



**General Certificate of Education**

**Mathematics 6360**

**MFP1      Further Pure 1**

**Mark Scheme**

*2010 examination - January series*

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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.**

Q	Solution	Mark	Total	Comments
<b>1(a)</b>	$\alpha + \beta = 2, \alpha\beta = \frac{1}{3}$	B1B1	2	
<b>(b)</b>	$\alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$ ... = $8 - 3(\frac{1}{3})(2) = 6$	M1 m1A1	3	or other appropriate formula m1 for substn of numerical values; A1 for result shown (AG)
<b>(c)</b>	Sum of roots = $\frac{\alpha^3 + \beta^3}{\alpha\beta}$ ... = $\frac{6}{\frac{1}{3}} = 18$ Product = $\alpha\beta = \frac{1}{3}$ Equation is $3x^2 - 54x + 1 = 0$	M1 A1F B1F A1F	4	ft wrong value for $\alpha\beta$ ditto Integer coeffs and “= 0” needed; ft wrong sum and/or product
	<b>Total</b>		<b>9</b>	
<b>2(a)</b>	$z^2 = 1 + 2i + i^2 = 2i$	M1A1	2	M1 for use of $i^2 = -1$
<b>(b)</b>	$z^8 = (2i)^4$ ... = $16i^4 = 16$	M1 A1	2	or equivalent complete method convincingly shown (AG)
<b>(c)</b>	$(z^*)^2 = (1 - i)^2$ ... = $-2i = -z^2$	M1 A1	2	for use of $z^* = 1 - i$ convincingly shown (AG)
	<b>Total</b>		<b>6</b>	
<b>3</b>	$\sin \frac{\pi}{2} = 1$ stated or used Introduction of $2n\pi$ Going from $4x + \frac{\pi}{4}$ to $x$ $x = \frac{\pi}{16} + \frac{1}{2}n\pi$	B1 M1 m1 A1	4	Deg/dec penalised in 4th mark (or $n\pi$ ) at any stage incl division of all terms by 4 or equivalent unsimplified form
	<b>Total</b>		<b>4</b>	
<b>4(a)</b>	$\mathbf{I} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ Attempt at $(\mathbf{A} - \mathbf{I})^2$ $(\mathbf{A} - \mathbf{I})^2 = \begin{bmatrix} 0 & 4 \\ 3 & 0 \end{bmatrix} \begin{bmatrix} 0 & 4 \\ 3 & 0 \end{bmatrix} = 12\mathbf{I}$	B1 M1 A1	3	stated or used at any stage with at most one numerical error
<b>(b)</b>	$\mathbf{A} - \mathbf{B} = \begin{bmatrix} 0 & 1 \\ 3-p & 0 \end{bmatrix}$ $(\mathbf{A} - \mathbf{B})^2 = \begin{bmatrix} 3-p & 0 \\ 0 & 3-p \end{bmatrix}$ ... = $(\mathbf{A} - \mathbf{I})^2$ for $p = -9$	B1 M1A1 A1F	4	M1 A0 if 3 entries correct ft wrong value of $k$
	<b>Total</b>		<b>7</b>	

## MFP1

Q	Solution	Mark	Total	Comments
5(a)	$x^{-1/2} \rightarrow \infty$ as $x \rightarrow 0$	E1	1	Condone “ $x^{-1/2}$ has no value at $x = 0$ ”
(b)(i)	$\int x^{-1/2} dx = 2x^{1/2} (+c)$	M1A1		M1 for correct power of $x$
	$\int_0^{1/6} x^{-1/2} dx = \frac{1}{2}$	A1F	3	ft wrong coefficient of $x^{1/2}$
(ii)	$\int x^{-5/4} dx = -4x^{-1/4} (+c)$	M1A1		M1 for correct power of $x$
	$x^{-1/4} \rightarrow \infty$ as $x \rightarrow 0$ , so no value	E1F	3	ft wrong coefficient of $x^{-1/4}$
	<b>Total</b>		<b>7</b>	
6(a)(i)	Coords (3, 2), (9, 2), (9, 4), (3, 4)	M1A1	2	M1 for multn of $x$ by 3 or $y$ by 2 (PI)
(ii)	$R_2$ shown correctly on insert	B1	1	
(b)(i)	$R_3$ shown correctly on insert	B2,1F	2	B1 for rectangle with 2 vertices correct; ft if c's $R_2$ is a rectangle in 1st quad
(ii)	Matrix of rotation is $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$	B1	1	
(c)	Multiplication of matrices	M1		(either way)
	Required matrix is $\begin{bmatrix} 0 & 2 \\ -3 & 0 \end{bmatrix}$	A1	2	or other complete method
	<b>Total</b>		<b>8</b>	
7(a)(i)	Asymptotes $x = 2, y = 0$	B1B1	2	
(ii)	One correct branch	B1		
	Both branches correct	B1	2	no extra branches; $x = 2$ shown
(b)(i)	$f(3) = -1, f(4) = 3$	B1		where $f(x) = (x-3)(x-2)^2 - 1$ ; OE
	Sign change, so $\alpha$ between 3 and 4	E1	2	
(ii)	$f(3.5)$ considered first	M1		OE but must consider $x = 3.5$
	$f(3.5) > 0$ so $3 < \alpha < 3.5$	A1		Some numerical value(s) needed
	$f(3.25) < 0$ so $3.25 < \alpha < 3.5$	A1	3	Condone absence of values here
	<b>Total</b>		<b>9</b>	

## MFP1

Q	Solution	Mark	Total	Comments
8(a)	$\Sigma r^3 + \Sigma r = \frac{1}{4}n^2(n+1)^2 + \frac{1}{2}n(n+1)$	M1	4	at least one term correct
	Factor $n$ clearly shown $\dots = \frac{1}{4}n(n+1)(n^2 + n + 2)$	m1 A1A1		or $n + 1$ clearly shown to be a factor OE; A1 for $\frac{1}{4}$ , A1 for quadratic
(b)	Valid equation formed	M1	5	OE of the correct quadratic SC 1/2 for $n = 10$ after correct quad
	Factors $n, n + 1$ removed	m1		
	$3n^2 - 29n - 10 = 0$	A1		
	Valid factorisation or solution $n = 10$ is the only pos int solution	m1 A1		
<b>Total</b>			<b>9</b>	
9(a)	$x = 2, y = 0 \Rightarrow \frac{4}{a^2} - 0 = 1$ so $a = 2$	E2,1	4	E1 for verif'n or incomplete proof
	Asymps $\Rightarrow \pm \frac{b}{a} = \pm 2$ so $b = 2a = 4$	E2,1		ditto
(b)	Line is $y - 0 = m(x - 1)$	B1	4	OE  OE (no fractions) convincingly shown (AG)
	Elimination of $y$	M1		
	$4x^2 - m^2(x^2 - 2x + 1) = 16$	A1		
	So $(m^2 - 4)x^2 - 2m^2x + (m^2 + 16) = 0$	A1		
(c)	Discriminant equated to zero	M1	3	OE convincingly shown (AG)
	$4m^4 - 4m^4 - 64m^2 + 16m^2 + 256 = 0$	A1		
	$-3m^2 + 16 = 0$ , hence result	A1		
(d)	$m^2 = \frac{16}{3} \Rightarrow \frac{4}{3}x^2 - \frac{32}{3}x + \frac{64}{3} = 0$	M1	5	using $m = \pm \frac{4}{\sqrt{3}}$ or from equation of hyperbola; dep't on previous m1
	$x^2 - 8x + 16 = 0$ , so $x = 4$	m1A1		
	Method for $y$ -coordinates	m1		
	$y = \pm 4\sqrt{3}$	A1		
<b>Total</b>			<b>16</b>	
<b>TOTAL</b>			<b>75</b>	