GCE 2005



January Series

Mark Scheme

Mathematics

MPC2

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Key to mark scheme and abbreviations used in marking

M m or dM A B E	mark is for method mark is dependent on one or more M marks and is for method mark is dependent on M or m marks and is for accuracy mark is independent of M or m marks and is for method and accuracy mark is for explanation			
or ft or F	follow through from previous			
	incorrect result	MC	mis-copy	
CAO	correct answer only	MR	mis-read	
CSO	correct solution only	RA	required accuracy	
AWFW	anything which falls within	FW	further work	
AWRT	anything which rounds to	ISW	ignore subsequent work	
ACF	any correct form	FIW	from incorrect work	
AG	answer given	BOD	given benefit of doubt	
SC	special case	WR	work replaced by candidate	
OE	ŌE	FB	formulae book	
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme	
–x EE	deduct <i>x</i> marks for each error	G	graph	
NMS	no method shown	с	candidate	
PI	possibly implied	sf	significant figure(s)	
SCA	substantially correct approach	dp	decimal place(s)	

MPC2

Q	Solution	Marks	Total	Comments
1(a)(i)	$y = x + 2x^{-1}$	B1		PI by sight of $-2x^{-2}$
	$\frac{dy}{dt} = 1 - 2x^{-2}$	M1	_	One term correct
	dx dx	A1	3	OE
(ii)	When $x = 2$, $\frac{dy}{dx} = 1 - \frac{2}{4} = \frac{1}{2}$	A1	1	CSO AG (be convinced)
(b)	When $x = 2, y = 3$	B1		For $y = 3$
	gradient of normal $= -2$	M1		$m \times m' = -1$ used
	Equation normal $y - 3 = -2(x - 2)$	M1		y - "3" = m(x-2) OE
		A1	4	Award at 1 st correct form
2(a)	Total		8	
2(a)	$32^2 = 24^2 + 24^2 - 2 \times 24 \times 24 \cos \theta$	M1		
	or $\sin \frac{1}{2}\theta = \frac{\frac{1}{2}(32)}{24}$ $\cos \theta = \frac{24^2 + 24^2 - 32^2}{2 \times 24 \times 24}$ 	ml		
	or $\frac{1}{2}\theta = \sin^{-1}\left(\frac{2}{3}\right)$ (= 0.7297) $\theta = 1.459 = 1.46$ to 3sf	A1	3	CSO AG (be convinced)
(b)	$Arc = r\theta$ $= 24 \times 1.459 = 35 cm$	M1 A1	2	Condone absent cm; 35 to 35.04
	21 ··· 1.159 55 cm	711	2	
(c)(i)	Area of sector = $\frac{1}{2}r^2\theta$	M1		Seen
	$= \frac{1}{2} (24)^2 (1.459) = 420.3 = 420 \text{ cm}^2$	A1	2	Condone absent cm ² ; 420 to 420.48
(ii)	Area of triangle = $\frac{1}{2}(24)(24)\sin\theta$	M1		OE
	[= 286. ()]			
	Shaded area = area of sector – area of triangle	ml		Dep on at least one of the previous two M marks. PI
	$\left[=\frac{1}{2}r^2\theta - \frac{1}{2}r^2\sin\theta\right] = 134\mathrm{cm}^2$	A1	3	Condone absent cm ²
	Total		10	

$\frac{1}{3}\log_a x = \log_a \frac{6}{2} \qquad (M$	MPC2 (cont				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Q		Marks	Total	Comments
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	3(a)(i)		M1		a + (n-1)d used; PI
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			A1		
(i) (i) (i) (i) (i) (i) (i) (i)				3	AG (be convinced)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		$\rightarrow u = y$	111	5	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(ii)	<i>a</i> = 10	B1	1	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(h)	$S_{20} = \frac{20}{2a} [2a + (20 - 1)d]$	M1		OF
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(0)	<u>L</u>		2	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(c)	$\frac{50}{20}$	AI	2	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		$\sum u_n - \sum u_n$	M1		OE
4(a) $\sqrt{x} = x^{\frac{1}{2}}$ B1 1 Accept $k = 0.5$ (b) $\sqrt{x} (x-1) = x^{\frac{1}{2}} x - x^{\frac{1}{2}} = x^{\frac{3}{2}} - x^{\frac{1}{2}}$ B1 1 Accept $k = 0.5$ (c) $\sqrt{x} (x-1) dx = \frac{x^{2.5}}{2.5} - \frac{x^{1.5}}{1.5} (+c)$ M1 A1 2 Accept $p = 1.5, q = 0.5$ (c) $\sqrt{x} (x-1) dx = \frac{x^{2.5}}{2.5} - \frac{x^{1.5}}{1.5} (+c)$ M1 Increases a power of x by 1 ft non-integer p (d) $\int_{1}^{2} dx = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right)$ M1 Limits; $F(2) - F(1)$ = $\left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(-\frac{1}{2.5} - \frac{1}{1.5}\right)$ M1 Fractional powers to surds $\left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = pr. ans$ A1 3 CSO AG (be convinced) Total 9 A A A A A A A A A A A (a) $ug_a x = \log_a 6^3 - \log_a 8$ M1 A			A1√	2	ft on $11525 - c's S_{20}$
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			111		
(b) $\sqrt{x}(x-1) = x^{\frac{1}{2}}x - x^{\frac{1}{2}} = x^{\frac{3}{2}} - x^{\frac{1}{2}}$ (c) $\int \sqrt{x}(x-1)dx = \frac{x^{2.5}}{2.5} - \frac{x^{1.5}}{1.5}$ (+c) M1 A1 A (d) $\int^{2} dx = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right)$ M1 $\dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right)$ M1 $\dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right)$ M1 $\dots = \left(\frac{4\sqrt{2}}{15} - \frac{20\sqrt{2}}{1.5}\right) - \left(-\frac{4}{15}\right) = \text{pr. ans}$ A1 3 CSO AG (be convinced) (c) $\frac{1}{\log_{a} x = \log_{a} 6^{3} - \log_{a} 8}$ M1 $\log_{a} x = \log_{a} (6^{3} + 8)$ M1 $x = 6^{3} + 8 = 27$ A1 3 CSO AG (be convinced) A1 3 CSO AG (be convinced) $\frac{1}{3} \log_{a} x = \log_{a} \frac{6}{2}$ (M	4(a)	Γ $\frac{1}{2}$		_	
$(\mathbf{d}) \begin{bmatrix} \mathbf{d} \\ \int_{1}^{2} \mathbf{d} x = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & m1 \\ \left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \text{pr. ans} & A1 \\ \frac{\mathbf{d} \\ \mathbf{d} \\ d$		$\sqrt{x} = x^2$		1	Accept $k = 0.5$
$(\mathbf{d}) \begin{bmatrix} \mathbf{d} \\ \int_{1}^{2} \mathbf{d} x = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & m1 \\ \left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \text{pr. ans} & A1 \\ \frac{\mathbf{d} \\ \mathbf{d} \\ d$	(D)	$\sqrt{r}(r-1) = r^{\frac{1}{2}}r = r^{\frac{1}{2}} = r^{\frac{3}{2}} = r^{\frac{1}{2}}$		2	Accept $p = 1.5$ $q = 0.5$
$(\mathbf{d}) \begin{bmatrix} \mathbf{d} \\ \int_{1}^{2} \mathbf{d} x = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & m1 \\ \left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \text{pr. ans} & A1 \\ \frac{\mathbf{d} \\ \mathbf{d} \\ d$		$\nabla x \left(x - 1 \right) = x x = x -x -x$		-	
$(\mathbf{d}) \begin{bmatrix} \mathbf{d} \\ \int_{1}^{2} \mathbf{d} x = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & M1 \\ \dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) & m1 \\ \left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \text{pr. ans} & A1 \\ \frac{\mathbf{d} \\ \mathbf{d} \\ d$	(0)	$\int \sqrt{x(x-1)} dx = \frac{x^{2.5}}{x^{2.5}} - \frac{x^{1.5}}{x^{1.5}} (+c)$	M1		Increases a power of x by 1
(d) $\int_{1}^{2} dx = \left(\frac{2^{2.5}}{2.5} - \frac{2^{1.5}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad M1$ Limits; F(2) – F(1) $\dots = \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad m1$ Fractional powers to surds $\left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \text{pr. ans} \qquad A1$ 3 CSO AG (be convinced) $\frac{1}{\log_{a} x} = \log_{a} 6^{3} - \log_{a} 8$ M1 A law of logs used correctly $\log_{a} x = \log_{a} (6^{3} \div 8)$ $x = 6^{3} \div 8 = 27$ A1 3 CSO AG (be convinced) $\frac{1}{3} \log_{a} x = \log_{a} \frac{6}{2} \qquad (M)$		2.5 1.5	A1√		ft non-integer p
$\int dx = \left(\frac{2}{2.5} - \frac{2}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad M1$ $\lim_{n \to \infty} \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad M1$ $\lim_{n \to \infty} \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad m1$ $\int \operatorname{Fractional powers to surds}$ $\left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \operatorname{pr. ans}$ $A1$ 3 $\operatorname{CSO AG (be convinced)}$ $\frac{1}{\log_a x = \log_a 6^3 - \log_a 8} \qquad M1$ $\log_a x = \log_a (6^3 \div 8) \qquad M1$ $x = 6^3 \div 8 = 27$ $A1$ 3 $A1$ 3 $A1$ 3 $A1$ 4 $A \text{ law of logs used correctly} \qquad A \text{ lifterent law of logs ax = 1 \log_a 6 - 3 \log_a 2 (M \text{ lifterent law of logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M lifterent law$			A1√	3	ft non-integer q
$\int dx = \left(\frac{2}{2.5} - \frac{2}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad M1$ $\lim_{n \to \infty} \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad M1$ $\lim_{n \to \infty} \left(\frac{4\sqrt{2}}{2.5} - \frac{2\sqrt{2}}{1.5}\right) - \left(\frac{1}{2.5} - \frac{1}{1.5}\right) \qquad m1$ $\int \operatorname{Fractional powers to surds}$ $\left(\frac{24\sqrt{2}}{15} - \frac{20\sqrt{2}}{15}\right) - \left(-\frac{4}{15}\right) = \operatorname{pr. ans}$ $A1$ 3 $\operatorname{CSO AG (be convinced)}$ $\frac{1}{\log_a x = \log_a 6^3 - \log_a 8} \qquad M1$ $\log_a x = \log_a (6^3 \div 8) \qquad M1$ $x = 6^3 \div 8 = 27$ $A1$ 3 $A1$ 3 $A1$ 3 $A1$ 4 $A \text{ law of logs used correctly} \qquad A \text{ lifterent law of logs ax = 1 \log_a 6 - 3 \log_a 2 (M \text{ lifterent law of logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M \text{ lifterent law logs ax = log_a \frac{6}{2} \qquad (M lifterent law$	(d)	$(2^{2.5}, 2^{1.5})$ (1 1)			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$\int_{-1}^{2} dx = \left \frac{2}{2.5} - \frac{2}{1.5} \right - \left(\frac{1}{2.5} - \frac{1}{1.5} \right)$	M1		Limits; $F(2) - F(1)$
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		$=\left(\frac{4\sqrt{2}}{2}-\frac{2\sqrt{2}}{2}\right)-\left(\frac{1}{2}-\frac{1}{2}\right)$	m1		Fractional powers to surds
Total95(a) $\log_a x = \log_a 6^3 - \log_a 8$ M1A law of logs used correctly $\log_a x = \log_a (6^3 \div 8)$ M1A different law of logs used correctly $x = 6^3 \div 8 = 27$ A13CSO AG (be convinced)ALT $\log_a x = \log_a 6 - 3\log_a 2$ (M $\frac{1}{3} \log_a x = \log_a \frac{6}{2}$ (M)		$(2.5 \ 1.5) (2.5 \ 1.5)$			· -
Total95(a) $\log_a x = \log_a 6^3 - \log_a 8$ M1A law of logs used correctly $\log_a x = \log_a (6^3 \div 8)$ M1A different law of logs used correctly $x = 6^3 \div 8 = 27$ A13CSO AG (be convinced)ALT $\log_a x = \log_a 6 - 3\log_a 2$ (M $\frac{1}{3} \log_a x = \log_a \frac{6}{2}$ (M)		$\begin{pmatrix} 24\sqrt{2} & 20\sqrt{2} \end{pmatrix}$ (4)			
Total95(a) $\log_a x = \log_a 6^3 - \log_a 8$ M1A law of logs used correctly $\log_a x = \log_a (6^3 \div 8)$ M1A different law of logs used correctly $x = 6^3 \div 8 = 27$ A13CSO AG (be convinced)ALT $\log_a x = \log_a 6 - 3\log_a 2$ (M $\frac{1}{3} \log_a x = \log_a \frac{6}{2}$ (M)		$\left(\frac{1}{15} - \frac{1}{15}\right) - \left(-\frac{1}{15}\right) = \text{pr. ans}$	Al	3	CSO AG (be convinced)
5(a) $\log_a x = \log_a 6^3 - \log_a 8$ M1A law of logs used correctly $\log_a x = \log_a (6^3 \div 8)$ M1M1A different law of logs used correctly $x = 6^3 \div 8 = 27$ A13CSO AG (be convinced)ALT $\log_a x = \log_a 6 - 3\log_a 2$ (M $\frac{1}{3} \log_a x = \log_a \frac{6}{2}$ (M				9	
$\begin{vmatrix} \log_{a} x = \log_{a}(6^{3} \div 8) \\ x = 6^{3} \div 8 = 27 \end{vmatrix}$ $\begin{vmatrix} M1 \\ A1 \end{vmatrix}$ $\begin{vmatrix} A \\ A1 \end{vmatrix}$ $\begin{vmatrix} A \\ A1 \end{vmatrix}$ $\begin{vmatrix} A \\ different \\ Iw of logs used correctly \\ CSO AG (be convinced) \\ \underline{ALT} \log_{a} x = 3 \log_{a} 6 - 3 \log_{a} 2 (M \\ \frac{1}{3} \log_{a} x = \log_{a} \frac{6}{2} (M \\ \frac{1}{3} \log_{a} x = \log_{a} \frac{1}{3} \log_{$	5(a)		M1		A law of logs used correctly
$x = 6^{3} \div 8 = 27$ A1 3 CSO AG (be convinced) $\underline{ALT} \log_{a} x = 3 \log_{a} 6 - 3 \log_{a} 2 (M + 1)$ $\frac{1}{3} \log_{a} x = \log_{a} \frac{6}{2} (M + 1)$			M1		A different law of logs used correctly
$\frac{\mathbf{ALT}}{\frac{1}{3}\log_a x} = 3\log_a 6 - 3\log_a 2 (M)$		$x = 6^3 \div 8 = 27$	A1	3	CSO AG (be convinced)
					· · · · · · · · · · · · · · · · · · ·
					$\frac{1}{2}\log_a x = \log_a \frac{6}{2} \tag{M1}$
					5 2
$x^3 = 3 \Rightarrow x = 27 $ (A1) C					$x^{\frac{1}{3}} = 3 \implies x = 27$ (A1) CSO
(b)(i) $\log_4 1 = 0$ B1	(b)(i)	$\log_4 1 = 0$	B1		
	(ii)		B1		SC in (b): For all four answers $\frac{1}{4}$; 1; $\frac{1}{2}$; 2
(iii) $\log_4 2 = 0.5$ B1 give 0/4; otherwise mark each	(iii)		B1		give 0/4; otherwise mark each
(iv) $\log_4 8 = 1.5$ B1 4 independently.	(iv)	-	B1	4	independently.
Total 7				7	

C2 (cont Q	Solution	Marks	Total	Comments
6(a)(i)	$(2+x)^3 =$			Any valid method; must contain all
	$(2^{3})+3(2^{2})(x)+3(2)(x^{2})+(x^{3})$	M1		components
	$\dots = 8 + 12x + 6x2 + x3 (*)$	A1		Accept $a = 12$
		A1	3	Accept $b = 6$
(ii)	$(2-x)^3 = 8 - 12x + 6x^2 - x^3 (**)$	M1		Clear $x \rightarrow -x$ in (i) OE
	(2 x) = 0 + 12x + 0x + x (-)	A1√	2	ft numerical <i>a</i> and <i>b</i>
(b)	$(2+x)^3 - (2-x)^3 = (*) - (**)$	M1		Subtracts the 2 expressions in (a)
	$\dots = 24x + 2x^3.$	Al	2	CSO AG (be convinced)
(c)	$\frac{\mathrm{d}y}{\mathrm{d}x} = 24 + 6x^2$	M1		A power of <i>x</i> decreased by 1
	dx For st. pt. $24 + 6x^2 = 0$	A1		
	Not possible since $24 + 6x^2 > 0$	E1	3	Any valid explanation
	Total		10	
7(a)	$A(0^{\circ},1)$	B1		Condone radians
	$B(45^{\circ},0)$	B1		Condone (0.785,0) or better.
	$C(270^{\circ}, -1)$	B1, B1	4	B1 for 270; B1 for -1
(b)	Stretch (I) in x-direction (II) with a			More than one transformation is M0
	scale factor $\frac{1}{2}$ (III)	M1A1	2	M1 for (I) and either (II) or (III)
	2 ()			
(c)	$\cos^{-1}0.37 = 68.284 (=\alpha)$	M1		$\cos^{-1}0.37$ (PI eg by 68.3 or 1.19)
	$x = \frac{\alpha}{2} = 34.1(42.)^{\circ}$	A1		Condone 34.2°, 34° or 0.596 rads
	2 2	211		
	$x = 180 - \frac{\alpha}{2}$	m1		OE eg $2x = 360 - \alpha$
	2			OE Need both (OE for $2x =$) with no
	$x = 180 + \frac{\alpha}{2}$ and $x = 180 + 180 - \frac{\alpha}{2}$	m1		extras (quadrants) within the given interval
	2x = 68.284;291.715;			
	428.284; 651.715			
	$x = (34.1^{\circ};)$. 1	~	
		A1	5	Dep. on all three method marks. Must b
	$145.9^{\circ}; 214.1^{\circ}; 325.9^{\circ}$			in degrees

MPC2 (cont)

Q	Solution	Marks	Total	Comments
8(a)	$\{y\text{-coordinate of } A \text{ is}\}$ 2	B1	1	
(b)(i)	h = 0.25	B1		
	Integral = $\frac{h}{2}$ {}			
	{} =			
	$f(0) + 2[f(\frac{1}{4}) + f(\frac{1}{2}) + f(\frac{3}{4})] + f(1)$	M1		
	{}=	1111		Condone one numerical slip
	$\frac{2}{2} + 4 + 2[(2.316+2.732+3.279(5.))]$ $\{= 6 + 2 \times 8.3276\} \{= 22.65(5)\}$	A1√		Accept values to 3sf (rnd or trunc) ft answer from (a) if not "2"
	Integral = $0.125 \times 22.655 = 2.8319$ Integral = 2.83 to 3 sf	A1	4	CAO Must be 2.83 (NMS scores 0/4)
(ii)	Relevant trapezia drawn on a copy of given graph	M1		Accept relevant single trapezium with its sloping side above the
	{Approximation is an}overestimate	A1	2	curve
(c)	$5 = 3^x + 1 \Longrightarrow 3^x = 4$	B1		
	$\log_{10} 3^x = \log_{10} 4$	M1		Takes ln or \log_{10} on both sides of $3^x = k$, where $k > 0$
	$x \log_{10} 3 = \log_{10} 4$	m1		Use of $\log 3^x = x \log 3$
	$x = \frac{\lg 4}{\lg 3} = 1.26185 = 1.2619 \text{ to } 4dp$	A1	4	Accept 4dp or better [If using T&I a full justification is required; else M0m0A0]
(d)	$f(x) = 3^{-x} + 1$	B1	1	
	Total		12	
	TOTAL		75	