AQA

A-LEVEL
FURTHER MATHEMATICS

MFP3 Further Pure 3
Report on the Examination

6360
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General

Presentation of work was usually very good. Some students made multiple attempts to answer various part questions, which sometimes resulted in them running out of time. A few students seemed to not realise that there was a Question 9 in this paper. Students should be advised to read through the question paper/answer booklet to ensure that they don't miss any questions and therefore marks available.

In general, students performed very well on questions which required solving differential equations. In contrast, part questions on polar coordinates and series expansions were not as well answered as in previous series.

Question 1

The majority of students scored the mark in part **(a)** by stating that the integral was improper because the interval of integration was infinite. A minority of students made reference to the integrand being undefined or used imprecise statements, neither of which scored the mark.

In part **(b)** most students applied integration by parts correctly. They also clearly showed the limiting process used to evaluate the improper integral. Loss of accuracy marks was usually due to sign errors or miscopying of previous correct work.

Question 2

This numerical methods question was again a good source of marks for many students although full marks were less common than in previous series. A small minority of students had difficulty evaluating the logarithms to base 2. A common error when finding the value of k_2 was to omit the +7 in the logarithmic term. A common miscopy was to write 1.667 instead of 1.1667. It was pleasing to see almost all final answers given to the required degree of accuracy and very few solutions consisting solely of a table of values.

Question 3

Finding the general solution of this second order differential equation was the best answered question on the paper. The majority of students scored full marks. Loss of marks was usually due to arithmetical errors in finding the coefficients for the particular integral.

Question 4

The majority of students who correctly applied the binomial expansion to the numerator generally scored full marks. Those who did not sometimes failed to divide at least three terms by x^4 in the resulting rational expression. Sign errors were the most common reason for loss of accuracy marks. An unexpected valid approach which removed the need to apply the binomial expansion was correctly presented by a small number of students, who scored full marks. They multiplied numerator and denominator by $3+\sqrt{9-kx^4}$ and then divided terms by x^4 before taking the limit.

Question 5

In part **(a)** most students recalled and used the correct conversion formulae to write the polar equation of the curve in Cartesian form. However, sign errors in rearranging the equation as well as incorrect expansions of $(5-2y)^2$ were not a rarity. Students who obtained the correct Cartesian equation generally stated the correct equations for the tangents parallel to the x-axis. Stating the incorrect equations, $x = \pm\frac{5}{3}$, for the tangents parallel to the y-axis was a common error.

Part **(b)** was generally not well answered. Although some excellent solutions were seen, a majority of students did not appreciate how to start to deduce the value of the given definite integral.

Question 6

In part **(a)** most students found a correct expression for $\frac{\mathrm{d}u}{\mathrm{d}x}$. A majority then presented a convincing solution to obtain the transformed differential equation by using a variety of approaches.

In part **(b)** most students obtained a correct first order differential equation in terms of y and x by using either an integrating factor or by separation of variables. At this stage the majority of students also found the value of the arbitrary constant. A minority of students stopped at this point. Those who could find the correct integrating factor usually went on to solve the differential equation correctly, although not all gave their final answer in the required form and so failed to gain the final accuracy mark.

Question 7

The majority of students scored full marks in part **(a)** for finding the correct general solution of the second order differential equation. Arithmetical and sign errors were the main reasons for students not getting accuracy marks.

Part **(b)** posed much more of a challenge as the use of given terms in a Maclaurin series to find the arbitrary constants in students' answers to part **(a)** has not been seen on previous MFP3 papers. Approximately one-third of students scored full marks and a similar proportion scored no marks. For the remaining students, many obtained correct values for the arbitrary constants but they never stated the exact expression for $\mathrm{f}(x)$. Instead they found the value for k and then used

$$\mathrm{f}\left(\frac{\pi}{6}\right) = \frac{1}{2} + k\left(\frac{\pi}{6}\right)^2.$$

Question 8

Part **(a)** proved to be the most challenging part question in the exam. Some excellent fully correct solutions were seen but these were rare. Almost three-quarters of the students failed to score any of the five marks available and more crucially many wasted valuable time as they made multiple attempts to show the result. Correct solutions were seen using a variety of approaches. Those students who wrote the equation of C_1 as $r\sec^2\theta = 4$ and used the identity $\sec^2\theta = 1 + \tan^2\theta$ to solve the equations of the curves simultaneously were the most successful. Just verifying that $r = 2$, $\theta = \frac{\pi}{4}$ satisfied the equations of both curves gained no credit in part **(a)**.

Just over half of the cohort scored at least 4 of the 8 marks in part **(b)**. The area bounded by OP, arc AP and OA was usually correctly found but a common error was to forget to then subtract the area of triangle OAP.

Question 9

Most students used the correct expansions for the two logarithmic terms in part **(a)** but some just gave two terms in their final answer. When attempted, the common error for the range of values of y was to include a non-strict inequality sign. It was disappointing to see some answers to part **(a)** which used x instead of y.

Part **(b)** was challenging. Although most students scored at least one mark for correctly applying the relevant logarithm law, recognition that the given identity could also be used to obtain $1 + x + x^2 = \frac{1 - x^3}{1 - x}$ was frequently missing. A majority of students who did apply this identity used the result from part **(a)** to get $\ln(1 + x^3) - \ln(1 - x^3) = 2x^3 + \frac{2}{3}x^9 + \frac{2}{5}x^{15}$ but then only included the term $-\frac{2}{3}x^3$ for $-[\ln(1 + x) - \ln(1 - x)]$. Those students who used the expansion of $\ln(1 + X)$ for $X = x + x^2$ and for $X = -x + x^2$ were rarely successful as they did not consider sufficient terms to score marks. Students who considered general forms of the coefficients of x^{6r-3} at an early stage had mixed success. Some excellent convincing solutions were seen from such an approach and the students that did this scored full marks.

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