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General Certificate of Education (A-level)
June 2011

Mathematics MFP1

(Specification 6360)

Further Pure 1

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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Key to mark scheme abbreviations

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
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
$-x$ EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
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.

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	Attempt at $0.5 \times y'(2)$ $(= 0.25)$	M1		Other variations are allowed
	$y(2.5) \approx 3.25$	A1		
	$y(3) \approx 3.25 + 0.5\,y'(2.5)$	m1		
	$\approx 3.25 + 0.2357(0)$	A1F		PI; OE; ft c's value for $y(2.5)$
	≈ 3.4857	A1	5	4 dp needed
	Total		**5**	
2(a)	$\alpha + \beta = -\frac{3}{2}$, $\alpha\beta = \frac{3}{4}$	B1B1	2	
(b)	$\alpha^2 + \beta^2 = \left(-\frac{3}{2}\right)^2 - 2\left(\frac{3}{4}\right) = \frac{3}{4}$	M1A1	2	AG; A0 if $\alpha + \beta$ has wrong sign
(c)	Sum $= 2(\alpha + \beta) = -3$	B1F		ft wrong value for $\alpha + \beta$
	Product $= 10\alpha\beta - 3\left(\alpha^2 + \beta^2\right) = \frac{21}{4}$	M1A1F		ft wrong values
	$x^2 - Sx + P\ (= 0)$	M1		Signs must be correct for the M1
	Eqn is $4x^2 + 12x + 21 = 0$	A1	5	Integer coeffs and '= 0' needed
	Total		**9**	
3(a)	Use of $z^* = x - \mathrm{i}y$	M1		
	$(z - \mathrm{i})(z^* - \mathrm{i}) = (x^2 + y^2 - 1) - 2\mathrm{i}x$	m1A1	3	A1 may be earned in (b)
(b)	Equating R and I parts	M1		
	$-2x = -8$ so $x = 4$	A1		
	$16 + y^2 - 1 = 24$ so $y = \pm 3$ $(z = 4 \pm 3\mathrm{i})$	m1A1	4	A0 if $x = -4$ used
	Total		**7**	
4(a)	Use of one law of logs or exponentials	M1		
	$\lg a = c$ and $\lg b = m$	A1		OE; both needed
	So $a = 10^c$ and $b = 10^m$	A1	3	
(b)	Points (1, 1.08), (5, 1.43) plotted	M1A1		M1 A0 if one point correct
	Straight line drawn through points	A1F	3	ft small inaccuracy
(c)(i)	Attempt at antilog of $Y(3)$	M1		OE
	When $x = 3$, $Y \approx 1.25$ so $y \approx 18$	A1	2	Allow AWRT 18
(ii)	Attempt at a as antilog of Y-intercept	M1		OE
	$a \approx 9.3$ to 10	A1	2	AWRT
	Total		**10**	
5(a)	$\cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$	B1		OE stated or used; deg/dec penalised at 5th mark
	$\cos(-\frac{\pi}{6}) = \frac{\sqrt{3}}{2}$	B1F		OE; ft wrong first value
	Introduction of $2n\pi$	M1		(or $n\pi$) at any stage
	Going from $3x - \frac{\pi}{6}$ to x	m1		incl division of all terms by 3
	GS: $x = \frac{\pi}{18} \pm \frac{\pi}{18} + \frac{2}{3}n\pi$	A1F	5	ft wrong first value
(b)	$n = 8$ will give the required solution	M1		GS must include $\frac{2}{3}n\pi$ for this
	... which is $\frac{16}{3}\pi$ (≈ 16.755)	A1	2	from correct GS; allow $\frac{48}{9}\pi$ or dec approx
	Total		**7**	

Q	Solution	Marks	Total	Comments
6(a)	$(5+h)^3 = 125 + 75h + 15h^2 + h^3$	B1	1	Accept unsimplified coefficients
(b)(i)	$y(5+h) = 100 + 65h + 14h^2 + h^3$	B1F		PI; ft numerical error in (a)
	Use of correct formula for gradient	M1		
	Gradient is $65 + 14h + h^2$	A2,1F	4	A1 if one numerical error made; ft numerical error already penalised
(ii)	As $h \to 0$ this $\to 65$	E2,1F	2	E1 for '$h = 0$'; ft wrong values for p, q, r
	Total		**7**	
7(a)(i)	$\mathbf{A}^2 = \begin{bmatrix} -2 & 2\sqrt{3} \\ -2\sqrt{3} & -2 \end{bmatrix}$	M1A1	2	M1 if at least two entries correct
(ii)	$\mathbf{A}^3 = \begin{bmatrix} 8 & 0 \\ 0 & 8 \end{bmatrix}$	M1		if at least two entries correct
	……..$= 8\mathbf{I}$	A1	2	
(b)(i)	$\mathbf{A}^3$ gives enlargement with SF 8 (centre the origin)	M1A1F	2	M1 for enlargement (only); ft wrong value for k
(ii)	Enlargement and rotation Enlargement scale factor 2 Rotation through 120° (antic'wise)	M1 A1 A1	3	Some detail needed
	Total		**9**	
8(a)(i)	Asymptotes $x = -2$, $x = 2$, $y = 0$	B1 × 3	3	
(ii)	Middle branch generally correct Other branches generally correct All branches approaching asymps Intersection at $\left(0, -\frac{1}{4}\right)$ indicated	B1 B1 B1 B1	4	Allow if max pt not in right place Asymps must be shown correctly on diagram or elsewhere; B0 if any other intersections are shown
(b)	$y = -2$ when $x = \pm\sqrt{3.5}$	B1		Allow NMS
	Sol'n $-2 < x < -\sqrt{3.5}, \sqrt{3.5} < x < 2$	B2,1	3	Condone dec approx'n for $\sqrt{3.5}$; B1 if $\le$ used instead of $<$
	Total		**10**	
9(a)(i)	Elimination to give $x = \frac{1}{8}x^2$ A is (8, 8)	M1 A1	2	OE NMS 2/2
(ii)	Equation of Q is $x = \frac{1}{8}y^2$	B1	1	OE; condone $y = \sqrt{8x}$
(iii)	Points of contact are images in $y = x$	E1	1	
(b)(i)	Eliminating y to give $-x + c = \frac{1}{8}x^2$ (ie $x^2 + 8x - 8c = 0$) Distinct roots if $\Delta > 0$ $\Delta = 64 + 32c$, so $c > -2$	M1 E1 A1	3	 stated or implied convincingly shown (AG)
(ii)	For tangent $c = -2$, so $x^2 + 8x + 16 = 0$ ... and $x = -4$, $y = 2$	M1 A1		OE
	Reflection in $y = x$ $x = 2$, $y = -4$	M1 A1F	4	or other complete method ft wrong answer for first point; allow NMS 2/2
	Total		**11**	
	TOTAL		**75**	