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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 very good, and candidates usually answered the questions in numerical order. Candidates appeared to have sufficient time to attempt all the questions within the time allowed.

Candidates generally performed better on this paper than the corresponding paper last year.

Once again, many candidates failed to complete the boxes on the front cover to indicate the numbers of the questions that they had answered.

Teachers may wish to emphasise the following points (some of which have been highlighted in previous reports) to their students in preparation for future examinations in this unit:

- Just listing values in a well-labelled table to solve a differential equation numerically eliminates the possible awarding of method marks if the values are incorrect. Candidates would be well advised to indicate, by showing the relevant formulae and substitutions into them, how the values in the table have been obtained.

- 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.

- The number of arbitrary constants in the general solution of a differential equation is the same as the order of the differential equation.

Question 1

The majority of candidates were able to correctly use the given improved Euler formula to find the approximate value of $y(2.1)$ to four decimal places. Otherwise, the most common error was to use $y_r + h$ instead of $y_r + k_1$ in writing k_2 as $0.1\ln(2.1+3.1)$. There was a minority of candidates who failed to gain marks because they gave the wrong answer for $y(2.1)$ and showed no method in their working, instead just giving a table of incorrect values.

Question 2

Most candidates differentiated the given expression correctly and substituted the result into the given differential equation. Subsequently, however, there were many cases of an incorrect expansion for the term $-3y$ which lead to the values for two of the four constants being incorrect. In part (b), it was pleasing to find only a small number of candidates trying to use an integrating factor with the original differential equation. The successful candidates either used the auxiliary equation $m - 3 = 0$ or used the reduced equation and then separated the variables. A common error, after finding $m = 3$, was to assume that this represented repeated roots, leading to a complementary function of the form $e^{3x}(Ax + B)$, with two arbitrary constants for this first order differential equation. The error for those using the separation of variables method was to omit the arbitrary constant.

Question 3

Part (a) was generally answered correctly, with most candidates showing sufficient detail in reaching the printed result. Although most candidates started their solution for part (b) by successfully substituting $r\cos\theta$ for x and $r\sin\theta$ for y into either the given equation or the alternative form given in part (a), many failed to go on to score full marks because they did not consider and eliminate the negative square root (or the second solution of the quadratic equation).

Question 4

Most candidates scored full marks for their solution to part (a). Again, part (b) was answered well by the majority of candidates, but it was not uncommon to find solutions which used the wrong integrating factor, x, or lacked an arbitrary constant. Those candidates who started part (c) by equating their answer for (b) to $\frac{dy}{dx}$ and integrating normally scored both marks, although some lost the accuracy mark because their general solution of this second order differential equation did not contain two arbitrary constants.

Question 5

Most candidates applied integration by parts accurately to obtain the correct answer for the integral of $x^3 \ln x$. Although many candidates gave a correct explanation in part (b) for why the integral was improper, there were others whose incorrect explanations centred on the limit e or the interval of integration being infinite. For full marks in part (c), candidates were expected to pay particular attention to the value of the limit of, for example, $a^4 \ln a$ as a tended to 0.

Question 6

In part (a), many candidates scored high marks for finding the general solution of the second order differential equation, with the most common slip being a wrong expansion of brackets, which led to -9 instead of -3 for the constant part of the particular integral. A more serious but less common error was to look for a particular integral of the form $axe^{-2x} + b$. Part (b) proved, as expected, to be more of a challenge to candidates, with many unable to deal with the boundary condition expressed as a limit. This was the first time that this had appeared on an examination paper for this unit and, in general, only the better candidates could handle it.

Question 7

The examiners expected candidates to evaluate $3!$ in the expansion for $\sin 2x$, although credit was given retrospectively if the evaluation was left until part (c). Most candidates gave the correct expansion in part (a), and it was pleasing to find a greater proportion of the candidates than last summer applying the chain rule and product rule correctly in part (b)(i). Although Maclaurin's theorem was well known, a significant number of candidates who had obtained a wrong value for the second derivative in part (b)(i) tried to convince the examiners that it led to the printed result in part (b)(ii). Such candidates would have been better advised to look for their error in part (b)(i). Although many candidates scored the three marks in part (c), there were others who did not show the division of the numerator and denominator by x before finding the limit as x tended to zero.

Question 8

Parts (a) and (b) were generally answered well, but some candidates did not identify the critical value of 5 on their sketches. In part (c), although the usual errors were seen — for example the wrong expansion $(5 + 2\cos\theta)^2 = 25 + 10\cos\theta + 4\cos^2\theta$ or a sign error in the identity for $4\cos^2\theta$ in terms of $\cos 2\theta$ — most candidates had a thorough understanding of the method required to find the area of the region bounded by the curve. Although only a minority of candidates scored full marks for the final part of this last question, it is pleasing to report that a significant number of other candidates were awarded partial credit for finding an expression for OQ, although many lost at least one mark because they used $\pi - \alpha$ instead of $\alpha - \pi$ for θ. The most common wrong method seen involved the integral $\int_{-\pi+\alpha}^{\pi} \frac{1}{2}r^2 \, d\theta$, for which no credit was awarded.

Mark Ranges and Award of Grades

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