AQA

A-LEVEL
MATHEMATICS

MFP4 Further Pure 4
Report on the Examination

6360
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General

Overall, the paper had a variety of questions that allowed students to show their ability across a wide range of topics. Stronger students encountered some more challenging sections that allowed them to show their ability, whilst weaker students were able to demonstrate key skills in such topics as the use of the vector product in geometry, rules of matrix determinants, factorising determinants, inverting 3×3 matrices and invariance. Students seemed to be very well prepared for the paper and there was a noticeable reduction in numerical errors. Generally speaking, students used the more standard methods of solution and, as a result, were able to show their ability.

Question 1

Part (a) was a very straightforward start to the paper with a noticeable reduction in the number of errors in the middle term of the vector product.

In part (b), most students had no problem using their result from part (a) to find the area of the triangle, with only a few forgetting the factor "$\frac{1}{2}$" or not giving an exact value of the area.

Question 2

Almost all students had no problem untangling the equations to obtain the determinant of matrix $\mathbf{B}$. The most common loss of marks occurred when students reached det $\mathbf{B}^{-1}$ and simply stopped or were confused about how to relate det $\mathbf{B}$ and det $\mathbf{B}^{-1}$ at the very end, with many inserting a negative sign rather than finding the reciprocal.

Question 3

Part (a) was the first question part where the stronger students were able to start showing their ability. Use of the standard row and column factorisation techniques was the best way to earn marks. Those who attempted the all-or-nothing approach of fully expanding the determinant in part (a)(ii) sometimes came unstuck. Those who used the expected method of factorisation were the most successful, though a surprising number of students lost the a from the central $-3a$ term at the beginning of part (a)(ii). Those who neglected to extract the factor 7 at the very end were penalised by a single mark.

In part (b), students seemed to understand the term "linearly dependent" and generally only dropped marks here due to errors when following through from part (a).

Question 4

Parts (a) and (b) were standard questions requiring students to show that matrix $\mathbf{A}$ was non-singular for a particular value of k and then finding the inverse of $\mathbf{A}$. Students have been well prepared for this technique and generally performed well.

In part (c), students were expected to realise that $k = -1$ would be substituted into their inverse matrix. Unfortunately, some students tried to solve a general equation in k and never reached the stage of substituting $k = -1$. This gained them no credit as they had not answered the question. Virtually every student understood that they should not attempt an algebraic simultaneous-equation approach or to simply use their calculator functions to write down the answer. In this part, most marks were lost due to errors made in part (b) following through from their incorrect inverse matrix.

Question 5

This question produced much unnecessary algebra and as such there was a wide spread of marks.

In part (a), a large number of students found a general expansion in λ and p rather than simply substituting the value $\lambda = 2$ as directed in the question. This led to a large amount of algebraic manipulation that, if incorrect, received no credit. Those students who actually substituted $\lambda = 2$ at the beginning generally scored full marks.

In part (b), those who had been successful in part (a) generally went on to score well, but even those who had made errors in part (a) were usually able to earn some marks for their method.

A number of students seemed to have forgotten to do part (c) of this question. This could have been attempted totally independently of the other parts of the question using the top two rows of the matrix $\mathbf{M}$ and the given information that $\lambda = 2$ was an eigenvalue.

Question 6

This question really allowed the stronger students to show their ability.

In part (a), a number of students defined an invariant line instead of “a line of invariant points”; others were so vague that they were unable to be given any credit for their answer.

A large number of students either confused parts (b) and (c) or tried to find an invariant line in part (b) and felt there was nothing left to say in part (c). Even those who knew what they were doing often lost the last marks of part (c) since, after finding $m = -1$, they simply assumed that $y = -x + c$ rather than substituting $m = -1$ into the non-x-coefficient equation and showing that c can have any value. Only the strongest students managed to earn full marks.

Question 7

Most students were able to demonstrate their understanding of transformations in this question. With the matrix $\mathbf{M}$ having a simple structure and T_1 being an enlargement, most students were able to find the determinant of $\mathbf{M}$ in part (a) and recognise that T_2 was a rotation about the y-axis. However, a number became confused with scale factors of enlargement and volume scale factors in part (b)(i), and most forgot that in part (b)(ii) for a rotation about the y–axis, the top right entry should have been $\sin\theta$ and not $-\sin\theta$. This led to most students dropping the last marks in part (b)(ii).

Question 8

This question, like last year, was a good source of marks for students.

Part (a) was generally well answered, with only a few students using $\begin{pmatrix} 2 \\ 4 \\ -3 \end{pmatrix}$ as a point on the plane or thinking that $\mathbf{n} = \begin{pmatrix} 2 \\ 4 \\ -3 \end{pmatrix} \times \begin{pmatrix} 5 \\ 2 \\ -1 \end{pmatrix}$.

Part (b) saw the most fudging of solutions of any question part in the paper. The directional vector $\mathbf{n}$ was given in the question and as such had to be legitimately found. The number of instances of incorrect mathematical statements such as $\begin{pmatrix} -12 \\ 6 \\ -12 \end{pmatrix} = \begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix}$ was noticeably down on last year. However, instances of fiddling the solution, such as $\begin{pmatrix} -12 \\ -6 \\ -12 \end{pmatrix} = -6\begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix}$, were noticeably up on last year. More credit was given to those students who accepted that they had made a mistake and used their value of $\mathbf{n}$, than to those who tried to fudge the right value of $\mathbf{n}$ as above.

In part (c), most students earned full marks, unless the wrong vector $\mathbf{n}$ was used in part (a).

Part (d) proved to be quite difficult for most students. In part (d)(i), a number of students tried to overcomplicate things by finding algebraic expressions in terms of x, y and z that went on for a couple of pages or more. This approach generally lost its way before the first mark could be earned. The standard method of equating the determinant of the 3x3 matrix of the normal vectors to zero, as there was no unique point, quickly scored marks and was generally done very successfully.

In part (d)(ii), there was a lot of guessing of geometrical configurations. “Shear” was a popular guess, despite it being clearly stated that there was no point in common. Without proper supporting evidence, there were no marks available for a guess.

Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

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

UMS conversion calculator