

Version 1.0: 0107



# **General Certificate of Education**

## **Mathematics 6360**

**MFP1          Further Pure 1**

## **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.**

**MFP1**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>1(a)(i)</b>	Roots are $\pm 4i$	M1A1	2	M1 for one correct root or two correct factors
<b>(ii)</b>	Roots are $1 \pm 4i$	M1A1	2	M1 for correct method
<b>(b)(i)</b>	$(1+x)^3 = 1 + 3x + 3x^2 + x^3$	M1A1	2	M1A0 if one small error
<b>(ii)</b>	$(1+i)^3 = 1 + 3i - 3 - i = -2 + 2i$	M1A1	2	M1 if $i^2 = -1$ used
<b>(iii)</b>	$(1+i)^3 + 2(1+i) - 4i$ $\dots = (-2 + 2i) + (2 - 2i) = 0$	M1 A1	 2	 with attempt to evaluate convincingly shown ( <b>AG</b> )
<b>Total</b>			<b>10</b>	
<b>2(a)(i)</b>	$A + B = \begin{bmatrix} \sqrt{3} & 0 \\ 1 & 0 \end{bmatrix}$	M1A1	2	M1A0 if 3 entries correct; Condone $\frac{2\sqrt{3}}{2}$ for $\sqrt{3}$
<b>(ii)</b>	$BA = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$	B3,2,1	3	Deduct one for each error; <b>SC</b> B2,1 for <b>AB</b>
<b>(b)(i)</b>	Rotation $30^\circ$ anticlockwise (abt $O$ )	M1A1	2	M1 for rotation
<b>(ii)</b>	Reflection in $y = (\tan 15^\circ)x$	M1A1	2	M1 for reflection
<b>(iii)</b>	Reflection in $x$ -axis  <b>Alt:</b> Answer to (i) followed by answer to (ii)	B2F  M1A1F	2  (2)	1/2 for reflection in $y$ -axis ft (M1A1) only for the <b>SC</b> M1A0 if in wrong order or if order not made clear
<b>Total</b>			<b>11</b>	
<b>3(a)</b>	$\alpha + \beta = -2, \alpha\beta = \frac{3}{2}$	B1B1	2	
<b>(b)</b>	Use of expansion of $(\alpha + \beta)^2$ $\alpha^2 + \beta^2 = (-2)^2 - 2\left(\frac{3}{2}\right) = 1$	M1 m1A1	 3	 convincingly shown ( <b>AG</b> ); m1A0 if $\alpha + \beta = 2$ used
<b>(c)</b>	$\alpha^4 + \beta^4$ given in terms of $\alpha + \beta, \alpha\beta$ and/or $\alpha^2 + \beta^2$ $\alpha^4 + \beta^4 = -\frac{7}{2}$	M1A1  A1	  3	  M1A0 if num error made  OE
<b>Total</b>			<b>8</b>	

**MFP1 (cont)**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>4(a)</b>	$\lg y = \lg a + b \lg x$	M1A1	2	M1 for use of one log law
<b>(b)</b>	Use of above result $a = 10$ $b = \text{gradient}$ $\dots = -\frac{1}{2}$	M1 A1 m1 A1	4	OE; PI by answer $\pm \frac{1}{2}$
	<b>Total</b>		<b>6</b>	
<b>5(a)</b>	Asymptotes $y = 0, x = -1, x = 1$	B1 $\times$ 3	3	
<b>(b)</b>	Three branches approaching two vertical asymptotes Middle branch passing through $O$ Curve approaching $y = 0$ as $x \rightarrow \pm \infty$ All correct	B1 B1 B1 B1	4	Asymptotes not necessarily drawn with no stationary points with asymptotes shown and curve approaching all asymptotes correctly
<b>(c)</b>	Critical values $x = -1, 0$ and $1$ Solution set $-1 < x < 0, x > 1$	B1 M1A1	3	M1 if one part correct or consistent with c's graph
	<b>Total</b>		<b>10</b>	
<b>6(a)(i)</b>	$(2r-1)^2 = 4r^2 - 4r + 1$	B1	1	
<b>(ii)</b>	$\sum (2r-1)^2 = 4 \sum r^2 - 4 \sum r + \sum 1$ $\dots = \frac{4}{3}n^3 - \frac{4}{3}n + \sum 1$ $\sum 1 = n$ Result convincingly shown	M1 m1A1 B1 A1	5	<b>AG</b>
<b>(b)</b>	Sum = $f(100) - f(50)$ $\dots = 1\,166\,650$	M1A1 A2	4	M1 for $100 \pm 1$ and $50 \pm 1$ <b>SC</b> $f(100) - f(51) = 1\,156\,449$ : 3/4
	<b>Total</b>		<b>10</b>	

**MFP1 (cont)**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>7(a)</b>	Particular solution, eg $-\frac{\pi}{6}$ or $\frac{5\pi}{6}$ Introduction of $n\pi$ or $2n\pi$ GS $x = -\frac{\pi}{6} + n\pi$	B1 M1 A1F	3	Degrees or decimals penalised in 3rd mark only  OE(accept unsimplified); ft incorrect first solution
<b>(b)(i)</b>	$f(0.05) \approx 0.542\ 66$ $g(0.05) \approx 0.542\ 68$	B1 B1	2	either value AWRT 0.5427 both values correct to 4DP
<b>(ii)</b>	$\frac{g(h) - g(0)}{h} = \frac{\sqrt{3}}{2} - \frac{1}{4}h$	M1A1	2	M1A0 if num error made
<b>(iii)</b>	As $h \rightarrow 0$ this gives $g'(0) = \frac{\sqrt{3}}{2}$	A1F	1	AWRT 0.866; ft num error
<b>Total</b>			<b>8</b>	
<b>8(a)</b>	$x = 10 \Rightarrow 4 - \frac{y^2}{9} = 1$ $\Rightarrow y^2 = 27$ $\Rightarrow y = \pm 3\sqrt{3}$	M1 A1 A1	3	PI
<b>(b)</b>	One branch generally correct Both branches correct Intersections at $(\pm 5, 0)$	B1 B1 B1	3	Asymptotes not needed With implied asymptotes
<b>(c)</b>	Required tangent is $x = 5$	B1F	1	ft wrong value in (b)
<b>(d)(i)</b>	$y$ correctly eliminated Fractions correctly cleared $16x^2 - 200x + 625 = 0$	M1 m1 A1	3	convincingly shown ( <b>AG</b> )
<b>(ii)</b>	$x = \frac{25}{4}$ Equal roots $\Rightarrow$ tangency	B1 E1	2	No need to mention repeated root, but B0 if other values given as well Accept 'It's a tangent'
<b>Total</b>			<b>12</b>	
<b>TOTAL</b>			<b>75</b>	