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ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Education

# Mathematics 6360

## MFP2 Further Pure 2

# Report on the Examination

*2007 examination - June series*

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## General
Candidates found this paper slightly more demanding than in previous years, although there were some splendid scripts. The one feature that was particularly noticeable this year was that some candidates did not give convincing explanations when explanations were required. The general standard of presentation was good.

## Question 1
Almost all candidates were successful with part (a) However, in part (b) a number of candidates used $\sum r^2$ and $\sum r$ to evaluate $\sum_{50}^{99} r\,(3r+1)$ contrary to the requirement of the question and so, even with a correct answer, scored no marks. The most successful candidates for this part of the question were those who carefully wrote out a number of rows including the first and last row, to illustrate the cancellations. Some candidates went awry when writing down the first or last terms of the series.

## Question 2
Whilst part (a) was usually correctly done, part (b)(i) was poorly answered. Some candidates were able to comment on the condition that as the sum of the squares of the roots was less than zero there would have to be complex roots, but few stated the conditions that the coefficients of the cubic equation were all real. The value of *p* in part (b)(ii) was very often correct but in part (c)(i) a very common error as to use $\sum \alpha^2 = -12$ in order to find the third root. This method led to $\alpha^2 = 4$ from which almost all candidates using this method wrote $\alpha = 2$ without even considering the possibility that $\alpha$ could equal $-2$. Part (c)(ii) was usually worked correctly although $\alpha\beta\gamma = +\,q$ appeared from time to time.

## Question 3
There were many incomplete solutions to this question. Whilst most candidates used the de Moivre's Theorem correctly, many candidates either equated real parts only to arrive at an incorrect answer, or equated imaginary parts. In this latter case, the solution $\theta = -\dfrac{\pi}{30}$ appeared frequently in spite of the request in the question that $\theta$ should be positive, or the correct answer appeared but from an incomplete solution. Some candidates solved $\cos\theta = 0$ and $\sin\theta = -1$ but gave two different values of $\theta$ as their answer, one from each equation.

## Question 4
This is the first time that a question has been set on inverse trigonometrical functions since this topic was included in the MFP2 specification. It was clear that many candidates did not know what $\tan^{-1}x$ was. They were able to complete part (a) with the help of the formulae booklet although even then there was confusion between the derivatives of $\tan^{-1}$ and $\tanh^{-1} x$ as the derivative of $\tan^{-1}$ was given as $\dfrac{1}{1-x^2}$.

However it was part (b) that revealed the true lack of understanding of inverse trigonometrical functions. Part (b) was either abandoned altogether or when attempted $\tan^{-1}x$ was frequently written as $\dfrac{1}{\tan x}$ .

## Question 5

Explanations in part (a) were very unclear and generally far from convincing. Candidates generally referred to what had happened to the coordinates of the points represented by $z_1$ and $z_2$, but few made allusion to the significance of $i$ in the $iz_1$. The neatest solutions came from candidates who considered multiplication of a complex number by $i$ as a rotation anticlockwise of $\frac{1}{2}\pi$. Inaccurate copying of the diagram in part (b) caused loss of marks. For in*stance,* although candidates knew that the locus $L_1$ was the perpendicular bisector of $AB$, poor diagrams meant that their line did not pass through the origin. Again, for the locus $L_2$, although the majority of candidates drew a half line through $B$, their line was not always parallel to $OA$. Part (c) proved to be beyond most candidates probably because few realised that the point of intersection of $L_1$ and $L_2$ was, in fact, the fourth vertex of the square whose three other vertices were $A$, $O$ and $B$

## Question 6

Part (a) was usually answered correctly although there were many very long-winded algebraic methods employed including the multiplication out of just about every bracket followed immediately by their re-factorisation. There was however much muddled thinking in part (b). Whilst most candidates had some outline of the method of induction many candidates attempted this part with no reference whatever to the series product in question, whilst others tried to **add** the $(k+1)^{\text{th}}$ term to the sum of $k$ products. Candidates who did consider the series usually used $\sum$ rather than $\Pi$ but this was not penalised.

## Question 7

This question was generally answered well and many candidates were able to score 12 out of the available 15 marks. Part (a) was well answered apart from a few candidates who wrote $\frac{\mathrm{d}y}{\mathrm{d}x} = 2x^{-\frac{1}{2}}$ followed by $\frac{1}{2x^{\frac{1}{2}}}$. In part (b) there were two main sources of error. The first was to interchange $\mathrm{d}x$ with $\mathrm{d}\theta$ without any consideration of $\frac{\mathrm{d}x}{\mathrm{d}\theta}$, and the second was to write $\sqrt{\frac{4\sinh^2\theta + 4}{4\sinh^2\theta}}$ as $\frac{2\sinh\theta + 2}{2\sinh\theta}$. There were also a few candidates who were unable to differentiate $4\sinh^2\theta$.

In part (b)(i), most candidates were able to integrate $8\cosh^2\theta$ correctly but few were able to arrive at the printed result in part (b)(ii). Two factors contributed to this. Candidates either failed to change the limits for $x$ to the corresponding limits for $\theta$ or else wrote the answer with no evident method. This was unacceptable as the answer for the arc lengths was given.

## Question 8

Candidates were usually able to establish the result in part (a) although the methods used were sometimes somewhat inelegant. Part (a)(ii) was reasonably well done although some carelessness was in evidence in this part. For instance, some candidates although showing that the argument of $z^3$ was $\pm\frac{1}{4}\pi$ continued their solution with only $+\frac{1}{4}\pi$ and so arrived at a total of three roots. Others having reached $|z^3| = \sqrt{8}$ then thought that $|z| = \sqrt{8}$ also.

A few candidates used a method which, although possible, was not really suitable. They replaced the $z^3$ in $z^6 - 4z^3 + 8 = 0$ with $2 \pm 2i$ and so arrived at $z^6 = \pm 8i$. This latter equation gave the twelve roots of $z^{12} = -64$ and the method was incomplete unless $6$ of the roots were rejected. Part (b) was generally well done, but part (c) was really only completed by candidates who had correctly answered part (a)(ii).

## Mark Ranges and Award of Grades

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