# GCE

# MATHEMATICS

## MFP1 Further Pure 1
## Report on the Examination

6360
June 2013

Version: 1.1

Further copies of this Report are available from aqa.org.uk

## General

Presentation of work was generally very good. There was no clear evidence that students were short of time and a large majority of students completed their solution to a question at a first attempt. Students generally found this paper to be more demanding than the corresponding June 2012 paper and significantly harder than the January 2013 paper. There were some less predictable parts of questions which students found more testing.

Teachers may wish to continue to emphasise the following points to their students in preparation for future examinations in this unit:

- When asked to show a printed result, sufficient lines of working should be shown and checked thoroughly to ensure that there are no errors, particularly if alterations have been made in later lines of the solution to obtain the printed answer. The final line of working should be written in a form that matches the printed result. Where relevant, a final statement must be made to clearly show that the required conclusion has been reached.
- The final answer should always be given in the required form as stated in the question.

## Question 1

The majority of students scored full marks for this opening question which tested the Newton-Raphson method. The common errors were mainly arithmetical, with an incorrect evaluation of $f'(10)$ as $324$, instead of its correct evaluation as $284$, being the most common. A small minority of students did not give their answer to the required degree of accuracy and so did not score the final mark. This question was not attempted by significantly more students than usual. Not all non-attempts were from the weaker students. It should be noted that the required formula is given in the formulae booklet.

## Question 2

Many correct answers were submitted for part (a) in this question which tested $2\times2$ matrices including the identity matrix $\mathbf{I}$. In part (b) the most successful starting approach was to find the matrix for $\mathbf{A}-\mathbf{B}+\mathbf{AB}$ in terms of $p$, equate it to the matrix for $k\mathbf{I}$ to show that $p=-7$ and then to work with $\mathbf{A}-\mathbf{B}+\mathbf{AB}$ and show that it was equal to $-27\mathbf{I}$.
A minority of students found the correct value of $k$ but either did not convincingly show that $\mathbf{A}-\mathbf{B}+\mathbf{AB}=k\mathbf{I}$ or made an incorrect concluding statement. It was disappointing to see some students writing down an incorrect matrix for $\mathbf{I}$.

## Question 3

The majority of students were able to find the correct general solution of the given trigonometric equation although all the usually errors were also seen, including only dealing with half the solutions, having forgotten to include those obtained from $5x+40=360n-65$. Some students made errors when rearranging such equations and some others left part of their final answer in radians. Part (b) was less familiar and required knowledge and use of the relevant surd forms for the cosine of various angles. Those less able students who attempted this part of the question generally started by rationalising the given surd and rarely gained any credit. Better solutions started by recalling that $\cos\frac{\pi}{4}=\frac{1}{\sqrt{2}}$ and then writing the given $\frac{\sqrt{3}-1}{2\sqrt{2}}$ as $\left(\cos\frac{\pi}{4}\right)\left(\frac{\sqrt{3}}{2}-\frac{1}{2}\right)$.

A majority of those who reached this stage went on to correctly replace the $\frac{\sqrt{3}}{2}$ by $\cos\frac{\pi}{6}$ but a significant proportion of these students failed to score the final mark because they replaced the $-\frac{1}{2}$ by $-\cos\frac{\pi}{3}$ instead of the required $+\cos\frac{2\pi}{3}$ or its relevant equivalent.

## Question 4

This question which tested the complex numbers section of the specification proved, as expected, to be more demanding than the corresponding questions in recent MFP1 papers. In part (a)(i) a common wrong answer for $(z-2\mathrm{i})^*$ was $x+\mathrm{i}y+2\mathrm{i}$. Those students who started by writing $(x+\mathrm{i}y-2\mathrm{i})^*$ were generally more successful. There were some very good solutions to part (a)(ii), but some able students, having found the correct values for $x$ and $y$, either stopped at that point or else gave their final answer as $\frac{1}{3}+\frac{4}{3}\mathrm{i}$ which indicated that they thought that solving the given equation meant finding the value of $(z-2\mathrm{i})^*$ and not the value of $z$. It was quite common to see some students making no attempt to equate real parts and imaginary parts, with final answers left in a form similar to $x+4y-3+(2-y-4x)\mathrm{i}$. The final part of the question was answered well by those who based their statement on:

- coefficients must be real for conjugate roots or
- sum of roots $(=2p)$ cannot be $-10\mathrm{i}$ if $p$ is real or
- product of the roots $\left(p^2+q^2\right)$ cannot be $-29$ if $p$ and $q$ are real.

However, correct statements were in the minority. Common wrong answers for example, 'it is not the difference of two squares' suggested that students were treating the roots $p\pm\mathrm{i}q$ as the factors of the quadratic expression $z^2+10\mathrm{i}z-29$.

## Question 5

This question which tested the calculus section of the specification proved to be a good source of marks, although full marks were a rarity mainly due to a lack of detail in the explanations for part (a)(ii). Most students applied the correct method for finding the gradient of the line $PQ$ but sometimes errors in the expansion of brackets were not always completely corrected at each stage even though the printed answer was 'produced'. In part (a)(ii), it was pleasing to see an increase in the use of $h \to 0$ rather than the more usual $h=0$. Examiners also expected students to state the actual value of the gradient of the line $x+y=0$, rather than just give a general result for parallel lines, as well as writing a concluding statement that the lines were parallel. In part (b) most students applied the correct method by multiplying out the bracket before integrating but there were a surprisingly many who had sign errors in their later work. In contrast there were some excellent solutions seen which involved the 'Lim' notation correctly applied.

## Question 6

This question tested roots and coefficients of a quadratic equation. Almost all students wrote down the correct values in part (a). In part (b) a large proportion of students quoted and used the correct identity for $\alpha^3+\beta^3$ but a significant number failed to score the final mark because they did not show sufficient evaluations before writing down the printed answer. With the answer given, examiners expected to see correct evaluations of each of $(-1.5)^3$ and $-3(-3)(-1.5)$ before the printed answer was stated. Average grade students generally picked up the method marks in part (c) but, in general, only the more able students could cope with the algebraic demands needed to obtain the correct quadratic equation. However, it was pleasing to see that there were fewer students than normal who missed off the '$=0$' from their quadratic equation.

## Question 7

This question proved to be the most challenging question on the paper. In part (a) most students scored the method mark but a significant number failed to score the remaining mark. Some statements had the root lying between $-9447$ and $22380$, others failed to specify '$51$' and '52' and others failed to mention the sign change each of which resulted in the loss of the second mark. In part (b)(i) many scored the method marks but a significant proportion did not use $\sum_{r=1}^{n} 1 = n$, just using $1$ instead of $n$. Full correct answers for (b)(i) were seen relatively frequently but that cannot be said for the final two demanding parts of the question. In part (b)(ii) many failed to correctly factorise $4n^2-1$ within their correct expression $2n(4n^2-1)$ and very few of those that did could correctly identify the three terms as $(2n-1)$, $(2n)$ and $(2n+1)$ and make the necessary statement that these were 'consecutive integers'. There was slightly more success in the final part of the question but a common wrong approach involved starting with $\frac{n}{6}(n+1)(2n+1) > 180000$.

## Question 8

This question, which tested matrix transformations, was not attempted by a significantly higher proportion of students than the other questions on the paper. However, there were more students who scored full marks for this question than for any of the last seven questions on the paper. Part (a) was generally answered correctly with many able to just write down the correct matrix $\begin{bmatrix} 1 & 0 \\ 0 & 3 \end{bmatrix}$ for the stretch. The most common wrong answers were either $\begin{bmatrix} 3 & 0 \\ 0 & 1 \end{bmatrix}$ or $\begin{bmatrix} 0 & 0 \\ 0 & 3 \end{bmatrix}$. In part (b)(i), the majority of students quoted or used the correct matrix from the formulae booklet but some took $\theta$ to be $30^\circ$ instead of $60^\circ$. A small minority left their answer in trigonometric form instead of using the surd form as instructed. In part (b)(ii) there were a significant number of students who wrote down and multiplied their matrices in the wrong order.

## Question 9

Students showed that they had prepared well for this style of question and some very good solutions were seen although full marks was a rarity due mainly to the demands of part (b)(iii). In part (a) many students gave the correct three equations of the asymptotes although '$y=0$' was a common wrong answer. In part (b)(i) errors were made in rearranging the terms resulting in incorrect signs. Although the printed answer was frequently stated, it did not always follow from correct previous lines. Again, for a printed answer, the details of all steps should be shown and any alterations applied to all relevant lines of working. In part (b)(ii), the majority of students attempted to find the discriminant and then use $b^2-4ac\geq 0$, although miscopies of the terms, the negative sign lost in $-(3k+1)$ and the '2' not squared in finding $b^2$ were all seen, sometimes followed by a further error to produce the printed answer. Solutions to part (b)(iii), when attempted, did not always address the 'Hence' or show that there was only one stationary point. Many students missed the fact that $k=0$ was a critical value of the printed inequality and a significant number claimed that $k=1$ produced the stationary point $(1, 0)$. Better solutions used $k=0$ to find the stationary point but many of these did not attempt to give an explanation of why $k=1$ was excluded or gave the unacceptable explanation '$y=1$ is an asymptote' to dismiss it. In part (c) the quality of the sketches was very variable. There were many good sketches seen but some other students would have found it easier to show the behaviour of the curve as it approached the asymptotes if they had used a ruler to draw the asymptotes and so had clear vertical and horizontal (dashed) lines.

## Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

## Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

**UMS conversion calculator** www.aqa.org.uk/umsconversion