AQA

A-LEVEL
FURTHER MATHEMATICS

MFP3 Further Pure 3
Report on the Examination

6360
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General

Students were able to attempt all questions in the time available. In most scripts, students completed their solution to a question at the first attempt. Presentation of work was not always as good as in recent series. Examples of this were seen in Question **4 (a)** where it was not always easy to distinguish between x and t in some students' solutions.

Question 1

This standard numerical methods question was answered correctly by the vast majority of students. A few students were heavily penalised after an arithmetic slip because their entire solution only consisted of a table of values.

Question 2

Part **(a)(i)** was answered better than similar questions in the previous two series. The most common error was forgetting to differentiate the $6x$ when finding the value of the fourth derivative at $x = 0$.

Students who found the correct values in part **(a)(i)**, almost always scored both marks in part **(a)(ii)**.

Part **(b)**, solving a standard second order differential equation, was a good source of marks for almost all students. Numerical slips in finding the particular integral was the main reason for loss of marks.

Question 3

Most of the students stated the correct expansion in part **(a)(i)**.

In part **(a)(ii)** a significant minority of students ignored the word 'Hence' and applied a Maclaurin series, for which there was no credit. Successful students applied the first law of logarithms to the two previous expressions and recognised that the required expansion was half the sum of the previous two expansions.

In part **(a)(iii)** it was pleasing to see students who had experienced difficulties with part **(a)(ii)** gaining full marks by recognising that the given expression could be written in the form $\ln(1+\sin x) - \ln\cos x$ and subtracting the relevant expansions. Those students who used the 'or otherwise' approach were less successful. Their approach generally involved differentiation and applying Maclaurin. The main reason why most of these students did not obtain the correct answer was because they did not simplify the first derivative to $\sec x$ before attempting to find the higher derivatives.

Part **(b)** was generally answered correctly although there were slightly more students this year who did not get a constant term in both the numerator and the denominator before taking the limit.

Question 4

The quality of the responses to solving second order differential equations using a given substitution has steadily improved over each series. This was very evident in students' answers to part **(a)** where most students applied valid methods to find the correct expression for the second derivative. Slips in notation and poor mathematical communication were the main reasons for the loss of the A1cso mark.

The most common error in making the links into part **(b)** was to leave the right-hand side of the equation as $10x$ rather than $10\mathrm{e}^{t}$. Students usually gave the correct complementary function but a missing bracket before the $+5x$ in the final answer was not a rarity.

Question 5

This question was a more challenging test of the limiting process in finding the value of an improper integral and consequently produced a more widespread distribution of marks. Integration into the two natural logarithm terms created problems for a significant minority of students, mainly resulting in a wrong sign or multiplier for $\ln(1-\cos 3x)$. However, it was pleasing to see that even the less able students realised that the lower limit of zero needed to be replaced. Combining the logarithmic terms and then making the connection with the series expansion for $\cos 3x$ was a critical step which the majority of students missed. Although some excellent solutions were seen for full marks, some students lost the final A1cso mark because they did not show enough terms in the series expansion before taking the limit.

Question 6

Most students in part **(a)** stated a correct integrating factor and most used it to find the correct general solution of the given first order differential equation.

In part **(b)** the majority of students made no realistic attempt to show that the curve had a horizontal asymptote. The most successful students used their answer to part **(a)** and considered the limiting value as $x \to \infty$.

Part **(c)** proved to be the most challenging question on the paper. Many students scored two marks for finding the equation of the curve but most made no further progress. However, some excellent solutions were seen from a small minority of students who realised that the identification of the stationary points and their nature could be used to find the possible values of k.

Question 7

Most students scored the mark in part **(a)(i)** and the first two marks, for forming a polar equation, in part **(a)(ii)**. Only a minority of students obtained the required given polar equation. Successful students took the square root of both sides of $r^2 = \left(4 - r\cos\theta\right)^2$ and then used the double angle formula.

In part **(b)(i)** the common mistake, after finding $\theta = \frac{\pi}{3}$ from $\tan^{-1}\sqrt{3}$, was to either assume that the other value was $-\frac{\pi}{3}$ or to give a value outside of the given interval. Although the method of integration required in part **(b)(ii)** has been tested on previous MFP3 papers, most students struggled to integrate $\sec^4\frac{\theta}{2}$ correctly. More surprisingly, there were a minority of students who used the wrong general formula for the area of a circle when finding A_2. Once again some excellent solutions were also presented, including some completely correct ones based on the Cartesian equations.

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