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General Certificate of Education

Mathematics 6360

MPC2 Pure Core 2

Mark Scheme

2007 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.

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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	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.

MPC2

Q	Solution	Marks	Total	Comments
1(a)	{Area of sector =} $\frac{1}{2}r^2\theta$	M1		
	$= 0.5\times 36\times 1.2 = 21.6\ \text{cm}^2$	A1	2	Condone missing/wrong units throughout the paper
(b)	Arc = $r\theta$	M1		
	$= 6\times 1.2 = 7.2$	A1		
	Perimeter = 12 + 7.2 = 19.2 cm	A1ft	3	Ft on incorrect evaluation of 6×1.2
	Total		**5**	
2	$h = 1$	B1		PI
	f(x) = $\sqrt{2^x}$			
	Area $\approx$ h/2{…}			OE summing of areas of the 'trapezia'..
	{…}= f(0)+f(3)+2[f(1)+f(2)]	M1		
	{…}= 1 + √8 + 2(√2 + 2)	A1		OE
	(Area ≈) 5.3284… = 5.328 (to 3dp)	A1	4	CAO Must be 5.328
	Total		**4**	
3(a)(i)	{p =} 2	B1		Condone '$64=8^2$'
(ii)	{q =} – 2	B1ft		Ft on '– p' if q not correct
(iii)	{r =} 0.5	B1	3	Condone '$\sqrt{8} = 8^{0.5}$'
(b)	$\frac{8^x}{8^{0.5}} = 8^{-2} \Rightarrow 8^{x-0.5} = 8^{-2}$ OE	M1		Using parts (a) **&** valid index law to stage $8^c=8^d$ (PI)
	$\Rightarrow x-0.5=-2 \quad \Rightarrow x=-1.5$	A1ft	2	Ft on c's ($q + r$) if not correct (Accept correct answer without working)
	ALT: $\log 8^x = \log k$, $x\log 8 = \log k$; $x = -1.5$			(M1 A1)
	Total		**5**	
4(a)	$6^2 = 4^2 + 5^2 - 2(4)(5)\cos\theta$	M1		Use of the cosine rule
	$\cos\theta = \frac{4^2+5^2-6^2}{2(4)(5)}$	m1		Rearrangement
	$\cos\theta = \frac{5}{40} = \frac{1}{8}$	A1	3	CSO **AG** (be convinced)
(b)	$\cos^2\theta + \sin^2\theta = 1$	M1		Stated or used (PI)
	$\sin^2\theta = \frac{63}{64}$	A1		Or better
	$\sin\theta = \frac{\sqrt{63}}{8} = \frac{\sqrt{9\times 7}}{8} = \frac{3\sqrt{7}}{8}$	A1	3	**AG** (be convinced)
(c)	Area of triangle = $0.5\times 4\times 5\times \sin\theta$.	M1		
	….. = $\frac{30\sqrt{7}}{8}$ cm^2.	A1	2	OE (Condone 9.92)
	Total		**8**	

MPC2

Q	Solution	Marks	Total	Comments
5(a)	$ar = 48;\quad ar^3 = 3$	B1		For either. OE
	$\Rightarrow 16r^2 = 1$	M1		Elimination of *a* OE
	$r^2 = \frac{1}{16} \Rightarrow r = -\frac{1}{4}$	A1		CSO **AG** Full valid completion. **SC** Clear explicit verification (max B2 out of 3.)
	or $r = \frac{1}{4}$	B1	4	
(b)(i)	$a = -192$	B1	1	
(ii)	$\frac{a}{1-r} = \frac{a}{1-\left(-\frac{1}{4}\right)}$	M1		$\frac{a}{1-r}$ **used**
	$S_\infty = \frac{-768}{5}$ $(= -153.6)$	A1ft	2	Ft on candidate's value for *a*. i.e. $\frac{4}{5}a$ **SC** candidate uses $r = 0.25$, gives $a = 192$ and sum to infinity = 256. (max. B0 M1A1)
	Total		**7**	

MPC2

Q	Solution	Marks	Total	Comments
6(a)(i)	$y = x + 1 + 4x^{-2} \Rightarrow \frac{dy}{dx} = 1 - 8x^{-3}$	M1 A2,1,0	3	Power $p \to p-1$ (A1 if $1 + ax^n$ with $a = -8$ or $n = -3$)
(ii)	$1 - 8x^{-3} = 0$	M1		Puts c's $\frac{dy}{dx} = 0$
	$x^3 = 8$	m1		Using $x^{-k} = \frac{1}{x^k}$ to reach $x^a = b$, $a>0$ or correct use of logs.
	$x = 2$ When $x = 2$, $y = 4$	A1 A1ft	4	
(iii)	At (1, 6), $\frac{dy}{dx} = 1 - 8 = -7$	M1		Attempt to find $y'(1)$
	Gradient of normal = $\frac{1}{7}$	M1		Use of or stating $m \times m' = -1$
	Equation of normal is $y - 6 = m[x - 1]$	M 1		m numerical
	$y - 6 = \frac{1}{7}(x - 1)$ $\{\frac{y-6}{x-1} = \frac{1}{7};\ 7y = x + 41\}$	A1ft	4	OE ft on c's answer for (a)(i) provided at least A1 given in (a)(i) and previous 3M marks awarded
(b)(i)	$\int x\left(+1 + \frac{4}{x^2}\right) dx =$ …….. $= \frac{x^2}{2} + x - 4x^{-1}$ $\{+c\}$	M1 A2,1,0	3	One of three terms correct. For A2 need all <u>three</u> terms as printed or better (A1 if 2 of 3 terms correct)
(ii)	$\{\text{Area=}\}\ \int_1^4 x + 1 + \frac{4}{x^2} dx =$ $\left[\frac{x^2}{2} + x - \frac{4}{x}\right]_1^4 = (8 + 4 - 1) - \left(\frac{1}{2} + 1 - 4\right)$	M1		Dealing correctly with limits; F(4)–F(1) (must have integrated)
	= 13.5	A1	2	
	Total		**16**	

MPC2

Q	Solution	Marks	Total	Comments
7(a)	$(1+2x)^8$	M1		Any valid method. PI by correct value for a, b or c
	$=1+\binom{8}{1}(2x)^1+\binom{8}{2}(2x)^2+\binom{8}{3}(2x)^3+$			
	$= 1 + 16x + 112x^2 + 448x^3 + \ldots.$	A1A1		A1 for each of a, b, c
	$\{a=16,\ b=112,\ c=448\}$	A1	4	
(b)	x^3 terms <u>from expn.</u> of $\left(1+\frac{1}{2}x\right)(1+2x)^8$			
	are cx^3 and $\frac{1}{2}x\left(bx^2\right)$	M1		Either
	$cx^3 + \frac{1}{2}x\left(bx^2\right)$	A1		b, c or candidate's values for b and c from **(a)**
	Coefficient of x^3 is $c+0.5\,b=\ 504$	A1ft	3	Ft on candidate's $(c+0.5b)$ provided b and c are positive integers >1
	Total		**7**	

MPC2

Q	Solution	Marks	Total	Comments
8(a)	$\{x =\}\ \cos^{-1}(0.3) = 1.266\ldots \quad \{= \beta\}$	M1		$\cos^{-1}(0.3)$ PI by eg 72° or 73°
	$\{x =\}\ 2\pi - \beta$	m1		Condone degrees or mix.
	$x = 1.27, \quad 5.02$	A1	3	Accept 1.26 to 1.27 with 5.01 to 5.02 inclusive
(b)(i)	$M(\pi, -1)$	B1;B1	2	B1 for each coordinate
(ii)	$\{x_Q =\}\ 2\pi - \alpha$	B1	1	OE (unsimplified)
(c)	Stretch **(I)** in x-direction **(II)** scale	M1		Need**(I)** & one of **(II)**,**(III)**
	factor $\frac{1}{2}$ **(III)**	A1	2	
(d)	$\cos 2x = \cos\frac{4\pi}{5} \Rightarrow 2x = \frac{4\pi}{5}$	B1		OE. (From correct work)
	$\Rightarrow x = \frac{2\pi}{5}\ (= \alpha)$			Condone decimals/degrees
	$x = \pi - \alpha$; OE	M1		OE eg $2x = 2\pi - \frac{4\pi}{5}$ Correct quadrant; condone degrees/decimals/mix
	$x = \pi + \alpha$; $x = 2\pi - \alpha$; OE	m1		Need both (OE for $2x$=) with no extras (quadrants) within the given interval. Condone degrees/decimals/mix
	$x = \frac{2\pi}{5},\ \frac{3\pi}{5},\ \frac{7\pi}{5},\ \frac{8\pi}{5}$	A1	4	Need all 4 solutions for x but condone unsimplified provided in terms of π Ignore extra values outside the given interval.
	Total		**12**	

MPC2

Q	Solution	Marks	Total	Comments
9(a)	$3\log_a x = \log_a 8 \Rightarrow \log_a x^3 = \log_a 8$	M1		OE use of the log law
	$x^3 = 8 \Rightarrow x = 2$	A1	2	
(b)	$3\log_a 6 - \log_a 8 = \log_a 6^3 - \log_a 8$	M1		Correct use of one log law
	$= \log_a \frac{6^3}{8}$	M1		Correct use of a different log law
	$= \log_a \frac{216}{8} = \log_a 27$	A1	3	CSO **AG** (be convinced)
(c)(i)	$\{p =\} 3\log_{10} 3 - \log_{10} 8$	M1		Substitute $x = 3$
	$p = \log_{10} \frac{3^3}{8} = \log_{10} \frac{27}{8}$	A1	2	**AG** (be convinced)
(ii)	Gradient of $PQ = \frac{q-p}{6-3}$	M1		used $\frac{\text{difference in } y\text{-coords}}{\text{difference in } x\text{-coords}}$
	……. $= \frac{\log_{10} 27 - \log_{10} \frac{27}{8}}{3}$	A1		Any correct exact form
	……. $= \frac{1}{3}\log_{10}\left(27 \div \frac{27}{8}\right)$	m1		Correct use of log law
	Gradient $= \frac{1}{3}\log_{10} 8 = \log_{10} 2$	A1	4	**AG** (be convinced)
	Total		**11**	
	TOTAL		**75**	