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Mathematics MFP2

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Further Pure 2

Report on the Examination

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General

There were many good responses to this paper and most students were able to present much creditworthy material. It must, however, be reiterated, as it has been in previous reports, that when printed answers are given, students are responsible for giving adequate reasoning and explanation as to how they obtained their answers. This applied to a lesser extent to some questions in which printers answers were not given. Presentation was generally adequate.

Question 1

The sketch of $y = \cosh x$ was almost invariably answered correctly in part (a). The most common approach to part (b) was to solve the quadratic equation and then to either use the formula for $\cosh^{-1} x$ in its logarithmic form in which case the solution $-\ln 3$ was generally lost, in spite of the hint given in part (a), or to express the equation $\cosh x = 5/3$ in terms of e^x in which case both answers were usually correctly obtained. Some students chose to express the quadratic equation in terms of e^x, but this led to a quartic in e^x, which they were then unable to solve. The reasons for rejecting the solution $\cosh x = -1/2$ were generally adequate.

Question 2

It was pleasing to see many neat and fully or nearly correct answers to this question. It was clear that students had taken considerable care over their diagrams. The circle was well drawn, but the perpendicular bisector perhaps not quite so well. A few attempts at the perpendicular bisector were drawn through the origin, whilst occasionally others were drawn parallel to one of the axes. The final mark was lost by some students who shaded the minor segment between the line and the circle, rather than identify the minor arc of the circle.

Question 3

This question was well answered. In part (a), errors, when they occurred, were a lack of demonstration that $r2^{r+1} - r2^r$ was in fact equal to $r2^r$. And in part (b), errors included students writing a correct but unfinished answer in the sense that a correct answer had been obtained, but had been left in a form different that that required by the question.

Question 4

Part (a) was invariably correctly quoted. However, in part (b) responses fell into several categories. The most successful students used the fact that α, β, and γ were each roots of the given cubic equation and therefore each satisfied that equation. Others quoted the formula for $\sum\alpha^3$ and, provided this quotation was correct, usually went on to secure full marks. A third category was those students who attempted to obtain $\sum\alpha^3$ by considering $(\sum\alpha)^3$ but these rarely succeeded, finding the algebra involved too complicated to handle. Some solutions ended at this juncture due to students not realising that a cubic equation with real coefficients must have a pair of complex conjugate roots if one root is complex. Part (c), apart from the odd slip of sign, was well done. In part (d), those students who replaced z by $\frac{1}{z}$ in the original cubic equation completed this part of the question quickly, but those who tried to find the sums and products of the reciprocals of α, β and γ usually ended up with at least one incorrect result.

Question 5

There were not many convincing solutions to part (a) of this question as there was clearly much confusion between the inverse of a function and the reciprocal of a function. There was also, surprisingly, few complete solutions to part (b). The chain rule for differentiation was simply not applied and many students, after writing $\frac{-1}{\sqrt{1-\frac{1}{x^2}}}$ attempted to convert this expression to the printed answer.

Question 6

There were many approaches to the first part of Question 6, but few completely correct solutions. Some students expressed both sides of the identity in terms of exponential functions in order to show them equal and these were largely successful. Many others worked with either the RHS or the LHS of the identity, often ending up with $\frac{1}{2}\cosh^2 2x + \frac{1}{2}\cosh 2x$ but were unable to complete it convincingly. Part (b) was generally answered well, although not all recognised the identity $2\sinh x \cosh x = \sinh 2x$ which in turn led to some lengthy solutions. Part (c) was also answered well, with many completely correct solutions, and errors, when they did occur, were largely errors of sign or arithmetic slips.

Question 7

Whilst most students made an attempt at this question, not many provided a convincing solution. The mechanics of the method of induction were usually present, but a real understanding of the theory and argument behind it was clearly lacking on many scripts. In showing that the sum to $k + 1$ terms of the given series was equal to the sum to k terms plus the $(k+1)^{\text{th}}$ term students made clear sign errors with consequent attempts to make the working out fit the solution. Part (b) was less successful, especially when a student used inequalities. Whilst the use of equalities was condoned, some students having arrived at 315.2, still gave a final incorrect answer.

Question 8

Overall, this question was answered quite well. Part (a) was usually correct. In part (b)(i) a number of students gave their answer as $16\cos^4 2\theta$ instead of an equation in z although some were able to recover this mark in subsequent working. The common error in part (b)(ii)was to replace $z^8 + \frac{1}{z^8}$ by $\cos 8\theta$ rather than $2\cos 8\theta$ and if this occurred it did mean that in part (c), students would arrive at a trigonometric equation they were unable to solve, and in part (d) an integral for which they could not score full marks. One unusual feature of part (d) was that a significant number of students, when attempting the integral, used the RHS of the equation in part (c) as their integrand.

Mark Ranges and Award of Grades

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