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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC2 Pure Core 2

Mark Scheme

2006 examination – January 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.

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

$\surd$ 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	or equivalent	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)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Q	Solution	Marks	Total	Comments
1	$y'(x)=16-x^{-2}$	M1 A1		One term correct Both correct
	$y'(x)=16-\dfrac{1}{x^2}$	B1		$x^{-2}=\dfrac{1}{x^2}$ OE PI
	$y'(x)=0\Rightarrow 16x^2=1$;	M1		c's $y'(x)$=0 and one relevant further step
	$\Rightarrow x=\pm\dfrac{1}{4}$	A1	5	Both answers required.
	Total		**5**	
2(a)	$h=1$	B1		PI
	Integral $=\dfrac{h}{2}\{\ldots\}$ $\{\ldots\}=\mathrm{f}(0)+\mathrm{f}(4)+2[\mathrm{f}(1)+\mathrm{f}(2)+\mathrm{f}(3)]$	M1		OE summing of areas of the four trapezia. [0.75+0.35+0.15+0.079…]
	$=\left[1+\dfrac{1}{17}+2\left(\dfrac{1}{2}+\dfrac{1}{5}+\dfrac{1}{10}\right)\right]$	A1		Exact or to 3dp values Condone one numerical slip
	Integral = 1.329	A1	4	**CSO**. Must be 1.329
(b)	Increase the number of ordinates	E1	1	OE
	Total		**5**	
3(a)	$\log 0.8^x=\log 0.05$ | $x=\log_{0.8} 0.05$ (**M1**)	M1		**NMS**: **SC** B2 for 13.425 or better (B1 for 13.4 or 13.43; 13.42)
	$x\log_{10} 0.8=\log_{10} 0.05$ oe	A1		
	$x=13.425$ to 3dp | 13.425 (**A2**) (**else A1** for 1 or 2dp)	A1	3	Condone greater accuracy
(b)(i)	$\dfrac{a}{1-r}$	M1		$S_\infty=\dfrac{a}{1-r}$ **<u>used</u>**
	$\dfrac{a}{1-r}=5a\Rightarrow a=5a(1-r)$	A1		Or better
	$\Rightarrow 1=5(1-r)\Rightarrow r=\dfrac{4}{5}=0.8$	A1	3	AG (be convinced)
(ii)	n^{th} term = $20\times(0.8)^{n-1}$	M1		Condone $20\times(0.8)^n$.
	n^{th} term < 1 $\Rightarrow$ $0.8^{n-1}<\dfrac{1}{20}$ oe	A1		$0.8^{n-1}<0.05$ or $0.8^{n-1}=k$, where k =0.05 or k rounds **up** to 0.050
	Least n is 15	A1F	3	If not 15, ft on integer part of [answer (a)+2] provided n>2 **SC** 3/3 for 15 if no error **SC** n^{th} term=16^{n-1}M1A0A0
	Total		**9**	

MPC2 (cont)

Q	Solution	Marks	Total	Comments
	[**Note: Calc. set in wrong mode, penalise only once on the paper**.] **Condone missing units throughout the question.**			
4(a)	Area of triangle $=\frac{1}{2}(12)(8)\sin\theta$	M1		Use of $\frac{1}{2}ab\sin C$ or full equivalent
	$\sin\theta=\frac{20}{48}$ [=0.41(666…)]	A1		OE (giving 0.412 to 0.42)
	$\Rightarrow$ θ = 0.4297(7…) = 0.430 to 3sf	A1	3	AG(need to see >3sf value)
(b)	$\{AB^2=\}8^2+12^2-2\times8\times12\times\cos\theta$	M1		
	= 64 + 144 – 174.5….	m1		Accept 33 to 34 inclusive if three values not separate
	$\Rightarrow$ AB = 5.78… = 5.8 cm to 2sf	A1	3	If not 2sf condone 5.78 to 5.79 inclusive. Condone ±
(c)(i)	Arc $AD=8\theta$; = 3.44.. = 3.4 cm to 2sf	M1; A1	2	If not 2sf condone 3.438 to 3.44 inclusive
(ii)	Area of sector = $\frac{1}{2}r^2\theta$	M1		Stated or used [or 13.7(6..) seen]
	Shaded area = Area of triangle – sector area	M1		Difference of areas
	Shaded area $=20-0.5\times8^2\times\theta$ = 6.2 cm^2 to 2sf	A1	3	Condone 6.24 to 6.2472
	Total		**11**	
5(a)	$150=200p+q$	M1		Either equation
	$120=150p+q$	A1		Both (condone embedded values for the M1A1)
		m1		Valid method to solve two simultaneous eqns in p and q to find either p or q
	p = 0.6	A1		AG (condone if left as a fraction)
	q = 30	B1	5	
(b)	$u_4=102$	B1F√	1	Ft on (72 + q)
(c)	$L=pL+q$; $L=0.6L+30$	M1		
	$L=\frac{q}{1-p}$	m1		
	L = 75	A1F√	3	Ft on 2.5q
	Total		**9**	

MPC2 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	Stretch **(I)** in y-direction **(II)** Scale factor 2 **(III)**	M1A1	2	>1 transformation is M0. M1 for **(I)** <u>and</u> either **(II)** or **(III)** or **(III)**
(ii)	Reflection; in x-axis	M1 A1	2	'Reflection'/ 'reflect(ed)' (or in y-axis or $y = 0$ or $x = 0$)
(iii)	Translation; $\begin{bmatrix} 30^\circ \\ 0 \end{bmatrix}$	B1 B1	2	'Translation'/'translate(d)' Accept **full** equivalent in words provided linked to 'translation/move/shift' and **positive** x-direction (Note: B0 B1 is possible)
(b)	$\{\theta - 30^\circ =\} \sin^{-1}(0.7) = 44.4\ldots^\circ$ ……… = 180° – 44.4° θ = 74.4°, 165.6°	M1 m1 A1	3	Inverse sine of 0.7 PI eg by sight of 44, 74 or better Valid method for 2nd angle Condone >1dp accuracy
(c)	$\ldots = \cos^2 x + 2\cos x \sin x + \sin^2 x\ +$ $\cos^2 x - 2\cos x \sin x + \sin^2 x$	M1		Award for either bracket expanded correctly
	$\ldots. = 2\cos^2 x + 2\sin^2 x$ $= 2(\cos^2 x + \sin^2 x) = 2\ (1)$ $= 2$	A1 M1 A1	4	OE $\cos^2 x + \sin^2 x = 1$ stated or used. AG (be convinced)
	Total		**13**	
7(a)	$2\log_a n - \log_a(5n-24) = \log_a 4$ $\Rightarrow \log_a n^2 - \log_a(5n-24) = \log_a 4$	M1		A law of logs used
	$\Rightarrow \log_a\left[\dfrac{n^2}{5n-24}\right] = \log_a 4$	M1		A second law of logs used leading to both sides being single log terms or single log term on LHS with RHS=0
	$\Rightarrow \dfrac{n^2}{5n-24} = 4$			
	$\Rightarrow n^2 - 20n + 96 = 0$	A1	3	**CSO.** AG
(b)	$\Rightarrow (n-8)(n-12) = 0$ $\Rightarrow n = 8,\ 12$	M1 A1	2	Accept alternatives eg formula, completing of sq..
	Total		**5**	

MPC2 (cont)

Q	Solution	Marks	Total	Comments
8(a)	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{3}{2}x^{\frac{1}{2}}-3$	M1 A1	2	One term correct Both correct
(b)(i)	When $x = 0$, $\frac{\mathrm{d}y}{\mathrm{d}x}=-3$ Eqn of tangent at O is $y=-3x$	B1F√ B1F√	 2	Ft provided answer < 0. OE Ft on $y'(0)$
(ii)	At (9,0) $\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{3}{2}(9)^{\frac{1}{2}}-3$ Eqn tangent at A is $y-0=y'(9)[x-9]$ $\Rightarrow\ y=\frac{3}{2}(x-9)\ \Rightarrow\ 2y=3x-27$	M1 m1 A1	 3	Attempt to find $y'(9)$ OE **CSO**. AG
(iii)	Eliminating $y\Rightarrow\ -6x=3x-27$ $9x=27\ \Rightarrow\ x=3$ When $x = 3$, $y=-9$. $\{P(3,-9)\}$	M1 A1F A1F	 3	OE method to one variable (eg $2y=-y-27$) [A1F for each coordinate; only ft on $y = kx$ tangent in (b)(i) for $k < 0$]
(c)	$\int\left(x^{\frac{3}{2}}-3x\right)\mathrm{d}x=\frac{2}{5}x^{\frac{5}{2}}-\frac{3x^2}{2}\ \ (+c)$	M1 A2,1,0	 3	One power correct Condone absence of "$+c$" and unsimplified forms
(d)	$\int_0^9\left(x^{\frac{3}{2}}-3x\right)\mathrm{d}x=$ $=\frac{2}{5}\times9^{\frac{5}{2}}-\frac{3}{2}\times9^2-0$ $=-24.3$ Area of triangle $OPA=\frac{1}{2}\times9\times\lvert y_P\rvert$ Sh.Area $=\frac{1}{2}\times9\times\lvert y_P\rvert-\left\lvert\int_0^9\left(x^{\frac{3}{2}}-3x\right)\mathrm{d}x\right\rvert$ $=40.5-24.3=16.2$	B1 M1 M1 M1 A1	 5	PI Correct use of limits following integration OE
	Total		**18**	
	TOTAL		**75**	