AQA

AS
FURTHER MATHEMATICS

MFP1 Further Pure 1
Report on the Examination

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General

Presentation of work was reported as being very good. Most students were able to make an attempt at all questions. However, there was evidence that a large minority of students abandoned the final part of question 2 without realising that it could be answered without using the answer to the previous part.

Question 1

This question which tested the use of Euler's method was attempted by a much higher proportion of students than the previous occasion that this topic was tested. A significant majority of students scored full marks. Other than arithmetic errors, the loss of marks was mainly due to either not giving the final answer to the requested degree of accuracy or applying an extra iteration. Students who just used a table of values and made a numerical error were often penalised more heavily because the table lacked the required evidence for the method marks to be awarded.

Question 2

Students found this question, which tested the roots and coefficients of a quadratic equation, to be more challenging than anticipated. In part **(a)** several students ignored the coefficient '5' and just equated p to the sum of the roots and q to the product of the roots which gained no credit. Other students just stated that $b^2 - 4ac = 400$ followed by the printed answer without the necessary evidence of linking it to the difference of the roots being equal to $\frac{\sqrt{b^2 - 4ac}}{a}$.

A variety of correct methods were seen, the most common one involved

$\alpha(\alpha + 4) = \frac{q}{5} \Rightarrow 20q = 100(\alpha^2 + 4\alpha)$, $\quad 2\alpha + 4 = -\frac{p}{5} \Rightarrow p^2 = 100(\alpha^2 + 4\alpha + 4)$ followed by a correct elimination of α to obtain the printed answer.

Fewer than half the students scored a mark in part **(b)(i)**. Other more successful students sometimes produced pages of algebraic manipulation to find the product and sum of the new roots, whereas the most able just stated :

$$\alpha^2(\alpha + 4)^2 = [\alpha(\alpha + 4)]^2 = \frac{q^2}{25}, \quad \alpha^2 + (\alpha + 4)^2 = [\alpha + (\alpha + 4)]^2 - 2\alpha(\alpha + 4) = \frac{p^2}{25} - \frac{2q}{5} = \frac{10q + 400}{25}.$$

Incorrect expressions in terms of q for the sum and product of the 'new' roots were followed through for the award of the third mark, but common errors were often seen, namely, a wrong sign for the coefficient of x or an equation not formed.

A large number of students made no attempt to answer the final part of the question. The most successful students solved $(\alpha + 4)^2 = \alpha^2$ to get $\alpha = -2$ and then substituted into $\alpha(\alpha + 4) = \frac{q}{5}$ to show $q = -20$.

Question 3

Most students scored full marks in part **(a)** of this question on complex numbers.

Although part **(b)** was more challenging, the majority of students presented a fully correct solution. In general students who evaluated $z - \mathrm{i}$ and then $(z-\mathrm{i})^*$ separately tended to be more successful.

A common error for other students was to write $(z-\mathrm{i})^*$ as though it was equal to $z^* - \mathrm{i}$. Most students scored the method mark for equating real parts and equating imaginary parts and further marks for solving the simultaneous equations were frequently scored by those who had previously found the correct value for $(z-\mathrm{i})^*$.

Question 4

Most students appreciated that the integrand, $\frac{1}{2x\sqrt{x}}$, needed to be manipulated before integration could take place but this expression was often incorrectly written as $2x^{-1.5}$. In part **(b)**, marks were often lost due to poor notation with the letters c and d being replaced by 0 and ∞ respectively. Successful students used 'as $c \to 0$, $\frac{1}{\sqrt{c}} \to \infty$' and 'as $d \to \infty$, $\frac{1}{\sqrt{d}} \to 0$' or used Lim notation correctly.

Question 5

Part **(a)** of this question which tested general solutions of trigonometric equations was answered correctly by a high proportion of students. The most popular method was to use the single general form $2x + \frac{\pi}{2} = n\pi + \frac{\pi}{3}$ although the equivalent 'double' form $2x + \frac{\pi}{2} = 2n\pi + \frac{\pi}{3}$ with $2x + \frac{\pi}{2} = 2n\pi + \frac{4\pi}{3}$ was also used to score full marks.

Part **(b)**, as expected proved to be a challenge even to the most able. Most students who attempted the question just chose a couple of random values of n and stated the resulting surd values without any further justification on completeness. The most successful students presented a solution which initially treated $\sin 3x$ and $\sin 4x$ separately.

It was disappointing to see a minority of students writing and using $\sin 3x - \sin 4x = -\sin x$.

Question 6

In part **(a)** of this question which related to an ellipse, a high proportion of students scored both marks usually by sketching the ellipse and the four relevant tangents and then calculating the area of the corresponding rectangle. Other students seemed to have misunderstood the question as they drew a rhombus inside the ellipse and calculated its area.

Part **(b)** was answered correctly by just over half the students. Some students just gave a description of the stretch without the matrix for which no credit was awarded. The common wrong matrices which gained partial credit were $\begin{bmatrix} 1 & 0 \\ 0 & 0.5 \end{bmatrix}$ and $\begin{bmatrix} 1 & 0 \\ 0 & 4 \end{bmatrix}$.

In part **(c)(i)**, identification that the translation was 3 to the right was frequently written or drawn on a diagram by the students but a significant minority then incorrectly stated $a = -3$.

Part **(c)(ii)** allowed for a number of valid approaches, but the most successful one involved applying the given translation to E_1 to find the equation of E_2, then manipulating this equation to write it in a form similar to the one printed in part **(c)**. Students using this approach then compared coefficients of x to find p and then compared coefficients of y and constant terms from which they found values for q. The most common errors involved incorrect multiplication of brackets or using $y + b$ in the initial forming of the equation for E_2.

Question 7

Part **(a)** of this question which tested series was answered correctly by a high proportion of students. It was pleasing to see the majority of students taking out common factors rather than forming a quartic polynomial and then relying on the use of the calculator which has been so costly, in terms of marks, in the past.

In contrast, part **(b)** created a real challenge to all but the most able students. Most students struggled to decide how to split the series and then what values to sum to and also how to create a general expression. The most successful students started by writing the series as

either $1^2 + 2^2 + 3^2 + ... + (2n-1)^2 + (2n)^2 - 2\left[2^2 + 4^2 + ... + (2n)^2\right] = \sum_{r=1}^{2n} r^2 - 8\sum_{r=1}^{n} r^2$

or $1^2 + 3^2 + 5^2 + ... + (2n-1)^2 - \left[2^2 + 4^2 + ... + (2n)^2\right] = \sum_{r=1}^{n}(2r-1)^2 - \sum_{r=1}^{n}(2r)^2 = \sum_{r=1}^{n}(-4r+1)$

Some excellent correct solutions were seen.

Question 8

This question tested both the rules of matrices and their use with transformations. Parts **(a)** and **(b)** were correctly answered by many students.

In part **(c)(i)** most students scored full marks but a very common error was to not take account of the fact that theta was an obtuse angle. A minority of students took obtuse to imply that the angle was reflex, but the most common error was to use $\cos\theta = \frac{4}{5}$. A slightly more significant minority of students took the given exact value for $\sin\theta$ and used an approximate trigonometric value for each element in the matrix.

In part **(c)(ii)** many students showed that they knew how to tackle the question but in addition to the errors referred to above, students multiplied the matrices in the wrong order or did not give their final answer in coordinate form. Special cases were applied to cover the errors relating to a wrong sign for $\cos\theta$ or for a wrong order of multiplying the matrices.

Question 9

This question, which tested rational functions, was generally a good source of marks for students. In part **(a)** a very high proportion of students gave the correct equations for the vertical asymptotes but less able students either gave $y = 0$ as the equation of the horizontal asymptote or did not consider one.

In part **(b)**, examiners expected students to present a 'correct solution only' in reaching the printed answer and the majority of students did so. Some careless work was seen and penalised, for example, it was not uncommon to see '$= 0$' missing so that $b^2 - 4ac \geq 0$ was being applied to a quadratic expression rather than a quadratic equation.

In part **(c)** most students identified the critical values and went on to show the equations which had repeated roots. In general these were solved correctly although a sign error for an x-coordinate was not a rarity. Despite the clear warning, differentiation was seen in a small number of cases. Students should take care to ensure that they show all necessary stages in their work so that it is clear that calculus has not been used. Those students who solved the correct equations to find the correct stationary points generally went on to find the correct exact distance for PQ.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

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