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General Certificate of Education

Mathematics 6360

MFP3 Further Pure 3

Report on the Examination

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General

Presentation of work was generally good and most candidates completed their solution to a question at the first attempt. Candidates usually answered the questions in numerical order and most appeared to have sufficient time to attempt all eight questions. Questions 1, 3 and 5 were the three best answered questions on the paper; candidates found questions 6 and 8 to be the two most demanding questions on the paper.

Teachers may wish to emphasise the following points to their students in preparation for future examinations in this module.

- Writing down a formula in general form before substituting relevant values may lead to the award of method marks even if an error is made in the substitution.
- An integral with ∞ as a limit is improper because the interval of integration is infinite.
- A general solution to a first order differential equation should have one arbitrary constant and the general solution to a second order differential equation should have two arbitrary constants.

Question 1

Numerical solutions of first order differential equations continue to be a good source of marks for all candidates and this was the best answered question on the paper. Very few candidates mixed up the x and y values in applying the given formulae. Almost all candidates gave their final answers to the required degree of accuracy.

Question 2

Most candidates were able to find $\frac{\mathrm{d}y}{\mathrm{d}x}$ and $\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}$ correctly, although some less able candidates failed to apply the chain rule. Although a few candidates in part (b) attempted to use the printed expansion of $\ln(1+x)$ from the formulae booklet instead of applying the prescribed method, the majority of candidates answered the question as instructed and showed good knowledge of Maclaurin's theorem. Many candidates failed to appreciate that in part (c) they had to replace x with $-x$, and instead multiplied both their x and x^2 terms by -1. A significant minority of candidates in part (d) did not realise that they had to write the expression as the difference of their two expansions.

Question 3

This question was answered well with the majority of candidates able to use the given substitution correctly. Most candidates were able to show that they knew how to find and use an integrating factor to solve a first order differential equation. However, a significant number of candidates failed to write their general solutions with the required number of arbitrary constants.

Question 4

This question on series expansions and the limiting process was generally answered very well, but a significant minority of candidates in part (b) did not explicitly reach the stage of a constant term in both the numerator and denominator before taking the limit as $x \to 0$.

Question 5

In part (a), it was pleasing to see a higher proportion of candidates than in previous papers using the given form of the particular integral rather than introducing the extra term $q\mathrm{e}^{-2x}$. The majority of candidates used the product rule correctly to find the value of the constant p. Most candidates showed that they knew the methods required to solve the second order differential equation, although a minority of candidates made the error of applying the boundary conditions to the complementary function before adding on the particular integral.

Question 6

In part (a), a significant number of candidates failed to give the correct reason for why the integral was improper, with most giving the reason that the integrand was undefined for the upper limit rather than that the interval of integration was infinite. In part (b)(i), a large number of candidates failed to use the substitution correctly. Part (b)(ii) was generally answered well with most candidates integrating by parts correctly to score 3 of the 5 marks available, but some candidates did not gain the final two marks as examiners did not see the lower limit replaced by, for example, a and the consideration of the limiting process as $a \to 0$. Part (b)(iii) was answered incorrectly by the majority of candidates, who usually either stated the same value or the reciprocal value of their answer to part (b)(ii).

Question 7

This unstructured question was answered well by many of the candidates. However, a significant minority of candidates did not even write down the correct form of the auxiliary equation, or they solved it incorrectly to give real rather than imaginary values. When finding the particular integral, a large number of candidates considered more terms than they needed to, and they did not always go on to show that the relevant coefficients of the extra terms were zero. The majority of candidates knew that they had to find a complementary function and a particular integral and almost all scored the final mark for combining the two to give the general solution.

Question 8

Part (a) was generally answered well with most candidates forming an equation in either $\sin\theta$ or r and solving it correctly to give the coordinates of P and Q. Candidates who tried to verify the coordinates of P generally failed to even verify them in both polar equations. Part (b) was the most demanding question on the paper. The majority of candidates scored at least 4 of the 11 marks by applying the formula $A = \frac{1}{2}\int r^2 \, \mathrm{d}\theta$ to find an area of a region partly bounded by the curve C and in doing so they correctly expanded $(1-\sin\theta)^2$, wrote $\sin^2\theta$ in terms of $\cos 2\theta$ and integrated correctly. The errors occurred because many candidates did not use the correct limits. A significant number of candidates also failed to find, or even consider the need for, the area of triangle OPQ and so correct answers for the area of the shaded region R were generally only presented by the most able candidates.

Mark Ranges and Award of Grades

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