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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC2 Pure Core 2

Mark Scheme

2005 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Key to mark scheme and abbreviations used in marking

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	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	OE	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
$-x$ EE	deduct x marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

Application of Mark Scheme

No method shown:	
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise
More than one method / choice of solution:	
2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only
Crossed out work	do not mark unless it has not been replaced
Alternative solution using a correct or partially correct method	award method and accuracy marks as appropriate

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MPC2

Q	Solution	Marks	Total	Comments
1(a)	Area = $\frac{1}{2}\times 5\times 4.8\times \sin 30^\circ$	M1		Use of $\frac{1}{2}ab\sin C$ OE
	$= 6$ cm^2.	A1	2	Condone absent cm^2. [**Note:** Calculator set in wrong mode, penalise only once on the paper.]
(b)	$AB^2 = 5^2 + 4.8^2 - 2\times 5\times 4.8\cos 30^\circ$	M1		RHS of cosine rule used
	$= 25 + 23.04 - 41.569$	m1		Correct order of evaluation
	$= 6.4707..$ $\Rightarrow AB = \sqrt{6.47...} = 2.5437$ $= 2.54$ cm to 3 sf	A1	3	Accept 'better' than 2.54 Condone absent cm
	Total		**5**	
2(a)	Arc = $r\theta$	M1		For $r\theta$ or 16θ or 16×1.5 OE multiplicatio
	$1.5r + r + r$ $(= 56)$	M1		For realising that perimeter is sum of two radii and arc.
	$3.5r = 56 \Rightarrow r = 16$	A1	3	**AG** Completion (condone verification)
(b)	Area of sector = $\frac{1}{2}r^2\theta$	M1		$\frac{1}{2}r^2\theta$ OE seen
	$= \frac{1}{2}16^2(1.5) = 192$ cm^2.	A1	2	Condone absent cm^2.
	Total		**5**	
3(a)	$u_1 = 87$; $u_2 = 84$	B1;B1 √	2	ft on $u_2 = u_1 - 3$ **SC** B1 for 90, 87
(b)	Common difference (d) is -3	B1	1	
(c)	$\sum_{n=1}^{k} u_n$ = sum of AP	M1		
	…….= $\frac{k}{2}[174 + (k-1)(-3)]$	A1√		OE ft on u_1 and use of $d = 3$ (For M1A1 ft condone n in place of k)
	$0 = \frac{k}{2}[177 - 3k] \Rightarrow 177 = 3k$ $\Rightarrow k = 59$	A1	3	Just the **single** value 59
ALTI	$= \sum_{n=1}^{k} 90 - \sum_{n=1}^{k} 3n = 90k - 3\left[\frac{k}{2}(k+1)\right]$	M1;A1		M1 split and either $90k$ or $\left[\frac{k}{2}(k+1)\right]$
	$0 = 90k - 1.5k(k+1) \Rightarrow k = 59$	A1		(For 1st two marks condone n in place of k)
	Total		**6**	

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MPC2 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$\sqrt{x} = x^{\frac{1}{2}}$	B1	1	Accept $p = 0.5$
(ii)	$\int \sqrt{x}\ \mathrm{d}x = \frac{x^{1.5}}{1.5}\{+c\}$	M1		Index raised by 1
		A1√	2	Correct ft on p. Condone missing '+c'
(iii)	Area = $\int_1^4 \sqrt{x}\ \mathrm{d}x$	B1		Limits 1 and 4 PI
	$\ldots\ldots = \frac{4^{1.5}}{1.5} - \frac{1}{1.5}$	M1		F(4) – F(1)
	$= \frac{14}{3}$	A1	3	Accept 4.66 or better
(b)(i)	$y = x^{\frac{1}{2}} \Rightarrow \frac{dy}{dx} = \frac{1}{2}x^{-\frac{1}{2}}$	M1		Index (p–1) ft
	When x= 4, $y'(4) = 0.25$	M1		Attempt to find $y'(4)$.
	When x= 4, $y = 2$	B1		
	Equation of tangent: $y - 2 = \frac{1}{4}(x - 4)$	A1	4	accept other forms
(ii)	When $x = 0$, $y = 1$ $B(0, 1)$	M1		Subs $x = 0$ **and** then $y = 0$ into equation of tangent. PI
	When $y = 0$, $x = -4$ $A(-4, 0)$	A1√		Correct ft y_B and x_A (may be awarded as part of area calculation)
	Area = 0.5(1)(4) = 2	A1√	3	ft wrong sloping tangent and max of 1 further slip. Final answer must be +'ve
(c)	Translation	B1		'Translation'/'translate(d)'
	$\begin{bmatrix} 1 \\ 0 \end{bmatrix}$	B1	2	Accept equivalent in words provided linked to 'translation/move/shift' (Note: B0B1 is possible)
(d)	$h = 1$ Integral = h/2 {……}	B1		PI
	$\{\ldots\} = \mathrm{f}(1) + 2[\mathrm{f}(2) + \mathrm{f}(3)] + \mathrm{f}(4)$	M1		OE summing of areas of the three traps
	$\{\ldots\} = 0 + 2\left(1 + \sqrt{2}\right) + \sqrt{3}$	A1		Condone 1 numerical slip
	Integral = $\frac{1}{2}\{\ 2(1 + 1.414\ldots) + 1.732\ \}$			
	Integral = 0.5×6.560… =3.28 to 3sf	A1	4	CAO Must be 3.28
	Total		**19**	

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MPC2 (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$\dfrac{a}{1-r}=4a$	M1		(Accept $S_\infty=\dfrac{a}{1-\frac{3}{4}}$)
	$\Rightarrow 1-r=\dfrac{a}{4a}$ or $a=4a(1-r)$	A1		Either (or better) (or $S_\infty=4a$ if M1 above)
	$1-r=\dfrac{1}{4}\Rightarrow r=\dfrac{3}{4}$	A1	3	**AG** CSO Be convinced. (or statement 4 times 1st term)
(b)	$(S_{10}=)\dfrac{48(1-r^{10})}{1-r}$	M1		Correct formula with n = 10 and one of $a=48$ or $r=\dfrac{3}{4}$ OE
	$=192(1–0.75^{10})=181.1878$ to 4dp	A1	2	
(c)(i)	$u_n=\underline{ar^{n-1}}=a\left(\dfrac{3}{4}\right)^{n-1}=48\left(\dfrac{3}{4}\right)^{n-1}$	B1		
	$u_{2n}=\underline{ar^{2n-1}}=a\left(\dfrac{3}{4}\right)^{2n-1}=48\left(\dfrac{3}{4}\right)^{2n-1}$	B1√	2	ft on candidate's $u_n=ar^{\text{function of }n}$
(ii)	$\dfrac{u_n}{u_{2n}}=\dfrac{ar^{n-1}}{ar^{2n-1}}=\dfrac{r^{n-1}}{r^{2n-1}}$	M1		Eliminating a (or 48) or log a
	$\log_{10}u_n-\log_{10}u_{2n}=\log_{10}\dfrac{u_n}{u_{2n}}$	M1		Using at least one log law
	$=\log_{10}\dfrac{r^{n-1}}{r^{2n-1}}=\log_{10}(r^{-n})$			
	$=-n\log_{10}\dfrac{3}{4}=n\log_{10}\dfrac{4}{3}$	A1	3	**AG** CSO Full valid completion
(iii)	$\log_{10}\left[\dfrac{u_{100}}{u_{200}}\right]=100\log_{10}\left(\dfrac{4}{3}\right)$	M1		
	$=12.49\ldots=12.5$ to 3 sf	A1	2	**AG** CSO Be convinced **SC:** Those applying 'hence' to (i) rather than to (ii) **Mark as B2**
	Total		**12**	

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MPC2 (Cont)

Q	Solution	Marks	Total	Comments
6(a)	$(1+x)^4 = 1+4x+6x^2+4x^3+x^4$	M1 A2,1	3	Full method A1 if four terms correct or just one slip
(b)(i)	$(1+\sqrt{5})^4 = 1+4\sqrt{5}+6(\sqrt{5})^2+$ $+4(\sqrt{5})^3+(\sqrt{5})^4$	M1		Substitute. √5 for x.
	$=1+4\sqrt{5}+6(5)+4(5\sqrt{5})+(25)$	A1ft		Two of 3 terms shown in brackets
	……….= $56+24\sqrt{5}$	A1	3	**AG** CSO Be convinced
(ii)	$\log_2(1+\sqrt{5})^4 = \log_2[8(7+3\sqrt{5})]$	M1		
	$=\log_2 8+\log_2(7+3\sqrt{5})$	m1		
	$=3+\log_2(7+3\sqrt{5})$	A1	3	CSO **SC** B1 Change to base 10 and verify
	Total		**9**	
7(a)	………= $x^5 - x^{-3}$	M1 A1	2	One power correct Accept $p = 5$, $q = -3$
(b)(i)	$f'(x) = 5x^4$ $+3x^{-4}$	B1√ B1√	2	ft on px^{p-1} ft on $-qx^{q-1}$ provided $q < 0$
(ii)	$f'(x)\left\{= 5x^4 + \frac{3}{x^4}\right\} > 0$	M1		M1 Considers sign of $f'(x)$; a statement "$f'(x) > 0$ OE" with 'f increasing'.
	⇒ f is increasing {function}	A1	2	A1 needs $f'(x)$ of the form $ax^4 + \frac{b}{x^4}$, where a and b both > 0 and no incorrect statements based on $f'(x)$ at different values of x
(c)	At (1,0), $f'(1) = 5+3 = 8$	M1		Attempts to find $f'(1)$
	⇒ grad. of normal = $-\frac{1}{8}$	m1 A1√	3	Use of $m \times m' = -1$ PI ft on wrong $f'(x)$
	Total		**9**	

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MPC2 (Cont)

Q	Solution	Marks	Total	Comments
8(a)(i)	$4\dfrac{\sin\theta}{\cos\theta}\sin\theta = 15$ $\Rightarrow 4\sin^2\theta = 15\cos\theta$	B1	1	**AG** Be convinced
(ii)	$\sin^2\theta + \cos^2\theta = 1$	M1		OE seen
	$4(1-\cos^2\theta) = 15\cos\theta$ $4\cos^2\theta + 15\cos\theta - 4 = 0$	A1	2	**AG** Be convinced
(b)(i)	$(4c-1)(c+4) = 0$	M1		Factorisation or formula or completion of square
	$c = -4$, $c = \dfrac{1}{4}$	A1	2	Both values
(ii)	Since $-1 \le \cos\theta$ $\{\le 1\}$, the only possible value for $\cos\theta$ is $\dfrac{1}{4}$	E1√	1	**AG** convincingly explained (Condone strict inequalities) Ft provided candidates answers for c are $\dfrac{1}{4}$ and a value k such that $k > 1$ or $k < -1$
(iii)	$\theta = 75.5°$	B1		
	$\theta = 284.5°$	B1√	2	Ft on [360 – c's 75.5°] as only other solution in the given interval
(c)	……….$\Rightarrow \cos 4x = \dfrac{1}{4}$	M1		Links with previous parts. PI
	$x = 19°, 71°$	A1√	2	Ft on (iii)/4…..(only ft if 2 answers in given range).
	Total		**10**	
	Total		**75**	