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Mathematics MFP4

(Specification 6360)

Further Pure 4

Report on the Examination

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General

All questions produced the full range of responses from students. In the best scripts, students were able to fully explain the methods step by step and hence secure high marks throughout the paper. Too often, though, a significant number of students failed to include enough working or explanation to secure marks.

Question 1

This was meant to be a straightforward starter question, but a significant number of students found it difficult. The problem lay in being able to use a complete method to find the solution to $p+6=2\sqrt{p^2+9}$ Furthermore, a full solution requires both $p=0$ and $p=4$ to be found before rejecting $p=0$.

Question 2

A number of students seemed not to know the result $\det A^{-1}=\dfrac{1}{\det A}$ even though this is listed in the specification as one of the results to be learnt. However, in part **(b)**, almost all students were able to show their understanding of the formula $\det AB=\det A\times\det B$. A number of students also did not appreciate the link between the determinant and the area scale factor.

Question 3

This proved to be a very demanding question. Some students were not prepared sufficiently enough to deal with vector algebra. It was concerning that so many students treated the vector expressions and vector product operator as standard algebraic expansions. A small number of students used components and expanded the full determinant to very little avail.

Question 4

This question elicited a good response from students. There was evidence of efficient use of graphic calculators in parts **(a)** and **(c)**. In part **(b)**, students had to produce a watertight proof to get both marks. It was disconcerting to find students writing "divide by A" or "cancel A", displaying a lack of understanding matrix algebra. In the final part, many chose not to use the inverse matrix to find the solutions and instead chose to use elimination. Varying degrees of success were seen – the most successful chose to eliminate y from the second and third equations.

Question 5

Expansions of determinants are well understood, although there were often sign errors with the terms 1, -1, $k+1$ and $k-1$. Several students failed to comment on their result to show they had understood what was meant by 'independent of k'. Many students failed to see the link between the determinant in part **(a)** and the rest of the question, with some starting again at each part. Furthermore, it is clear that students do not understand the concept of consistency of a system of equations. Many responses were seen that stated 'consistent' and gave a prism as the configuration or 'inconsistent' and sheaf.

Question 6

The two transformations were often correctly described, although on occasions the plane $z = 0$ became 'an axis' or 'line'. A small minority of students reversed the order of multiplication of the two matrices. In part **(c)** an eigenvector approach rarely scored many marks due to full determinant expansion errors, incorrectly setting the determinant of $\mathbf{M}_3 = 0$ or not realising that 1 was an eigenvalue. The approach of $\mathbf{M}_3\mathbf{v} = \mathbf{v}$ was far more successful apart from minor manipulation errors.

Question 7

Many students were able to show their understanding of eigenvalues and eigenvectors, scoring full marks in the process. They all approached the question by using the definition of eigenvalues and eigenvectors: $\mathbf{Mv} = \lambda\mathbf{v}$. The unsuccessful students tried in vain to use the characteristic equations getting lost in pages of algebra. The $\mathbf{UDU}^{-1}$ form was well understood by almost all students.

Question 8

Generally there was good response, with all students able to score marks in the earlier part of the question. The vector product evaluation through a determinant is well known; nevertheless, a handful of students made sign errors. Students also know how to apply the determinant to finding the area of a parallelogram. Many students did not appreciate the link between the parts of this question. Thus the determinant evaluated in part **(a)** was re-evaluated in part **(b)** albeit with the diagonals of the parallelogram instead. With regard to vector notation, students should realise that they must make key vectors clear, eg the zero vector written as $\underline{\mathbf{0}}$ or $\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$. Many students did not find the coordinates of $\mathbf{M}$ by using the mid-point result from Core 1 but instead chose to find the intersection point of two lines. Part **(c)(i)** proved most challenging. Those who used the scalar product or Cartesian form of the plane achieved the greatest success in finding the point of intersection of the line and plane. Part **(c)(ii)** was more successful with students choosing to evaluate triple scalar product or use area of base multiplied by the perpendicular height. When the latter was attempted the biggest fault lay in not using a correct perpendicular height.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website: http://www.aqa.org.uk/over/stat.html

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator www.aqa.org.uk/umsconversion