Examiners' Report
Principal Examiner Feedback

November 2021

Pearson Edexcel GCE
In Further Mathematics
Paper 01 Core Pure Mathematics 1

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Summary

The overall performance on the paper showed that many of those sitting were not adequately prepared for the examiner. There were several responses with no or very little work, so the statistics below need to be read with this in mind.

Question 1

(a) Most candidates made a good attempt at this part. With over half accessing the first 3 marks. Some were able to just write down a value for k or found the square root of the determinant to give a value which was usually correct. Of the latter, a few did not take the square root, and these gained no marks here. Those who obtained a value for k were then usually able to write down a valid equation and proceed to find a value for θ. The most common error was to give their angle in radians, not degrees, losing the A mark. Those who used Way 2 had more work to do to gain the marks. Most used the correct matrices representing the transformations but were often unable to form and solve two simultaneous equations to find values for k and for θ.

(b) Just over half of the candidates applied a correct method to find the area of S'. Many of these used the determinant to do so and obtained full marks. The mark scheme allowed full marks in this part following on from their value for k, providing the area of the original shape S was correct. Finding the area of S however did seem to cause many problems, so many scored M1A0, with only a third scoring full marks for this part.

Question 2

(a) A little over half of candidates accessed the first mark. The most common approach was to make an acceptable attempt at the series for $\cos^2\left(\frac{x}{3}\right)$ by replacing x with $\frac{x}{3}$ in the Maclaurin expansion for $\cos x$ and attempting to square. Some only used the first two terms for the $\cos x$ expansion, though many did go on to attempt to square. A few used the double angle identity for $\cos 2x$, and these mostly scored both marks. Only about a quarter of candidates managed to simplify every term completely to score both marks. Some started from scratch and use differentiation to generate the series but these gained no marks as the cosine series was required.

(b) This was less well attempted with less than half of candidates scoring the method. Most realised they had to multiply through by $\frac{1}{x}$ and if they then attempted the integral correctly usually gained the first two marks here. However, there were a few candidates who did not achieve a log term, so did not score the M. For those whose form was correct but who had incorrect coefficients only the final A mark for the value of their integral was generally lost. Many used an incorrect log base on their calculator so lost this mark even if their integration was completely correct.

(c) Quite a few made no attempt at this part, suggesting they are not confident in using their calculators. Others were perhaps in an incorrect calculator mode and did not get this mark as the answer was incorrect with less than half scoring the mark.

(d) Most candidates realised that some form of quantitative statement was required, but this mark was only available if (b) was correct to 2sf and (c) was the correct value. Only a fifth of the candidates score this mark.

Question 3

This question caused many problems and less than 10% of candidates gained full marks. The most popular method was the alternative on the mark scheme, which was harder work and more prone to error. Over a half did achieve the first three marks but then often went wrong or gave up with less than a third scoring the final two Ms. Some got very confused and substituted their expressions in the wrong places. Those who used the main method on the scheme usually only gained the first three marks. Most of them did not realise they had to divide through by an appropriate factor before equating coefficients, losing the last three marks. A common error was to let $x = 4w - 1$, and these usually scored a total of 2 marks.

Question 4

The overall performance on this question was better than the preceding questions, suggesting it is a more comfortable topic to students and could have appeared earlier in the paper, with the first 7 marks being score by over 50% of candidates, and only the final mark scored by fewer than 44%.

(i) (i) An easy start to this question with the majority gaining at least one mark (over 70% scored the mark in (b)). A common error was to confuse rows with columns in their first statement meaning slightly fewer scored this mark (55%).

(ii) There were several methods for finding the required values, mostly all successful with two thirds scoring the first two marks, and over 50% again scoring the third.

Most obtained the correct inverse matrix, and there was a follow through on their λ. Some used their calculators with values for a and b, which was also fine, while there were also attempts at finding the inverse matrix from scratch, which seemed to be an awful lot of work for one mark!

(iii) About two thirds of candidate successfully used a correct method to find the determinant and set it to 0. Many then did not realise that this reduced to $\cos 3\theta = 0$, and ended up using trigonometric identities for $\sin 2\theta$ and $\cos 2\theta$ to solve a more complicated equation. Very few gave all three possible values leading to the drop off noted above, commonly losing a value by dividing through by $\cos\theta$ and not considering it could equal 0. Others just gave one value $\pi/6$. These two marks were for solving a very straightforward trig equation which they should have been able to do in Maths A level

Question 5

(i) Fully correct integration was required for the first mark and was often given. Some had a coefficient of $-\frac{1}{2}$, suggesting they may have differentiated but a generous scheme allowed the M mark for any changed function in the required form, provided correct limits were used and a consideration of the infinite limit. Notation used tended to be good, which was pleasing, and many scored well, with over 60% scoring the first 2, and over 45% gaining the full three marks on this part.

(ii) (a) About half of candidates quoted or implied the correct formula for finding the mean value for the B mark. Integration was usually successful although there was an issue with the coefficients in many cases and some did not substitute limits explicitly. Just under 45% score the M mark, usually it was a lack of evidence that lost the mark, as calculus was required to be seen. Some forgot to integrate the 8 to give 8t, also losing two marks. Many did not get the last A mark as they did not show a full attempt at substitution, with just under a quarter gaining the A1 mark.

(b) Many candidates made no attempt at this part and less than 15% scored this mark.

Question 6

This question worked well in providing a structure with ramping with success in the first part being over 60%, tailing off gradually through the question with over 50% accessing the first half of (b), but only 20% successfully completing it, just over 20% accessing the M in (c), with 10% successful, and about 15%

(a) Most substituted to find a correct value for k. Very few attempted it but found an incorrect value.

(b) This part was generally well approached by the majority with the first 4 marks accessed by most. The correct form for their complementary function was given by nearly all who attempted the solution, and they were able to substitute the correct values for t and x to find a constant. A few stopped at this point but most who made progress then used the product rule to find an expression for the velocity, and the only common error was in evaluating their second constant.

(c) Many candidates used $t = 15$, but did not add 30 to their answer and so lost both marks. About 1 in 5 managed to score the method, but only 10% had a correct final answer.

(d) Comments involving air resistance were very common but not accepted as this did not relate to the model, which was silent on whether this was already considered or not. Only a few made a sensible comment and many made no attempt at all.

Question 7

There was a step up in difficulty from this question in the paper, perhaps a tail off towards the end of the exam, but the performance was not as high on the next questions. For this question 51% for the M mark in (b) was the best performing trait, and the only one over 50% scored.

(a) Only a third of candidates scored both marks in this part, with just over 40% accessing the method mark. Fortunately, a minimal conclusion was adequate for the A mark which limited the tail off. Some just found the scalar product with one of the direction vectors, others showed no calculations. A small number used the vector product, though marks were not available if no calculation was shown.

(b) This was very better attempted, though surprisingly not as well done as might have been expected. A little over half scored the M for knowing the correct procedure, with just over 40% scoring both marks.

(c) A very few candidates gained full marks for this part of the question, though a generous second method mark gave access to some candidates. Most did not know how to begin, with many not attempting it at all. The most common successful method was as in the main scheme. Those who did apply the perpendicular distance formula were usually able to find a value for *t*, but the majority only gave one value, with 25% success on the first mark dropping to less than 10% for the second. Those who got that far were usually able to gain the next, generous, M mark for finding a set of coordinates for *A*. Some found the point of intersection of the line and the plane but these attempts usually only scored the second M mark, with 36% accessing this mark, since they assumed this was the value of *t* that was required. Those who did achieve two correct values for *t* almost always went on to find both sets of coordinates.

Question 8

This proved a very challenging question, a step beyond most of the candidates taking the paper, with 30% success rate on the M in (b) being the best accessed mark of the question. Very few scored the final mark in (c). The context of the question was a barrier to many, as it seemed that most candidates did not understand the situation and so made very little progress as they could not set up the initial equation. Proceeding with any value for *r* could have gained marks, and candidates should attempt to proceed with some value in such cases as method and follow through marks will be available.

(a) Unfortunately the majority of candidates were unable to gain any marks at all in this part, with less than 15% scoring the M, and only 12% the A mark.

(b) Those who did attempt this part mainly used the Integrating Factor method even though the variables were separable. A correct method for the Integrating Factor was usually applied and the first 4 marks were available. About 30% were successful in getting under way, with a quarter progressing to the second mark, and about 20% scoring the first 4 marks. Very few put $r = 15$ and attempted to find a value for *t*, with less than 10% accessing the final M mark.

(c) Most were unable to comment as they had no value from part (b). Those who could have made a comment usually did not get the mark as their comment was too vague, so very few candidates scored this mark.

Question 9

A challenging closing question, but the first part did give a bit more access than question 8.

(a) About 40% of candidates used the correct hyperbolic substitution and these usually went on to use correct identities to gain the first two marks, though only 28% gained the first 4 marks. The next M mark required them to use identities and show clearly how to obtain the given form, and few managed to do this, with only 15% successfully completing the part.

(b) This part was not well done, perhaps as it was at the very end of the paper and time was running out. Only about 10% made any significant progress at all in this part, with very few fully correct responses, though about half who did make such progress reached at least the final M mark.
Very few used integration by parts to achieve the required form, but many instead tried another substitution which went nowhere. A few attempt parts in the wrong direction and again soon gave up. Many didn't realise that there was a link to part (a) even though they had been told this in the question. Those who did make some progress usually realised that the lower limit was 1 but many didn't show their evaluation clearly, so lost at least the last A mark.

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