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Mathematics MFP4

(Specification 6360)

Further Pure 4

Report on the Examination

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General

Candidates generally showed a good knowledge of the topics covered on this paper and a good grasp of the techniques necessary for answering the questions. Question 2 covered unfamiliar ground for many candidates, who failed to see the opportunity to use their knowledge of core trigonometry. Apart from that question, the first half of the paper was answered well, though some weaknesses appeared in question 4(b). After that, most candidates performed well on the earlier parts of each question but found great difficulty in completing the later parts. In some cases, candidates failed to use the most efficient methods for solving the precise questions asked. Even though they may eventually have gained full marks for finding a valid solution, they may well have found themselves having to rush their work on the final question.

Question 1

Most candidates scored highly on this question. In part (b), almost all candidates used the product of the two determinants found in part (a), but a substantial number showed a lack of maturity by expanding the product into a cubic expression and then attempting to factorise it, not always correctly.

Question 2

This question was not answered at all well by many candidates. Some failed to write down the matrices correctly and some failed to carry out the required matrix multiplication with the matrices in the right order. Then, relatively few candidates spotted the need to use the addition formulae, though those who did were mostly successful in giving the correct geometrical interpretation of the resulting matrix.

Question 3

Part (a) of this question was very well answered, though some candidates used a second vector product to establish the parallelism rather than simply taking out a factor 15 from their first vector product. In part (b), many candidates used the vector product already found and formed a scalar triple product which led quickly to the required value of t, but others seemed to be more familiar with the use of a determinant for this type of question, and this approach was equally successful though possibly taking up slightly more time.

Question 4

In part (a), most candidates realised that the determinant of the coefficients on the left-hand sides of the equations must be equated to zero, and thus obtained the required values efficiently. Solutions to part (b) were often marred by a failure to indicate which equations were being used at each step. Some candidates used the slightly dubious technique of replacing one of the variables by zero, while others produced a whole page of work and still failed to reach a value for b.

Question 5

Candidates generally showed a very good grasp of eigenvalues and eigenvectors in part (a)(i), though some were confused when forming the eigenvectors. The responses to part (a)(ii) were almost equally successful, but some faltered in tackling the inverse of a 2 by 2 matrix, either failing to include the reciprocal of the determinant or incorrectly manipulating the elements of the matrix to form the adjoint matrix.

In part (b)(i), many candidates earned partial credit, either by giving the eigenvalues but failing to show the connection with the diagonalised form, or by doing some good work with the diagonalised form and then failing to state clearly what the eigenvalues were. Part (b)(ii) was answered correctly in many cases but a common error was to write down the meaningless answers '$\mathbf{v}_1^{3}$' and '$\mathbf{v}_2^{3}$'. Some candidates used the matrix from part (a) in their answers to part (b), but this was accepted as they could still show whether they understood what was needed in part (b).

Question 6

In part (a)(i), most candidates knew how to convert the given equations into a suitable vector equation, but some lost a mark by writing 'L = ...' rather than '$\mathbf{r}$ = ...'. Part (a)(ii) was likewise answered well but often not perfectly, the usual fault here being a failure to show clearly why the line must pass through the origin.

Part (b) was found more difficult than part (a), even though it was in a two-dimensional context. Much confusion arose from the use of the same letters x and y to denote the coordinates of a general point before and after the transformation. Many candidates were able to carry out an appropriate matrix multiplication but were unsuccessful in their attempts to form a linear equation for the image line. In part (b)(ii), most candidates earned the first mark by comparing the gradients of the two lines, even if the equation of the second line was incorrect, but very few indeed realised that the 'distance' between the two parallel lines referred to the perpendicular distance between them.

Question 7

Most candidates were successful in part (a), though some used more efficient methods than others. Many made a good start in part (b) but were unable to express $2n^2 + 2n + 1$ as the sum of two squares, thus losing the last three marks in the question. Some candidates seemed to be unaware that the 'squares' asked for here had to be the squares of polynomials, or in part (c) the squares of integers.

Question 8

The first two parts of this question gave almost all candidates the chance to use techniques with which they were clearly very familiar. The last mark in part (a) was often lost by a failure to subtract the inverse cosine from 90°, or equivalently to use the inverse sine.

In part (c)(i), many candidates saw that the required vector could be found by using a vector product, but others formed linear equations which they then struggled to solve. Part (c)(ii) was beyond the grasp of most candidates, though they could pick up one mark by forming an equation of a line passing through P. Very few candidates saw the need to form another vector product from the direction vector of the line L and the vector found in part (c)(i).

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