



General Certificate of Education (A-level)
June 2011

Mathematics

MFP1

(Specification 6360)

Further Pure 1

Final

Mark Scheme

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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 $0.5 \times y'(2) (= 0.25)$ $y(2.5) \approx 3.25$ $y(3) \approx 3.25 + 0.5 y'(2.5)$ $\approx 3.25 + 0.2357(0)$ ≈ 3.4857	M1 A1 m1 A1F A1	5	Other variations are allowed PI; OE; ft c's value for $y(2.5)$ 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 = $2(\alpha + \beta) = -3$ Product = $10\alpha\beta - 3(\alpha^2 + \beta^2) = \frac{21}{4}$ $x^2 - Sx + P (= 0)$ Eqn is $4x^2 + 12x + 21 = 0$	B1F M1A1F M1 A1	5	ft wrong value for $\alpha + \beta$ ft wrong values Signs must be correct for the M1 Integer coeffs and '= 0' needed
	Total		9	
3(a)	Use of $z^* = x - iy$ $(z - i)(z^* - i) = (x^2 + y^2 - 1) - 2ix$	M1 m1A1	3	A1 may be earned in (b)
(b)	Equating R and I parts $-2x = -8$ so $x = 4$ $16 + y^2 - 1 = 24$ so $y = \pm 3$ ($z = 4 \pm 3i$)	M1 A1 m1A1	4	A0 if $x = -4$ used
	Total		7	
4(a)	Use of one law of logs or exponentials $\lg a = c$ and $\lg b = m$ So $a = 10^c$ and $b = 10^m$	M1 A1 A1	3	OE; both needed
(b)	Points (1, 1.08), (5, 1.43) plotted Straight line drawn through points	M1A1 A1F	3	M1 A0 if one point correct ft small inaccuracy
(c)(i)	Attempt at antilog of $Y(3)$ When $x = 3$, $Y \approx 1.25$ so $y \approx 18$	M1 A1	2	OE Allow AWRT 18
(ii)	Attempt at a as antilog of Y -intercept $a \approx 9.3$ to 10	M1 A1	2	OE AWRT
	Total		10	
5(a)	$\cos \frac{\pi}{6} = \frac{\sqrt{3}}{2}$ $\cos\left(-\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$ Introduction of $2n\pi$ Going from $3x - \frac{\pi}{6}$ to x GS: $x = \frac{\pi}{18} \pm \frac{\pi}{18} + \frac{2}{3}n\pi$	B1 B1F M1 m1 A1F	5	OE stated or used; deg/dec penalised at 5th mark OE; ft wrong first value (or $n\pi$) at any stage incl division of all terms by 3 ft wrong first value
(b)	$n = 8$ will give the required solution ... which is $\frac{16}{3}\pi$ (≈ 16.755)	M1 A1	2	GS must include $\frac{2}{3}n\pi$ for this 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)	$y(5 + h) = 100 + 65h + 14h^2 + h^3$ Use of correct formula for gradient Gradient is $65 + 14h + h^2$	B1F M1 A2,1F	4	PI; ft numerical error in (a) A1 if one numerical error made; ft numerical error already penalised
(ii)	As $h \rightarrow 0$ this $\rightarrow 65$	E2,1F	2	E1 for ' $h = 0$ '; ft wrong values for p, q, r
Total			7	
7(a)(i)	$A^2 = \begin{bmatrix} -2 & 2\sqrt{3} \\ -2\sqrt{3} & -2 \end{bmatrix}$	M1A1	2	M1 if at least two entries correct
(ii)	$A^3 = \begin{bmatrix} 8 & 0 \\ 0 & 8 \end{bmatrix}$ = $8I$	M1 A1	2	if at least two entries correct
(b)(i)	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 $x = -2, x = 2, y = 0$	$B1 \times 3$	3	
(ii)	Middle branch generally correct Other branches generally correct All branches approaching asymptotes Intersection at $(0, -\frac{1}{4})$ 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 $x = \pm\sqrt{3.5}$ Sol'n $-2 < x < -\sqrt{3.5}, \sqrt{3.5} < x < 2$	B1 B2,1	3	Allow NMS Condone dec approx'n for $\sqrt{3.5}$; B1 if \leq 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 $x = -4, y = 2$ Reflection in $y = x$ $x = 2, y = -4$	M1 A1 M1 A1F	4	OE or other complete method ft wrong answer for first point; allow NMS 2/2
Total			11	
TOTAL			75	