192 + 192 - 64) - (\frac{1}{4} - 3 + 12 - 16)]$	M1	
		$= 6\frac{3}{4}$	A1	**(13)**

Total **(75)**

Performance Record – C2 Paper B

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	logs	integr.	binomial	trig. eqn	circle	SP, trapezium rule	GP	cosine rule	factor theorem, area by integr.	
Marks	4	6	6	7	9	10	10	10	13	75
Student										

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Paper C

MARKING GUIDE

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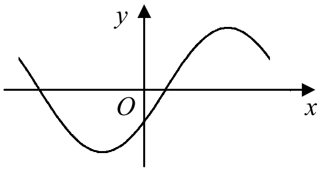
C2 Paper C – Marking Guide

1.		$(1-x)^6 = 1 + 6(-x) + \binom{6}{2}(-x)^2 + \ldots = 1 - 6x + 15x^2$	M1 A1	
		$(1+x)(1-x)^6 = (1+x)(1 - 6x + 15x^2 + \ldots)$ coeff. of $x^2 = 15 - 6 = 9$	M1 A1	**(4)**
2.	*(a)*	$\frac{a[1-(\frac{1}{3})^4]}{1-\frac{1}{3}} = 200$	M1 A1	
		$a = 200 \times \frac{27}{40} = 135$	A1	
	(b)	$= \frac{135}{1-\frac{1}{3}} = 202\frac{1}{2}$	M1 A1	**(5)**
3.	*(a)*	$(-4, 0)\ \therefore\ 0 = 4 - 20 + 16k + 128$	M1	
		$16k = -112,\ k = -7$	A1	
	(b)	$4 + 5x - 7x^2 - 2x^3 = 0$		
		$x = -4$ is a solution $\therefore$ $(x + 4)$ is a factor	B1	
		$\begin{array}{r\|rrrr} & -2x^2 & +\ x & +\ 1 & \\ \hline x+4 & -2x^3 & -\ 7x^2 & +\ 5x & +\ 4 \\ & -2x^3 & -\ 8x^2 & & \\ \hline & & x^2 & +\ 5x & \\ & & x^2 & +\ 4x & \\ \hline & & & x & +\ 4 \\ & & & x & +\ 4 \\ \hline \end{array}$	M1 A1	
		$\therefore\ (x+4)(1+x-2x^2) = 0$		
		$(x+4)(1+2x)(1-x) = 0$	M1	
		$x = -4$ (at A), $-\frac{1}{2}$, 1		
		$\therefore\ (-\frac{1}{2}, 0), (1, 0)$	A1	**(7)**
4.	*(a)*	*(i)* 	B2	
		(ii) $(-60, -1), (120, 1)$	B2	
	(b)	$x - 30 = -180 - 20.5, 20.5$	B1 M1	
		$= -200.5, 20.5$		
		$x = -170.5, 50.5$ (1dp)	M1 A1	**(8)**
5.	*(a)*	$= 3 - \log_8 8^{\frac{2}{3}}$	B1 M1 A1	
		$= 3 - \frac{2}{3} = \frac{7}{3}$	A1	
	(b)	$(2^2)^x - 3(2 \times 2^x) = 0$	M1	
		$(2^x)^2 - 6(2^x) = 0$		
		$2^x(2^x - 6) = 0$	M1	
		$2^x = 0$ (no solutions) or 6	A1	
		$x = \frac{\lg 6}{\lg 2} = 2.58$ (3sf)	M1 A1	**(9)**

6.	*(a)*	$f'(x) = -1 + 2x^{-\frac{1}{3}}$	M1 A1	
		$f''(x) = -\frac{2}{3}x^{-\frac{4}{3}}$	A1	
	(b)	for TP, $-1 + 2x^{-\frac{1}{3}} = 0$	M1	
		$x^{\frac{1}{3}} = 2$	M1	
		$x = 8$	A1	
		$\therefore\ (8, 6)$	A1	
	(c)	$f''(8) = -\frac{1}{24},\ f''(x) < 0\ \therefore$ maximum	M1 A1	**(9)**
7.	*(a)*	grad $PQ = \frac{8-2}{-3-(-5)} = 3$, grad $QR = \frac{4-8}{9-(-3)} = -\frac{1}{3}$	M1 A1	
		grad $PQ \times$ grad $QR = 3 \times (-\frac{1}{3}) = -1$	M1	
		$\therefore$ PQ perp. to QR, $\therefore \angle PQR = 90°$	A1	
	(b)	$\angle PQR = 90°$ $\therefore$ PR is a diameter	M1	
		$\therefore$ centre = mid-point of $PR = (\frac{-5+9}{2}, \frac{2+4}{2}) = (2, 3)$	M1 A1	
	(c)	radius = dist. $(-5, 2)$ to $(2, 3) = \sqrt{49+1} = \sqrt{50}$	B1	
		$\therefore\ (x-2)^2 + (y-3)^2 = (\sqrt{50})^2$	M1	
		$x^2 - 4x + 4 + y^2 - 6y + 9 = 50$		
		$x^2 + y^2 - 4x - 6y = 37$ [$k = 37$]	A1	**(10)**
8.	*(a)*	$= 12 \times (2\pi - \frac{2\pi}{3}) = 16\pi$ cm	M1 A1	
	(b)	chord $= 2 \times 12 \sin \frac{\pi}{3} = 24 \times \frac{\sqrt{3}}{2} = 12\sqrt{3}$	M1 A1	
		$P = (12 \times \frac{2\pi}{3}) + 12\sqrt{3}$	M1	
		$= 8\pi + 12\sqrt{3} = 4(2\pi + 3\sqrt{3})$ cm [$k = 4$]	A1	
	(c)	area of segment $= (\frac{1}{2} \times 12^2 \times \frac{2\pi}{3}) - (\frac{1}{2} \times 12^2 \times \sin \frac{2\pi}{3})$	M2	
		$= 72(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}) = 88.443$		
		as % of area of circle $= \frac{88.443}{\pi \times 12^2} \times 100\% = 19.6\%$ (1dp)	M1 A1	**(10)**
9.	*(a)*	$\begin{array}{ccccc} x & 2 & 4 & 6 & 8 \\ 1 + 3\sqrt{x} & 5.243 & 7 & 8.348 & 9.485 \end{array}$	M1 A1	
		area $\approx \frac{1}{2} \times 2 \times [5.243 + 9.485 + 2(7 + 8.348)]$	B1 M1 A1	
		$= 45.4$ (3sf)	A1	
	(b)	$= \int_2^8 (1 + 3\sqrt{x})\ dx$		
		$= [x + 2x^{\frac{3}{2}}]_2^8$	M1 A1	
		$= [8 + 2(2\sqrt{2})^3] - [2 + 2(2\sqrt{2})]$	M1	
		$= (8 + 32\sqrt{2}) - (2 + 4\sqrt{2})$	M1	
		$= 6 + 28\sqrt{2}$	A1	
	(c)	$= \frac{(6+28\sqrt{2}) - 45.4}{6+28\sqrt{2}} \times 100\% = 0.43\%$	M1 A1	**(13)**
			Total	**(75)**

Performance Record – C2 Paper C

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	binomial	GP	factor theorem, alg. div.	trig. graph, trig. eqn	logs	SP	circle	sector of a circle	trapezium rule, area by integr.	
Marks	4	5	7	8	9	9	10	10	13	75
Student										

FOR EDEXCEL

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Core Mathematics C2

Paper D

MARKING GUIDE

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C2 Paper D – Marking Guide

1. $= 3^4 + 4(3^3)(-2x) + 6(3^2)(-2x)^2 + 4(3)(-2x)^3 + (-2x)^4$ M1 A1
$= 81 - 216x + 216x^2 - 96x^3 + 16x^4$ B1 A1 **(4)**

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2. $(7 - x)^2 = x^2 + (x + 1)^2 - [2 \times x \times (x + 1) \times \cos 60]$ M1 A1
$49 - 14x + x^2 = x^2 + x^2 + 2x + 1 - x^2 - x$
$15x = 48, \quad x = \frac{16}{5}$ M1 A1 **(4)**

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3. $\frac{dy}{dx} = 1 - 8x^{-3}$ M1 A1
for SP, $1 - 8x^{-3} = 0$ M1
$x^3 = 8$
$x = 2 \ \therefore (2, 3)$ M1 A2 **(6)**

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4. $2(1 - \cos^2 x) - 2\cos x - \cos^2 x = 1$ M1
$3\cos^2 x + 2\cos x - 1 = 0$ A1
$(3\cos x - 1)(\cos x + 1) = 0$ M1
$\cos x = -1$ or $\frac{1}{3}$ A1
$x = 180$ or $70.5, 360 - 70.5$ B2 M1
$x = 70.5°$ (1dp), $180°$, $289.5°$ (1dp) A1 **(8)**

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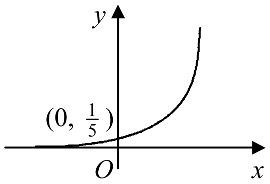
5. *(a)*



B2

(b) *(i)* $5^{x-1} = 10$
$(x - 1)\lg 5 = \lg 10 = 1$ M1
$x = \frac{1}{\lg 5} + 1 = 2.43$ M1 A1

(ii) $5^{x-1} = 2^x$
$(x - 1)\lg 5 = x \lg 2$ M1
$x(\lg 5 - \lg 2) = \lg 5$ M1
$x = \frac{\lg 5}{\lg 5 - \lg 2} = 1.76$ A1 **(8)**

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6. *(a)* $= f(\frac{1}{2}) = \frac{1}{4} + \frac{3}{4} - 3 + 1 = -1$ M1 A1

(b) *(i)* $= f(-2) = -16 + 12 + 12 + 1 = 9$ B1

(ii) $x = -2$ is a solution to $f(x) = 9$ i.e. $2x^3 + 3x^2 - 6x - 8 = 0$ M1 A1

$$\begin{array}{r|rrrr} & 2x^2 & -\ x & -\ 4 & \\ \hline x+2 & 2x^3 & +\ 3x^2 & -\ 6x & -\ 8 \\ & 2x^3 & +\ 4x^2 & & \\ \hline & & -\ x^2 & -\ 6x & \\ & & -\ x^2 & -\ 2x & \\ \hline & & & -\ 4x & -\ 8 \\ & & & -\ 4x & -\ 8 \\ \hline \end{array}$$

M1 A1

$\therefore (x + 2)(2x^2 - x - 4) = 0$
$x = -2$ or $\frac{1 \pm \sqrt{1+32}}{4}$ M1
$x = -2, -1.19$ (2dp), 1.69 (2dp) A1 **(9)**

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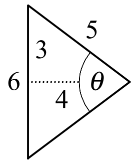
7.	*(a)*	$S_n = a + ar + ar^2 + \ldots + ar^{n-1}$	B1	
		$rS_n = ar + ar^2 + ar^3 + \ldots + ar^n$	M1	
		subtracting, $S_n - rS_n = a - ar^n$		
		$(1 - r)S_n = a(1 - r^n)$	M1	
		$S_n = \frac{a(1-r^n)}{1-r}$	A1	
	(b)	GP: $a = 10$, $r = 2$	B2	
		$S_{12} = \frac{10(2^{12}-1)}{2-1}$	M1 A1	
		$= 40\,950$	A1	**(9)**
8.	*(a)*	$\frac{\mathrm{d}y}{\mathrm{d}x} = 1 - 2x$	M1	
		grad $= 1 - 2 = -1$	A1	
		grad of normal $= \frac{-1}{-1} = 1$	M1	
		$y - 5 = 1(x - 1)$	M1	
		$y = x + 4$	A1	
	(b)	$5 + x - x^2 = x + 4$		
		$x^2 - 1 = 0$	M1	
		$x = 1$ (at P) or -1 $\therefore Q\,(-1, 3)$	A1	
	(c)	area under curve $= \int_{-1}^{1} (5 + x - x^2)\ \mathrm{d}x$		
		$= [5x + \frac{1}{2}x^2 - \frac{1}{3}x^3]_{-1}^{1}$	M1 A1	
		$= (5 + \frac{1}{2} - \frac{1}{3}) - (-5 + \frac{1}{2} + \frac{1}{3}) = 9\frac{1}{3}$	M1	
		area of trapezium $= \frac{1}{2} \times (3 + 5) \times 2 = 8$	B1	
		shaded area $= 9\frac{1}{3} - 8 = \frac{4}{3}$	M1 A1	**(13)**
9.	*(a)*	$(x - 4)^2 - 16 + (y - 5)^2 - 25 + 16 = 0$	M1	
		$(x - 4)^2 + (y - 5)^2 = 25$		
		$\therefore$ centre $(4, 5)$, radius $= 5$	A2	
	(b)	$x = 0$ $\therefore$ $y^2 - 10y + 16 = 0$	M1	
		$(y - 2)(y - 8) = 0$	M1	
		$y = 2, 8$ $\therefore (0, 2), (0, 8)$	A1	
	(c)			
		$6^2 = 5^2 + 5^2 - (2 \times 5 \times 5 \times \cos\theta)$	M2 A1	
		$\cos\theta = \frac{25+25-36}{50} = \frac{7}{25}$	A1	
	(d)	$\theta = \cos^{-1}\frac{7}{25} = 1.287$, $\sin\theta = 0.96$		
		area $= \frac{1}{2} \times 5^2 \times \theta - \frac{1}{2} \times 5^2 \times \sin\theta = \frac{25}{2}(1.287 - 0.96)$	M2 A1	
		$= 4.09$ (3sf)	A1	**(14)**
			Total	**(75)**

Performance Record – C2 Paper D

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	binomial	cosine rule	SP	trig. eqn	exponential graph, logs	remain. theorem, alg. div.	GP	area by integr.	circle, sector of a circle	
Marks	4	4	6	8	8	9	9	13	14	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper E

MARKING GUIDE

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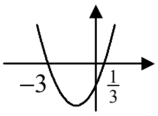
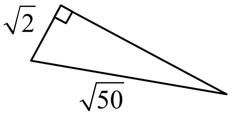
Written by Shaun Armstrong

C2 Paper E – Marking Guide

1.		$= [2x + x^{-1}]_2^4$	M1 A1	
		$= (8 + \frac{1}{4}) - (4 + \frac{1}{2}) = 3\frac{3}{4}$	M1 A1	**(4)**
2.		$f'(x) = 3x^2 + 8x - 3$	M1 A1	
		increasing when $3x^2 + 8x - 3 \geq 0$	M1	
		$(3x - 1)(x + 3) \geq 0$	M1	
		$x \leq -3$ or $x \geq \frac{1}{3}$ 	A1	**(5)**
3.	*(a)*	$= \log_2 (3^2 \times 5)$	B1	
		$= 2 \log_2 3 + \log_2 5 = 2p + q$	M1 A1	
	(b)	$= \log_2 \frac{3}{5 \times 2} = \log_2 3 - \log_2 5 - \log_2 2$	M1	
		$= p - q - 1$	B1 A1	**(6)**
4.	*(a)*	$(1 + kx)^7 = \ldots + \binom{7}{2}(kx)^2 + \ldots$	B1	
		$\therefore \frac{7 \times 6}{2} \times k^2 = 525$		
		$k^2 = \frac{525}{21} = 25$	M1	
		$k > 0 \therefore k = 5$	A1	
	(b)	$(1 + 5x)^7 = \ldots + \binom{7}{3}(5x)^3 + \ldots$		
		$\therefore$ coeff. of $x^3 = \frac{7 \times 6 \times 5}{3 \times 2} \times 125 = 4375$	M1 A1	
	(c)	$(1 + 5x)^7 = 1 + 35x + 525x^2 + \ldots$	B1	
		$(2 - x)(1 + 5x)^7 = (2 - x)(1 + 35x + 525x^2 + \ldots)$		
		$= 2 + 70x + 1050x^2 - x - 35x^2 + \ldots$	M1	
		$= 2 + 69x + 1015x^2 + \ldots$	A1	**(8)**
5.	*(a)*	$\frac{1}{2}\sqrt{3}$	B1	
	(b)	x 0 $\frac{\pi}{6}$ $\frac{\pi}{3}$	M1	
		$\cos^2 x$ 1 $\frac{3}{4}$ $\frac{1}{4}$	A1	
		area $\approx \frac{1}{2} \times \frac{\pi}{6} \times [1 + \frac{1}{4} + 2(\frac{3}{4})]$	B1 M1	
		$= 0.720$ (3sf)	A1	
	(c)	area of $S = \int_0^{\frac{\pi}{3}} \sin^2 x \; dx = \int_0^{\frac{\pi}{3}} (1 - \cos^2 x) \; dx$	M1	
		$= \frac{\pi}{3} - 0.71995 = 0.327$ (3sf)	M1 A1	**(9)**
6.	*(a)*	isosceles $\therefore \angle AMB = 90°$	B1	
		$BM = 4 \tan 30° = \frac{4}{\sqrt{3}}$	M1 A1	
		area $= \frac{1}{2} \times 8 \times \frac{4}{\sqrt{3}} = \frac{16}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{16}{3}\sqrt{3}$ cm^2	M1 A1	
	(b)	area of sector $= \frac{1}{2} \times 4^2 \times \frac{\pi}{6} = \frac{4}{3}\pi$	B1 M1	
		shaded area $= \frac{16}{3}\sqrt{3} - (2 \times \frac{4}{3}\pi)$	M1	
		$= \frac{16}{3}\sqrt{3} - \frac{8}{3}\pi = \frac{8}{3}(2\sqrt{3} - \pi)$ cm^2	A1	**(9)**

7.	*(a)*	$(-6, 5)\ \therefore\ 36 + 25 - 60 - 40 + k = 0$	M1	
		$k = 39$	A1	
	(b)	$(x + 5)^2 - 25 + (y - 4)^2 - 16 + 39 = 0$	M1	
		$(x + 5)^2 + (y - 4)^2 = 2$		
		$\therefore$ centre $(-5, 4)$, radius = $\sqrt{2}$	A2	
	(c)	 dist. $(2, 3)$ to centre = $\sqrt{49+1} = \sqrt{50}$	B1	
		$\therefore\ AB^2 = (\sqrt{50})^2 - (\sqrt{2})^2 = 48$	M1 A1	
		$AB = \sqrt{48} = \sqrt{16\times3} = 4\sqrt{3}$	M1 A1	**(10)**
8.	*(a)*	end of 1st year: $500 \times 1.06 = 530$	M1	
		start of 2nd year: $530 + 500 = 1030$		
		interest at end of 2nd year = 0.06×1030 = £61.80	M1 A1	
	(b)	end of 8th year: $500 \times (1.06 + 1.06^2 + 1.06^3 + ... + 1.06^8)$		
		$= 500 \times S_8$; GP, $a = 1.06$, $r = 1.06$	B1	
		$= 500 \times \frac{1.06[(1.06)^8 - 1]}{1.06 - 1}$	M1 A1	
		$= 5245.66\ \therefore$ £5246 (nearest pound)	A1	
	(c)	$(1.005)^{12} = 1.0617...$	M1 A1	
		end of 8th year: $500 \times \frac{1.0617[(1.0617)^8 - 1]}{1.0617 - 1} = 5285.71$	M1 A1	
		$\therefore$ £40 more in account (nearest pound)	A1	**(12)**
9.	*(a)*	$f(-1) = r\ \therefore\ -1 + k + 7 - 15 = r$	M1	
		$k = r + 9$	A1	
		$f(3) = 3r\ \therefore\ 27 + 9k - 21 - 15 = 3r$	M1	
		$3k = r + 3$		
		subtracting, $2k = -6$	M1	
		$k = -3$	A1	
	(b)	$r = -3 - 9 = -12$	B1	
	(c)	$f(x) = x^3 - 3x^2 - 7x - 15$		
		$f(5) = 125 - 75 - 35 - 15 = 0\ \therefore\ (x - 5)$ is a factor	M1 A1	
	(d)	$\begin{array}{rrrrr} & x^2 & +\ 2x & +\ 3 & \\ \cline{2-5} x-5\ \big) & x^3 & -\ 3x^2 & -\ 7x & -\ 15 \\ & x^3 & -\ 5x^2 & & \\ \cline{2-3} & & 2x^2 & -\ 7x & \\ & & 2x^2 & -\ 10x & \\ \cline{3-4} & & & 3x & -\ 15 \\ & & & 3x & -\ 15 \\ \cline{4-5} \end{array}$	M1 A1	
		$\therefore\ (x - 5)(x^2 + 2x + 3) = 0$		
		$x = 5$ or $x^2 + 2x + 3 = 0$		
		$b^2 - 4ac = 2^2 - (4 \times 1 \times 3) = -8$	M1	
		$b^2 - 4ac < 0\ \therefore$ no real solutions to quadratic		
		$\therefore$ only one real solution	A1	**(12)**
			Total	**(75)**

Performance Record – C2 Paper E

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	integr.	increasing function	logs	binomial	trapezium rule	sector of a circle	circle	GP	remain. theorem, alg. div.	
Marks	4	5	6	8	9	9	10	12	12	75
Student										

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper F

MARKING GUIDE

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Solomon Press

Written by Shaun Armstrong

C2 Paper F – Marking Guide

1.	*(a)*	$\angle BAC = 180 - (107 + 31) = 42$	B1	
		$\frac{BC}{\sin 42} = \frac{12.6}{\sin 31}$	M1	
		$BC = \frac{12.6 \sin 42}{\sin 31} = 16.4$ cm (3sf)	A1	
	(b)	$= \frac{1}{2} \times 12.6 \times 16.37 \times \sin 107 = 98.6\text{ cm}^2$ (3sf)	M1 A1	**(5)**
2.		$\int_2^3 (6\sqrt{x} - \frac{4}{\sqrt{x}})\,dx = [4x^{\frac{3}{2}} - 8x^{\frac{1}{2}}]_2^3$	M1 A2	
		$= [4(3\sqrt{3}) - 8\sqrt{3}] - [4(2\sqrt{2}) - 8\sqrt{2}]$	M1 B1	
		$= (12\sqrt{3} - 8\sqrt{3}) - (8\sqrt{2} - 8\sqrt{2})$		
		$= 4\sqrt{3} \quad [k = 4]$	A1	**(6)**
3.	*(a)*	x: 0, 0.5, 1, 1.5, 2		
		$\frac{1}{x^2+1}$: 1, 0.8, 0.5, 0.3077, 0.2	M1 A1	
		area $\approx \frac{1}{2} \times 0.5 \times [1 + 0.2 + 2(0.8 + 0.5 + 0.3077)]$	B1 M1	
		$= 1.10$ (3sf)	A1	
	(b)	area $= 8^2 \times 1.10385 = 70.6464$	M1	
		volume $= 2 \times 70.6464 = 141\text{ cm}^3$ (3sf)	A1	**(7)**
4.	*(a)*	$= 2^6 + 6(2^5)(y) + \binom{6}{2}(2^4)(y^2) + \binom{6}{3}(2^3)(y^3) + \ldots$	M1 A1	
		$= 64 + 192y + 240y^2 + 160y^3 + \ldots$	B1 A1	
	(b)	let $y = x - x^2$		
		$(2 + x - x^2)^6 = 64 + 192(x - x^2) + 240(x - x^2)^2 + 160(x - x^2)^3 + \ldots$	M1	
		$= 64 + 192(x - x^2) + 240(x^2 - 2x^3 + \ldots) + 160(x^3 + \ldots) + \ldots$	M1	
		$= 64 + 192x + 48x^2 - 320x^3 + \ldots$	A1	**(7)**
5.	*(a)*	$\frac{8 \sin x}{\cos x} - 3 \cos x = 0$	M1	
		$8 \sin x - 3 \cos^2 x = 0$		
		$8 \sin x - 3(1 - \sin^2 x) = 0$	M1	
		$3 \sin^2 x + 8 \sin x - 3 = 0$	A1	
	(b)	$(3 \sin x - 1)(\sin x + 3) = 0$	M1	
		$\sin x = -3$ (no solutions) or $\frac{1}{3}$	A1	
		$x = 0.34,\ \pi - 0.3398$	B1 M1	
		$x = 0.34,\ 2.80$ (2dp)	A1	**(8)**
6.	*(a)*	*(i)* $= 3^1 \times 3^x = 3y$	M1 A1	
		(ii) $= 3^{-1} \times (3^x)^2 = \frac{1}{3}y^2$	M1 A1	
	(b)	$3y - \frac{1}{3}y^2 = 6$		
		$y^2 - 9y + 18 = 0$		
		$(y - 3)(y - 6) = 0$	M1	
		$y = 3, 6$	A1	
		$3^x = 3, 6$		
		$x = 1,\ \frac{\lg 6}{\lg 3}$	B1 M1	
		$x = 1,\ 1.63$ (2dp)	A1	**(9)**

7.	*(a)*	$= 2 \times \sqrt{4+1} = 2\sqrt{5}$	M1 A1	
	(b)	$(x-5)^2 + (y-2)^2 = (\sqrt{5})^2$	M1	
		$(x-5)^2 + (y-2)^2 = 5$	A1	
	(c)	sub. $y = 2x - 3$ into eqn of C:		
		$(x-5)^2 + [(2x-3)-2]^2 = 5$	M1	
		$(x-5)^2 + (2x-5)^2 = 5$	A1	
		$x^2 - 6x + 9 = 0$		
		$(x-3)^2 = 0$	M1	
		repeated root $\therefore$ tangent	A1	
		point of contact (3, 3)	A1	**(9)**
8.	*(a)*	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{2}x^{-\frac{1}{2}} - 16x^{-3}$	M1 A2	
		for minimum, $\frac{1}{2}x^{-\frac{1}{2}} - 16x^{-3} = 0$	M1	
		$\frac{1}{2}x^{-3}(x^{\frac{5}{2}} - 32) = 0$		
		$x^{\frac{5}{2}} = 32$	A1	
		$x = (\sqrt[5]{32})^2 = 4$	M1	
		$\therefore\ (4, \frac{5}{2})$	A1	
	(b)	$= \int_1^9 (\sqrt{x} + \frac{8}{x^2})\ \mathrm{d}x$		
		$= [\frac{2}{3}x^{\frac{3}{2}} - 8x^{-1}]_1^9$	M1 A2	
		$= (18 - \frac{8}{9}) - (\frac{2}{3} - 8)$	M1	
		$= 24\frac{4}{9}$	A1	**(12)**
9.	*(a)*	$r = \frac{x+6}{x-2} = \frac{x^2}{x+6}$	M1	
		$(x+6)^2 = x^2(x-2)$	M1	
		$x^2 + 12x + 36 = x^3 - 2x^2, \qquad x^3 - 3x^2 - 12x - 36 = 0$	A1	
	(b)	when $x = 6$, LHS $= 216 - 108 - 72 - 36 = 0$ $\therefore$ $x = 6$ is a solution	B1	
		$\begin{array}{rl} & \quad x^2 + 3x + 6 \\ x-6 & \overline{\smash{)}\,x^3 - 3x^2 - 12x - 36} \\ & \underline{\ x^3 - 6x^2} \\ & \qquad 3x^2 - 12x \\ & \qquad \underline{3x^2 - 18x} \\ & \qquad\qquad 6x - 36 \\ & \qquad\qquad \underline{6x - 36} \end{array}$	M1 A1	
		$\therefore\ (x-6)(x^2 + 3x + 6) = 0$		
		$x = 6$ or $x^2 + 3x + 6 = 0$		
		$b^2 - 4ac = 3^2 - (4 \times 1 \times 6) = -15$	M1 A1	
		$b^2 - 4ac < 0$ $\therefore$ no real solutions to quadratic		
		$\therefore$ no other solutions	A1	
	(c)	$r = \frac{6+6}{6-2} = 3$	B1	
	(d)	$a = 6 - 2 = 4$		
		$S_8 = \frac{4(3^8 - 1)}{3-1} = 13\ 120$	M1 A1	**(12)**
			Total	**(75)**

Performance Record – C2 Paper F

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	sine rule	integr.	trapezium rule	binomial	trig. eqn	logs	circle	SP, area by integr.	GP, factor theorem, alg. div.	
Marks	5	6	7	7	8	9	9	12	12	75
Student										

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GCE Examinations
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Core Mathematics C2

Paper G

MARKING GUIDE

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Solomon
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Written by Shaun Armstrong

C2 Paper G – Marking Guide

1.		$= \int_{-2}^{0} (9x^2 - 6x + 1)\ dx$	M1	
		$= [3x^3 - 3x^2 + x]_{-2}^{0}$	M1 A1	
		$= (0) - (-24 - 12 - 2) = 38$	M1 A1	**(5)**
2.	*(a)*	$f(-1) = 0 \quad \therefore\ -1 - k - 20 = 0$	M1	
		$k = -21$	A1	
	(b)	$\begin{array}{rrrrr} & x^2 & -\ x & -\ 20 & \\ \cline{2-5} x+1\,\big) & x^3 & +\ 0x^2 & -\ 21x & -\ 20 \\ & x^3 & +\ x^2 & & \\ \cline{2-3} & & -\ x^2 & -\ 21x & \\ & & -\ x^2 & -\ x & \\ \cline{3-4} & & & -\ 20x & -\ 20 \\ & & & -\ 20x & -\ 20 \\ \cline{4-5} \end{array}$	M1 A1	
		$(x + 1)(x^2 - x - 20) = 0$		
		$(x + 1)(x + 4)(x - 5) = 0$	M1	
		$x = -4, -1, 5$	A1	**(6)**
3.	*(a)*	$5 \cos \theta = 2 \sin \theta$		
		$\frac{5}{2} = \frac{\sin\theta}{\cos\theta}$	M1	
		$\tan \theta = 2.5$	A1	
	(b)	$\tan 2x = 2.5$		
		$2x = 68.199,\ 180 + 68.199$	B1 M1	
		$2x = 68.199,\ 248.199$		
		$x = 34.1,\ 124.1$ (1dp)	M1 A1	**(6)**
4.	*(a)*	$(x - 2) \lg 3 = \lg 5$	M1	
		$x = \frac{\lg 5}{\lg 3} + 2 = 3.46$ (3sf)	M1 A1	
	(b)	$\log_2 (6 - y) + \log_2 y = 3$		
		$\log_2 [y(6 - y)] = 3$	M1	
		$y(6 - y) = 2^3 = 8$	M1	
		$y^2 - 6y + 8 = 0$		
		$(y - 2)(y - 4) = 0$	M1	
		$y = 2, 4$	A1	**(7)**
5.	*(a)*	$r = \frac{27}{36} = \frac{3}{4}$	M1 A1	
	(b)	$= 27 \times \frac{3}{4} = 20\frac{1}{4}$	M1 A1	
	(c)	$a \times (\frac{3}{4})^2 = 36$	M1	
		$a = 36 \times \frac{16}{9} = 64$	A1	
		$S_\infty = \frac{64}{1 - \frac{3}{4}} = 256$	M1 A1	**(8)**

6. *(a)*

x	2	3	4	5	6
y	2.89	6.36	11.55	18.50	27.27

B2

(b) area $\approx \frac{1}{2} \times 1 \times$ [2.89 + 27.27 + 2(6.36 + 11.55 + 18.50)] B1 M1 A1

$= 51.5$ (3sf) A1

(c) over-estimate B1

the curve passes below the top edge of each trapezium B1 **(8)**

---

7. *(a)* $\mathrm{f}'(x) = 12x - 3x^2$ M1 A1

for SP, $12x - 3x^2 = 0$

$3x(4 - x) = 0$ M1

$x = 0, 4$

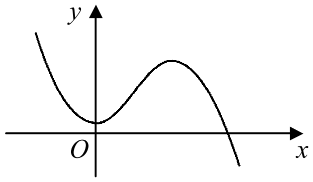
$\therefore$ (0, 2), (4, 34) A2

(b) $\mathrm{f}''(x) = 12 - 6x$ M1

$\mathrm{f}''(0) = 12,\ \mathrm{f}''(x) > 0\ \therefore$ (0, 2) minimum A1

$\mathrm{f}''(4) = -12,\ \mathrm{f}''(x) < 0\ \therefore$ (4, 34) maximum A1

(c)



B2

(d) $2 < k < 34$ B1 **(11)**

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8. *(a)* $= \frac{-8-4}{8-2} = -2$ M1 A1

(b) $= \left(\frac{2+8}{2}, \frac{4-8}{2}\right) = (5, -2)$ M1 A1

(c) perp. grad $= \frac{-1}{-2} = \frac{1}{2}$ M1

perp. bisector: $y + 2 = \frac{1}{2}(x - 5)$ M1 A1

centre where $y = 0\ \therefore x = 9 \Rightarrow (9, 0)$ M1 A1

(d) radius = dist. (2, 4) to (9, 0) $= \sqrt{49+16} = \sqrt{65}$ B1

$\therefore\ (x - 9)^2 + (y - 0)^2 = (\sqrt{65}\,)^2$ M1

$x^2 - 18x + 81 + y^2 = 65$

$x^2 + y^2 - 18x + 16 = 0$ A1 **(12)**

---

9. *(a)* $\frac{\sin B}{3} = \frac{\sin 2.2}{7}$ M1

$\sin B = \frac{3}{7} \sin 2.2$

$\angle ABC = 0.354$ (3sf) M1 A1

(b) $\angle BAC = \pi - (2.2 + 0.3538) = 0.588$ (3sf) M1 A1

(c) $= \frac{1}{2} \times 3 \times 7 \times \sin 0.5878 = 5.82\ \mathrm{m}^2$ (3sf) M1 A1

(d) $= 5.822 + [\frac{1}{2} \times 2^2 \times (2\pi - 0.5878)] + [\frac{1}{2} \times 1^2 \times (2\pi - 0.3538)]$ M3 A1

$= 20.2\ \mathrm{m}^2$ (3sf) A1 **(12)**

Total **(75)**

Performance Record – C2 Paper G

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	integr.	factor theorem, alg. div.	trig. eqn	logs	GP	trapezium rule	SP	circle	sine rule, sector of a circle	
Marks	5	6	6	7	8	8	11	12	12	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper H

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.

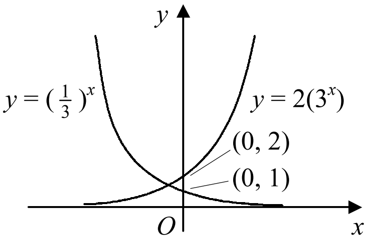
Method marks (M) are awarded for knowing and using a method.

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

(B) marks are independent of method marks.

Written by Shaun Armstrong

C2 Paper H – Marking Guide

1.	(a)	$x^2 + (y-3)^2 - 9 - 7 = 0$	M1	
		$\therefore$ centre (0, 3)	A1	
	(b)	$x^2 + (y-3)^2 = 16$	M1	
		$\therefore$ radius = 4	A1	**(4)**
2.	(a)	$P = 2r + (r \times 2.5) = \frac{9}{2}r = 36$	M1	
		$OA = r = 8$ cm	A1	
	(b)	$= (\frac{1}{2} \times 8^2 \times 2.5) - (\frac{1}{2} \times 8^2 \times \sin 2.5) = 60.8\text{ cm}^2$ (3sf)	M2 A1	**(5)**
3.	(a)	$7 - 2x - 3x^2 = \frac{2}{x}$, $7x - 2x^2 - 3x^3 = 2$	M1	
		$3x^3 + 2x^2 - 7x + 2 = 0$	A1	
	(b)	$x = -2$ is a solution $\therefore$ $(x+2)$ is a factor	B1	
		$\begin{array}{rrrrr} & 3x^2 & -4x & +1 & \\ \cline{2-5} x+2\big) & 3x^3 & +2x^2 & -7x & +2 \\ & 3x^3 & +6x^2 & & \\ \cline{2-3} & & -4x^2 & -7x & \\ & & -4x^2 & -8x & \\ \cline{3-4} & & & x & +2 \\ & & & x & +2 \\ \cline{4-5} \end{array}$	M1 A1	
		$\therefore$ $(x+2)(3x^2 - 4x + 1) = 0$		
		$(x+2)(3x-1)(x-1) = 0$	M1	
		$x = -2$ (at P), $\frac{1}{3}$, 1 $\therefore$ $(\frac{1}{3}, 6)$, (1, 2)	A2	**(8)**
4.	(a)	$= 1 + 4x + 6x^2 + 4x^3 + x^4$	M1 A1	
	(b)	(i) $= 1 + 4(\sqrt{2}) + 6(\sqrt{2})^2 + 4(\sqrt{2})^3 + (\sqrt{2})^4$	M1	
		$= 1 + 4\sqrt{2} + 6(2) + 4(2\sqrt{2}) + 4$	M1	
		$= 17 + 12\sqrt{2}$	A1	
		(ii) $(1 - \sqrt{2})^4 = 17 - 12\sqrt{2}$	B1	
		$(1 - \sqrt{2})^8 = [(1 - \sqrt{2})^4]^2 = (17 - 12\sqrt{2})^2$	M1	
		$= 289 - 408\sqrt{2} + 288$	M1	
		$= 577 - 408\sqrt{2}$	A1	**(9)**
5.	(a)	reflection in the y-axis	B1	
	(b)		B3	
	(c)	$(\frac{1}{3})^x = 2(3^x)$		
		$1 = 2 \times (3^x)^2$	M1	
		$3^{2x} = \frac{1}{2}$, $2x = \frac{\lg \frac{1}{2}}{\lg 3}$	M1	
		$x = \frac{\lg \frac{1}{2}}{2 \lg 3} = -0.32$	A1	
		$3^x = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{1}{2}\sqrt{2}$	M1	
		$y = 2(3^x) = 2 \times \frac{1}{2}\sqrt{2} = \sqrt{2}$	A1	**(9)**

6.	*(a)*	$\frac{dy}{dx} = 3x^2 + 2ax - 15$	M1 A1	
		SP when $x = -1$ ∴ $3 - 2a - 15 = 0$	M1	
		$a = -6$	A1	
		$y = x^3 - 6x^2 - 15x + b$		
		$(-1, 12)$ on curve ∴ $12 = -1 - 6 + 15 + b$	M1	
		$b = 4$	A1	
	(b)	$3x^2 - 12x - 15 = 0$	M1	
		$3(x - 5)(x + 1) = 0$	M1	
		$x = -1$ [at $(-1, 12)$] or 5		
		∴ $(5, -96)$	A1	**(9)**
7.	*(a)*	$\frac{1-8x^3}{x^2} = 0 \Rightarrow 1 - 8x^3 = 0$	M1	
		$x^3 = \frac{1}{8}$		
		$x = \frac{1}{2}$	M1 A1	
	(b)	$f(x) = x^{-2} - 8x$		
		$\int f(x)\ dx = \int (x^{-2} - 8x)\ dx$		
		$= -x^{-1} - 4x^2 + c$	M1 A2	
	(c)	$= -[-x^{-1} - 4x^2]_{\frac{1}{2}}^{2}$	M1	
		$= -\{(-\frac{1}{2} - 16) - (-2 - 1)\} = 13\frac{1}{2}$	M1 A1	**(9)**
8.	*(a)*	$\sin^2\theta = (2 - \sqrt{2})^2 = 4 - 4\sqrt{2} + 2 = 6 - 4\sqrt{2}$	M1	
		$\cos^2\theta = 1 - (6 - 4\sqrt{2}) = -5 + 4\sqrt{2}$	M1 A1	
	(b)	$2x - \frac{\pi}{6} = \frac{\pi}{3}, 2\pi - \frac{\pi}{3} = \frac{\pi}{3}, \frac{5\pi}{3}$	B1 M1	
		$2x = \frac{\pi}{2}, \frac{11\pi}{6}$	M1 A1	
		$x = \frac{\pi}{4}, \frac{11\pi}{12}$	M1 A2	**(10)**
9.	*(a)*	$ar = -48,\ ar^4 = 6$	B1	
		$r^3 = \frac{6}{-48} = -\frac{1}{8}$	M1	
		$r = \sqrt[3]{-\frac{1}{8}} = -\frac{1}{2}$	M1 A1	
		$a = \frac{-48}{-\frac{1}{2}} = 96$	A1	
	(b)	$= \frac{96}{1-(-\frac{1}{2})} = 64$	M1 A1	
	(c)	$S_n = \frac{96[1-(-\frac{1}{2})^n]}{1-(-\frac{1}{2})} = 64[1 - (-\frac{1}{2})^n]$	M1 A1	
		$S_\infty - S_n = 64 - 64[1 - (-\frac{1}{2})^n]$	M1	
		$= 64(-\frac{1}{2})^n = 2^6 \times (-1)^n \times 2^{-n} = (-1)^n \times 2^{6-n}$	M1	
		difference is magnitude, ∴ $= 2^{6-n}$	A1	**(12)**
			Total	**(75)**

Performance Record – C2 Paper H

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	circle	sector of a circle	factor theorem, alg. div.	binomial	exponential graphs, logs	SP	area by integr.	trig. eqn	GP	
Marks	4	5	8	9	9	9	9	10	12	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper I

MARKING GUIDE

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Written by Shaun Armstrong

C2 Paper I – Marking Guide

1. *(a)* $\frac{1}{2} \times 9.2^2 \times \angle AOB = 37.4$ M1

$\angle AOB = 0.884$ radians (3sf) A1

(b) $= (2 \times 9.2) + (9.2 \times 0.8837) = 26.5$ cm (3sf) M1 A1 **(4)**

---

2. $\frac{2}{p-1} = \frac{2p+5}{2}$ M1

$(2p + 5)(p - 1) = 4$ M1

$2p^2 + 3p - 9 = 0$ A1

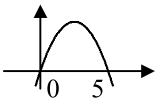
$(2p - 3)(p + 3) = 0, \quad p = -3, \frac{3}{2}$ M1 A1 **(5)**

---

3. $5x - x^2 = 0$

$x(5 - x) = 0$

crosses x-axis at (0, 0) and (5, 0) B1



area $= \int_0^5 (5x - x^2)\ dx$

$= [\frac{5}{2}x^2 - \frac{1}{3}x^3]_0^5$ M1 A2

$= (\frac{125}{2} - \frac{125}{3}) - (0) = 20\frac{5}{6}$ M1 A1 **(6)**

---

4. $1 - \cos^2 \theta = 4 \cos \theta$ M1

$\cos^2 \theta + 4 \cos \theta - 1 = 0$ A1

$\cos \theta = \frac{-4 \pm \sqrt{16+4}}{2} = -2 - \sqrt{5}$ (no solutions) or $-2 + \sqrt{5}$ M1 A1

$\theta = 76.3, 360 - 76.3$ B1 M1

$\theta = 76.3°, 283.7°$ (1dp) A1 **(7)**

---

5. *(a)* $-27 + 63 - 3p - 6 = 0, \quad p = 10$ M1 A1

(b) remainder $= f(2) = 8 + 28 + 20 - 6 = 50$ M1 A1

(c) $x = -3$ is a solution $\therefore (x + 3)$ is a factor B1

$$
\begin{array}{r|rrrr}
\multicolumn{1}{r}{} & x^2 & +\;4x & -\;2 & \\ \cline{2-5}
x+3 & x^3 & +\;7x^2 & +\;10x & -\;6 \\
 & x^3 & +\;3x^2 & & \\ \cline{2-3}
 & & 4x^2 & +\;10x & \\
 & & 4x^2 & +\;12x & \\ \cline{3-4}
 & & & -\;2x & -\;6 \\
 & & & -\;2x & -\;6 \\ \cline{4-5}
\end{array}
$$

M1 A1

$\therefore\ (x + 3)(x^2 + 4x - 2) = 0$

$x = -3$ or $x^2 + 4x - 2 = 0$

other solutions: $x = \frac{-4 \pm \sqrt{16+8}}{2} = -4.45, 0.45$ M1 A1 **(9)**

---

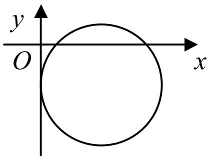
6. *(a)* $(x - 6)^2 - 36 + (y + 4)^2 - 16 + 16 = 0$ M1

$\therefore$ centre $(6, -4)$ A1

(b) $(x - 6)^2 + (y + 4)^2 = 36$ M1

$\therefore$ radius $= 6$ A1

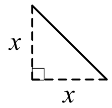
(c) B2



(d) $y = 0 \quad \therefore\ (x - 6)^2 + 16 = 36$ M1

$x = 6 \pm \sqrt{20} = 6 \pm 2\sqrt{5}$ A1

$AB = 6 + 2\sqrt{5} - (6 - 2\sqrt{5}) = 4\sqrt{5}$ M1 A1 **(10)**

7.	*(a)*	$(1 + ax)^n = 1 + n(ax) + \frac{n(n-1)}{2}(ax)^2 + \dots$	B2	
		$\therefore\ an = -24 \quad (1) \quad \text{and} \quad \frac{1}{2}a^2n(n-1) = 270 \quad (2)$	M1	
		$(1) \Rightarrow a = \frac{-24}{n}$ sub. (2) $\frac{288}{n}(n-1) = 270$	M1	
		$288n - 288 = 270n$	M1	
		$18n = 288$		
		$n = \frac{288}{18} = 16,\ a = -\frac{3}{2}$	A2	
	(b)	$1 - \frac{3}{2}x = 0.9985 \quad \therefore\ x = 0.001$	B1	
		$\therefore\ (0.9985)^{16} \approx 1 - 0.024 + 0.000\,270$	M1	
		$= 0.976\,27$ (5dp)	A1	**(10)**
8.	*(a)*	$\log_2(y-1) - \log_2 x = 1, \quad \log_2 \frac{y-1}{x} = 1$	M1	
		$\frac{y-1}{x} = 2^1 = 2$	M1	
		$y - 1 = 2x, \quad y = 2x + 1$	A1	
	(b)	$2\log_3 y = 2 + \log_3 x \Rightarrow \log_3 y^2 - \log_3 x = 2$	M1	
		$\frac{y^2}{x} = 3^2 = 9$	M1	
		$y^2 = 9x$	A1	
		sub. $y = 2x + 1 \quad (2x+1)^2 = 9x$	M1	
		$4x^2 + 4x + 1 = 9x$		
		$4x^2 - 5x + 1 = 0$		
		$(4x - 1)(x - 1) = 0$	M1	
		$x = \frac{1}{4}, 1$	A1	
		$\therefore\ x = \frac{1}{4}, y = \frac{3}{2}$ or $x = 1, y = 3$	A1	**(10)**
9.	*(a)*	area of XS $= \frac{1}{2} \times (8x + 10x) \times x = 9x^2$	M1	
		volume $= 9x^2y = 900$	M1	
		$\therefore\ y = \frac{100}{x^2}$	A1	
	(b)	 width of sloping sides $= \sqrt{2}\,x$	B1	
		$A = 8xy + 2(9x^2) + 2(\sqrt{2}\,xy)$	M1	
		$A = 18x^2 + 2xy(4 + \sqrt{2})$		
		$A = 18x^2 + 2x(4 + \sqrt{2}) \times \frac{100}{x^2}$	M1	
		$A = 18x^2 + \frac{200(4+\sqrt{2})}{x}$	A1	
	(c)	$\frac{\mathrm{d}A}{\mathrm{d}x} = 36x - 200(4 + \sqrt{2})x^{-2}$	M1 A1	
		for SP, $\quad 36x - 200(4 + \sqrt{2})x^{-2} = 0$	M1	
		$x^3 = \frac{200(4+\sqrt{2})}{36}$		
		$x = \sqrt[3]{\frac{50(4+\sqrt{2})}{9}} = 3.11$	A1	
	(d)	$A = 522$ (3sf)	B1	
		$\frac{\mathrm{d}^2A}{\mathrm{d}x^2} = 36 + 400(4 + \sqrt{2})x^{-3}$	M1	
		when $x = 3.11, \ \frac{\mathrm{d}^2A}{\mathrm{d}x^2} = 108, \ \frac{\mathrm{d}^2A}{\mathrm{d}x^2} > 0 \ \therefore$ minimum	A1	**(14)**
			Total	**(75)**

Performance Record – C2 Paper I

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	sector of a circle	GP	area by integr.	trig. eqn	remain. theorem, alg. div.	circle	binomial	logs	max./min. problem	
Marks	4	5	6	7	9	10	10	10	14	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper J

MARKING GUIDE

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C2 Paper J – Marking Guide

1. *(a)* 11 a.m. $\therefore\ t = 3$

$N = 20\,000 \times (1.06)^3 = 23820$ (nearest unit) — M1 A1

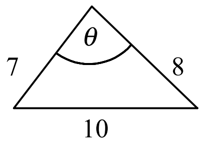
(b) $40\,000 = 20\,000 \times (1.06)^t$

$(1.06)^t = 2$ — M1

$t = \frac{\lg 2}{\lg 1.06} = 11.8957$ — M1 A1

11.8957 hours = 11 hours 54 mins $\therefore$ 7.54 p.m. — A1 **(6)**

2.



$10^2 = 7^2 + 8^2 - (2 \times 7 \times 8 \times \cos\theta)$ — M1 A1

$\cos\theta = \frac{49+64-100}{112} = \frac{13}{112}$

$\theta = 83.335$ — M1 A1

area $= \frac{1}{2} \times 7 \times 8 \times \sin 83.335$ — M1

$= 27.8\text{ cm}^2$ (3sf) — A1 **(6)**

---

3. *(a)*

x	0	0.25	0.5	0.75	1	M1
$\frac{4x}{(x+1)^2}$	0	0.64	0.8889	0.9796	1	A1

area $\approx \frac{1}{2} \times 0.25 \times [0 + 1 + 2(0.64 + 0.8889 + 0.9796)]$ — B1 M1

$= 0.752$ (3sf) — A1

(b) under-estimate — B1

the curve passes above the top edge of each trapezium — B1 **(7)**

---

4. *(a)* $(x + \frac{k}{x^2})^{15} = x^{15} + 15(x^{14})(\frac{k}{x^2}) + \binom{15}{2}(x^{13})(\frac{k}{x^2})^2 + \ldots$ — M1 A1

$\therefore\ 15k = 30$ — M1

$k = 2$ — A1

$A = \frac{15\times14}{2} \times k^2 = 420$ — A1

(b) $(x + \frac{2}{x^2})^{15} = \ldots + \binom{15}{5}(x^{10})(\frac{2}{x^2})^5 + \ldots$ — M1 A1

term indep. of $x = \frac{15\times14\times13\times12\times11}{5\times4\times3\times2} \times 32 = 96\,096$ — A1 **(8)**

---

5. *(a)* $4x^{\frac{1}{3}} - x = 0$

$x^{\frac{1}{3}}(4 - x^{\frac{2}{3}}) = 0$ — M1

$x^{\frac{1}{3}} = 0$ (at O) or $x^{\frac{2}{3}} = 4$ — M1

$x \geq 0\ \therefore\ x = (\sqrt{4})^3 = 8,\ a = 8$ — A1

(b) $= \int_0^8 (4x^{\frac{1}{3}} - x)\ \mathrm{d}x$

$= [3x^{\frac{4}{3}} - \frac{1}{2}x^2]_0^8$ — M1 A2

$= (48 - 32) - (0) = 16$ — M1 A1 **(8)**

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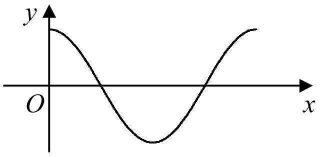
6. *(a)*



B2

(b) $(0, 1), (\frac{\pi}{4}, 0), (\frac{3\pi}{4}, 0)$ B3

(c) $\cos 2x = 0.5$

$2x = \frac{\pi}{3}, 2\pi - \frac{\pi}{3}$ B1 M1

$2x = \frac{\pi}{3}, \frac{5\pi}{3}$

$x = \frac{\pi}{6}, \frac{5\pi}{6}$ M1 A1 **(9)**

---

7. *(a)* $= (\frac{-2+4}{2}, \frac{6-1}{2}) = (1, \frac{5}{2})$ M1 A1

(b) radius = dist. $(-2, 6)$ to $(1, \frac{5}{2}) = \sqrt{9 + \frac{49}{4}} = \sqrt{\frac{85}{4}}$ M1 A1

$\therefore \ (x-1)^2 + (y - \frac{5}{2})^2 = (\sqrt{\frac{85}{4}})^2$ M1 A1

$x^2 - 2x + 1 + y^2 - 5y + \frac{25}{4} = \frac{85}{4}$

$x^2 + y^2 - 2x - 5y - 14 = 0$ A1

(c) $(2, 7)$, LHS $= 4 + 49 - 4 - 35 - 14 = 0 \ \therefore \ R$ lies on circle B1

$\angle PRQ = 90°$ B1 **(9)**

---

8. *(a)* $r = \frac{\log_3 16}{\log_3 4} = \frac{\log_3 4^2}{\log_3 4} = \frac{2\log_3 4}{\log_3 4} = 2$ M2 A1

(b) $ar = \log_3 4$

$a = \frac{\log_3 4}{2} = \frac{\log_3 2^2}{2} = \frac{2\log_3 2}{2} = \log_3 2$ M1 A1

(c) $S_6 = \frac{(2^6 - 1)\log_3 2}{2 - 1} = 63 \log_3 2$ M1 A1

$= 63 \times \frac{\lg 2}{\lg 3} = 39.7$ M1 A1 **(9)**

---

9. *(a)* $f(3) = 27 - 36 - 9 + 18 = 0 \ \therefore \ (x - 3)$ is a factor M1 A1

(b)

$$\begin{array}{r|l} & x^2 - x - 6 \\ \hline x - 3 & x^3 - 4x^2 - 3x + 18 \\ & \underline{x^3 - 3x^2} \\ & \quad - x^2 - 3x \\ & \quad \underline{- x^2 + 3x} \\ & \qquad - 6x + 18 \\ & \qquad \underline{- 6x + 18} \end{array}$$

M1 A1

$f(x) = (x - 3)(x^2 - x - 6)$

$f(x) = (x - 3)(x + 2)(x - 3) = (x + 2)(x - 3)^2$ M1 A1

(c) $(3, 0)$ B1

$(x - 3)$ is a repeated factor of $f(x) \ \therefore \ x$-axis is tangent where $x = 3$ B1

(d) $f'(x) = 3x^2 - 8x - 3$ M1 A1

for SP, $3x^2 - 8x - 3 = 0$ M1

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

$x = -\frac{1}{3}, 3 \qquad \therefore \ x = -\frac{1}{3}$ A1 **(13)**

Total **(75)**

Performance Record – C2 Paper J

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	logs	cosine rule	trapezium rule	binomial	area by integr.	trig. graph	circle	GP, logs	factor theorem, SP	
Marks	6	6	7	8	8	9	9	9	13	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper K

MARKING GUIDE

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C2 Paper K – Marking Guide

1.		$= [\,\frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x]_1^4$	M1 A1	
		$= (\,\frac{64}{3} - 40 + 16) - (\,\frac{1}{3} - \frac{5}{2} + 4) = -\frac{9}{2}$	M1 A1	**(4)**
2.		$\begin{array}{cccccc} x & 1 & 1.5 & 2 & 2.5 & 3 \\ \sqrt{4x-1} & \sqrt{3} & \sqrt{5} & \sqrt{7} & 3 & \sqrt{11} \end{array}$	M1	
		area $\approx \frac{1}{2} \times 0.5 \times [\,\sqrt{3} + \sqrt{11} + 2(\sqrt{5} + \sqrt{7} + 3)]$	B1 M1	
		$= 5.20$ (3sf)	A1	**(4)**
3.	*(a)*	*(i)* $= \log_2 x - \log_2 2 = y - 1$	M1 A1	
		(ii) $= \log_2 x^{\frac{1}{2}} = \frac{1}{2}\log_2 x = \frac{1}{2}y$	M1 A1	
	(b)	$2(y - 1) + \frac{1}{2}y = 8$		
		$y = 4$	M1	
		$\log_2 x = 4, \quad x = 2^4 = 16$	M1 A1	**(7)**
4.	*(a)*	$f'(x) = -1 - 3x^2$	M1 A1	
		$x^2 \geq 0$ for all real $x \Rightarrow -1 - 3x^2 \leq -1$	M1	
		$\therefore\ f'(x) < 0 \Rightarrow f(x)$ is decreasing for all values of x	A1	
	(b)	$f(1) = 2 - 1 - 1 = 0\ \therefore\ (1, 0)$ on curve	B1	
	(c)	$= \int_0^1 (2 - x - x^3)\ dx$		
		$= [2x - \frac{1}{2}x^2 - \frac{1}{4}x^4]_0^1$	M1 A1	
		$= (2 - \frac{1}{2} - \frac{1}{4}) - (0) = \frac{5}{4}$	M1 A1	**(9)**
5.	*(a)*	$\cos^2 P = 1 - (\,\frac{2}{3}\,)^2 = \frac{5}{9}$	M1	
		acute $\therefore \cos \angle QPR = \sqrt{\frac{5}{9}} = \frac{1}{3}\sqrt{5}$	A1	
	(b)	$QR^2 = 7^2 + (\,3\sqrt{5}\,)^2 - (2 \times 7 \times 3\sqrt{5} \times \frac{1}{3}\sqrt{5}\,)$	M1 A1	
		$QR^2 = 49 + 45 - 70 = 24$		
		$QR = \sqrt{24} = \sqrt{4 \times 6} = 2\sqrt{6}$	M1 A1	
	(c)	$\frac{\sin Q}{3\sqrt{5}} = \frac{\frac{2}{3}}{2\sqrt{6}}$	M1	
		$\sin Q = \frac{\sqrt{5}}{\sqrt{6}}$		
		$\angle PQR = 65.9°$ (1dp)	M1 A1	**(9)**

6.	*(a)*	p(−2) = 20 $\therefore$ $-16 + 4 - 2a + b = 20$	M1	
		$b = 2a + 32$	A1	
	(b)	p(−3) = 0 $\therefore$ $-54 + 9 - 3a + b = 0$	M1	
		sub. $-45 - 3a + (2a + 32) = 0$	M1	
		$a = -13,\ b = 6$	A2	
	(c)	$\begin{array}{rl} & 2x^2 - 5x + 2 \\ \hline x+3 \big) & 2x^3 + x^2 - 13x + 6 \\ & 2x^3 + 6x^2 \\ \hline & -5x^2 - 13x \\ & -5x^2 - 15x \\ \hline & 2x + 6 \\ & 2x + 6 \\ \hline \end{array}$	M1 A1	
		$p(x) = (x + 3)(2x^2 - 5x + 2)$		
		$p(x) = (x + 3)(2x - 1)(x - 2)$	M1 A1	**(10)**
7.	*(a)*	$x + \frac{\pi}{4} = 1.2490,\ \pi + 1.2490 = 1.2490,\ 4.3906$	B1 M1	
		$x = 0.46,\ 3.61$ (2dp)	M1 A1	
	(b)	$2 \sin y \cos y = \sin y$	M1	
		$\sin y\,(2 \cos y - 1) = 0$	M1	
		$\sin y = 0$ or $\cos y = \frac{1}{2}$	A1	
		$y = 0,\ \pi$ or $\frac{\pi}{3},\ 2\pi - \frac{\pi}{3}$	B1 M1	
		$y = 0,\ \frac{\pi}{3},\ \pi,\ \frac{5\pi}{3}$	A1	**(10)**
8.	*(a)*	centre = (2, 3)	B1	
		radius = $\sqrt{4+9} = \sqrt{13}$	M1	
		$\therefore\ (x - 2)^2 + (y - 3)^2 = (\sqrt{13})^2$	M1	
		$(x - 2)^2 + (y - 3)^2 = 13$	A1	
	(b)	$y = 0\ \therefore\ (x - 2)^2 + 9 = 13$	M1	
		$x = 2 \pm \sqrt{4} = 0$ (at O) or $4\ \therefore\ B\,(4, 0)$	A1	
	(c)	grad of radius = $\frac{0-3}{4-2} = -\frac{3}{2}$	M1	
		$\therefore$ grad of tangent = $\frac{-1}{-\frac{3}{2}} = \frac{2}{3}$	M1 A1	
		$\therefore\ y - 0 = \frac{2}{3}(x - 4)$	M1	
		$3y = 2x - 8$		
		$2x - 3y = 8$	A1	**(11)**
9.	*(a)*	$r = 1.5$		
		$u_4 = 1 \times (1.5)^3 = 3.375$ mm	M1 A1	
	(b)	$w = 2 \times S_8$; GP, $a = 1,\ r = 1.5$	M1	
		$= 2 \times \frac{1[(1.5)^8 - 1]}{1.5 - 1}$	M1 A1	
		= 98.516 = 98.5 mm (3sf)	A1	
	(c)	areas form GP, $a = \pi \times 1^2 = \pi,\ r = (1.5)^2 = 2.25$	B2	
		total area = $\frac{\pi[(2.25)^{10} - 1]}{2.25 - 1} = 8354.8\ \text{mm}^2$	M1 A1	
		$= \frac{8354.8}{10^2}\ \text{cm}^2 = 83.5\ \text{cm}^2$ (3sf)	A1	**(11)**
			Total	**(75)**

Performance Record – C2 Paper K

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	integr.	trapezium rule	logs	decreasing function, area by integr.	cosine rule, sine rule	remain. theorem, alg. div.	trig. eqn	circle	GP	
Marks	4	4	7	9	9	10	10	11	11	75
Student										

FOR EDEXCEL

GCE Examinations
Advanced Subsidiary

Core Mathematics C2

Paper L

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.

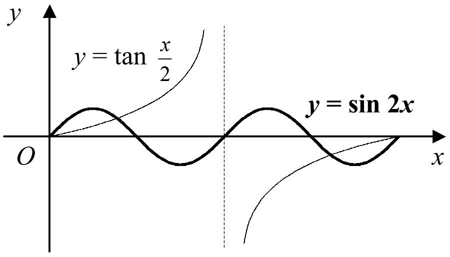
Method marks (M) are awarded for knowing and using a method.

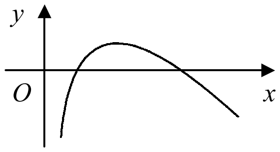
Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.

Written by Shaun Armstrong

C2 Paper L – Marking Guide

1.	*(a)*	$r = \frac{-15}{75} = -\frac{1}{5}$	M1 A1	
	(b)	$= \frac{75}{1-(-\frac{1}{5})} = 62\frac{1}{2}$	M1 A1	**(4)**
2.	*(a)*	$(x+4)^2 - 16 + (y-2)^2 - 4 + k = 0$	M1	
		$\therefore$ centre $(-4, 2)$	A1	
	(b)	for x-axis to be tangent, radius must be 2	B1	
		$(x+4)^2 + (y-2)^2 = 20 - k$		
		$\therefore\ 20 - k = 2^2$	M1	
		$k = 16$	A1	**(5)**
3.		area of segment $= (\frac{1}{2} \times r^2 \times \frac{\pi}{3}) - (\frac{1}{2} \times r^2 \times \sin\frac{\pi}{3})$	B1 M2	
		$= \frac{1}{6}r^2\pi - \frac{1}{4}r^2\sqrt{3}$	A1	
		shaded area $= \frac{1}{6}r^2\pi - 2(\frac{1}{6}r^2\pi - \frac{1}{4}r^2\sqrt{3})$	M1	
		$= \frac{1}{6}r^2\pi - \frac{1}{3}r^2\pi + \frac{1}{2}r^2\sqrt{3}$		
		$= \frac{1}{2}r^2\sqrt{3} - \frac{1}{6}r^2\pi = \frac{1}{6}r^2(3\sqrt{3} - \pi)$	A1	**(6)**
4.	*(a)*		B2 B2	
	(b)	4 solutions	B1	
		the graphs intersect at 4 points	B1	**(6)**
5.	*(a)*	$\log_a 27 - \log_a 8 = 3$		
		$\log_a \frac{27}{8} = 3$	M1	
		$a^3 = \frac{27}{8},\ a = \sqrt[3]{\frac{27}{8}} = \frac{3}{2}$	M1 A1	
	(b)	$(x+3)\lg 2 = (x-1)\lg 6$	M1	
		$x(\lg 6 - \lg 2) = 3\lg 2 + \lg 6$	M1	
		$x = \frac{3\lg 2 + \lg 6}{\lg 6 - \lg 2} = 3.52$	M1 A1	**(7)**
6.	*(a)*	$= 2^4 + 4(2^3)(x) + 6(2^2)(x^2) + 4(2)(x^3) + x^4$	M1 A1	
		$= 16 + 32x + 24x^2 + 8x^3 + x^4$	B1 A1	
	(b)	$(2-x)^4 = 16 - 32x + 24x^2 - 8x^3 + x^4$	M1	
		$(2+x)^4 + (2-x)^4 = 32 + 48x^2 + 2x^4,\quad A = 32, B = 48, C = 2$	A1	
	(c)	$32 + 48x^2 + 2x^4 = 136$		
		$x^4 + 24x^2 - 52 = 0$		
		$(x^2 + 26)(x^2 - 2) = 0$	M1	
		$x^2 = -26$ (no real solutions) or 2	A1	
		$x = \pm\sqrt{2}$	A1	**(9)**

7.	*(a)*	$f(2) = 16 - 20 + 2 + 2 = 0 \quad \therefore\ (x - 2)$ is a factor	M1 A1	
	(b)	$\begin{array}{r l} & 2x^2 - x - 1 \\ x-2 & \overline{)\,2x^3 - 5x^2 + x + 2} \\ & \underline{2x^3 - 4x^2} \\ & -x^2 + x \\ & \underline{-x^2 + 2x} \\ & -x + 2 \\ & \underline{-x + 2} \end{array}$	M1 A1	
		$f(x) = (x - 2)(2x^2 - x - 1) = (x - 2)(2x + 1)(x - 1)$	M1 A1	
	(c)	$x = -\frac{1}{2}, 1, 2$	B1	
	(d)	$\sin\theta = 2$ (no solutions), $-\frac{1}{2}$ or 1		
		$\theta = \pi + \frac{\pi}{6}, 2\pi - \frac{\pi}{6}$ or $\frac{\pi}{2}$	M1 B1	
		$\theta = \frac{\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$	A2	**(11)**
8.	*(a)*	$3 - x^{\frac{1}{2}} - 2x^{-\frac{1}{2}} = 0, \qquad 3x^{\frac{1}{2}} - x - 2 = 0$	M1	
		$x - 3x^{\frac{1}{2}} + 2 = 0, \qquad (x^{\frac{1}{2}} - 1)(x^{\frac{1}{2}} - 2) = 0$	M1	
		$x^{\frac{1}{2}} = 1, 2$	A1	
		$x = 1, 4 \quad \therefore\ (1, 0), (4, 0)$	A1	
	(b)	$\frac{dy}{dx} = -\frac{1}{2}x^{-\frac{1}{2}} + x^{-\frac{3}{2}}$	M1 A1	
		for minimum, $\quad -\frac{1}{2}x^{-\frac{1}{2}} + x^{-\frac{3}{2}} = 0$	M1	
		$-\frac{1}{2}x^{-\frac{3}{2}}(x - 2) = 0$		
		$x = 2,\ y = 3 - \sqrt{2} - \frac{2}{\sqrt{2}} \quad \therefore\ (2, 3 - 2\sqrt{2})$	A2	
	(c)	$\frac{d^2y}{dx^2} = \frac{1}{4}x^{-\frac{3}{2}} - \frac{3}{2}x^{-\frac{5}{2}}$	M1	
		when $x = 2$, $\frac{d^2y}{dx^2} = \frac{1}{8\sqrt{2}} - \frac{3}{8\sqrt{2}} = -\frac{1}{4\sqrt{2}}$, $\frac{d^2y}{dx^2} < 0 \quad \therefore$ maximum	A1	
	(d)		B2	**(13)**
9.	*(a)*	$x = 4 \quad \therefore\ y = 12 - 8 + 2 = 6$	B1	
		$\frac{dy}{dx} = 3 - 2x^{-\frac{1}{2}}$	M1 A1	
		grad $= 3 - 1 = 2$	M1	
		$\therefore\ y - 6 = 2(x - 4)$	M1	
		$y = 2x - 2$	A1	
	(b)	area under curve $= \int_0^4 (3x - 4\sqrt{x} + 2)\ dx$		
		$= [\frac{3}{2}x^2 - \frac{8}{3}x^{\frac{3}{2}} + 2x]_0^4$	M1 A2	
		$= (24 - \frac{64}{3} + 8) - (0) = 10\frac{2}{3}$	M1	
		tangent meets x-axis when $y = 0 \Rightarrow x = 1$	M1	
		area of triangle $= \frac{1}{2} \times 3 \times 6 = 9$	A1	
		shaded area $= 10\frac{2}{3} - 9 = \frac{5}{3}$	M1 A1	**(14)**
			Total	**(75)**

Performance Record – C2 Paper L

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Total
Topic(s)	GP	circle	sector of a circle	trig. graph	logs	binomial	factor theorem, trig. eqn	SP	area by integr.	
Marks	4	5	6	6	7	9	11	13	14	75
Student										