Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

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Pearson Edexcel International Advanced Level In Further Pure 1 (WFM01)

Paper : WFM01/01

General

The majority of candidates produced accurate work across most questions with question 9, on induction, and question 6, on the hyperbola, being the two most challenging questions.

However, there are still many candidates who give far to concise work, in both size and detail. On screen very small writing just gets big and blurry when enlarged, not clearer, which does not aid markers, and marks cannot be awarded for illegible work, while likewise a lack of working can be costly when methods must be seen to score marks, especially if answer are incorrect. Using the space on the paper is advised.

Report on individual questions

Question 1

This was generally well done with over 70% of candidates scoring full marks.

(a)There were a few who made slips in finding the determinant, and it was occasionally used incorrectly, multiplying rather than dividing, but the more common errors in this part were an incorrect adjoint matrix. Where the adjoint was incorrect it was usually due to forgetting to transpose the leading diagonal entries.

(b)There were a few more slips for this part than in part (a) with only 70% scoring the final mark, but over 85% did achieve both method marks. Slips either in the calculation of the inverse matrix, copying entries between parts or incorrect solving of the equation in *a* were the difficulties. Though an incorrect use of the determinant could still lead to a correct result for (b) (since the determinant was 1), this was not permitted the mark as it followed error.

Several candidates failed to write out a full matrix equation, usually using **I** for the identity and implying a correct identity by working, while a small number of candidates were not aware of what constituted the identity matrix at all. A quirky uncommon method was to multiply $\mathbf{A}$ and $\mathbf{A}^{-1}$ and equate the result to $\mathbf{A} + \mathbf{A}^{-1}$ which was not the simplest possible approach, or alternatively multiply through by $\mathbf{A}$ and solving $\mathbf{A}^2 + \mathbf{I} = \mathbf{A}$. Most however used the more direct approach.

Only a few candidates tested all four elements worked, although some did. Others solved for one equation and confirmed their solution with another. But the majority just solved the equation for one (typically the leading) element.

Question 2

This was a question that was very well approached by the majority, although the modal mark was 8 out of 9, scored by 45% of candidates. In most cases it was the A mark in part (a) that was lost. With a mean score of 7.5/9 it was the second-best performing question, behind question 3.

(a)Almost all candidates found correct values of f(2.8) and f(2.9), scoring the M mark, but only about 33% went on to secure the A mark. The main cause of loss of the A mark was failing to refer to continuity in the conclusion, but other omissions were lack of mention of a root or the existence of a sign change.

(b)This part was very well answered with over 84% of candidates securing all three marks, and over 97% scoring the first 3. The differentiation was correct in 95% of cases, with occasional slips the main issue. Cases of integrating instead of differentiating were rare, with 99% of candidates scoring the method. The use of Newton-Raphson method was also very good, though a large proportion of candidates did not include intermediate working, which is a risky strategy, here and in part (c). Slips in simplifying the derivative were the most common reason for loss of the final mark, with only very few losing it due to not giving the answer to the accuracy specified.

(c)This part was less well done, though still performed well overall with nearly 75% fully correct. Most candidates did attempt linear interpolation, although there were occasional attempts at interval bisection, and sometimes it was omitted completely. The most common error was a sign error in an otherwise correct interpolation statement, using f(2.9) rather than |f(2.9)|. There were also quite a lot of variants of method, but first method in MS most common.

Question 3

The best performing question on the paper, with a mean mark of 8/9 and over 60% of candidates scoring full marks. This is a topic in which candidates are well drilled, and it was pleasing to see very few making sign errors in the values for the sum and product. There were also very few cases where candidate had solved the equation, against the instruction of the question.

(a)This part was almost always answered correctly, with only very occasional errors, such as forgetting to divide through by 2. Very few made a sign error, and only a very minor number of candidates solved the equation to try and find these.

(b)Again very well answer with over 90% of candidates scoring full marks on this part. The correct formula was used for sum of squares of the roots by the vast majority, though there were a few more errors in the formula for the sum of cubes of the roots.

(c)This was generally attempted well, though it was not as successfully completed as the previous parts. The errors made varied between incorrect formation of the required expression and substitution of incorrect values into (correct) expressions. It was common to get this wrong in only one of the two expressions, though neither expression was particularly problematic – it was surprising that many could not form the correct product of roots having formed the correct sum. Most candidates applied the method to find the new equation, scoring the dM1, paying attention to the signs needed for terms, although there was confusion in some cases depending on how they had stated the sum of the roots. A few omitted the "=0", but this was uncommon.

Question 4

Another well answered question, with over 50% of solutions being fully correct and mean mark around 6/7. The sketch of the real root proved to be problematic for some, and this was the mark lost most often.

(a)Almost all achieved the $-1+3i$, even in otherwise low scoring scripts, with those who did not attempt the question being the main reason for failing to score this first mark.

(b)Most candidates were able to make a start, though some were let down by poor algebra subsequently, both in finding the quadratic and then dividing to find the linear factor. A few candidates stopped once they had reached the quadratic factor, but most proceeded, usually via long division, to attempt the linear term. Where long division was used there were quite a few cases of $b = 50$ rather than $b = -50$ being given due to misreading/misinterpreting the result. Attempts at the alternative method were not uncommon and usually successful depending on the functions of the calculator students were using. Those with calculators able to simplify complex expression generally scored full marks, but those who manipulated by hand were prone to error or gave up.

(c)Some candidates did not attempt the Argand diagram at all, but just provided the 3 roots. However, most did attempt it, plotting at least the two complex roots. There was a wide variety in the standard of sketches (as usual). Many were sloppy or small as well as imprecise – others tried to plot them. Most managed to make the conjugate roots look like reflections although some marks were lost. Many omitted the real root, however, whilst others placed the real root closer to the origin than corresponded to the complex roots.

Question 5

This was generally well done but as usual critically depended on factorising skills. Part (b) proved troublesome for some, and as such this question saw the difficulty level rise from this point in the paper. Nevertheless, the modal score was 8/8, achieved by about 45% of candidates.

(a)The first 2 marks were achieved by the majority, with only a few failing to make a start at all or attempt a proof by induction instead of using the standard summation formulae. About 90% reached a fully correct expression, with the most common error being in the final term, where some used "n" for the sum to n terms (in some cases through an incorrect initial expansion, in other cases perhaps an expectation that it should be n due to previous practiced questions). As part (a) was a proof some intermediate working was need before the final given answer but was not always provided. In this type of problem candidates should look for the obvious common factors, and make sure they reach suitable intermediate terms before stating a given answer.

There were a few who fully expanded, failing to spot the obvious common factors, and tended to lose their way and try to claim the result without reducing to a quadratic factor.

(b)Less than 80% scored marks in this question, a significant drop from previous parts of the questions to this point. Most did show an understanding of the need to try to evaluate $f(2n+1)$

– f(n) although some made fundamental slips (such as using f($2n$) instead) so did not achieve the mark. Some others used f(n +1) instead of f(n), while many simply did not attempt the part at all. A few tried to get f($2n$+1) from by repeating work, rather than using the result in (c)Again, candidates should look out for common factors. If the $n(n+1)$ factor was not extracted early then it was much less likely to lead to success. Some people worked very hard to achieve the dM1 by expanding fully before attempting various long divisions to find factors and the success rate for the A was 50% (from 70% for the dM) mainly due to numerical slips.

Question 6

This question proved more challenging, with nearly 20% of candidates failing to score, with about 25% scoring the modal mark of 7/8.

(a)Many candidates were unable to find the correct coordinates at the intersection, sometimes leaving in terms of t or as expressions in x, and this generally meant they did not access the question at all. Those who managed at least the x coordinate in terms of k usually proceeded with a correct method to find the gradient and many went onto form the equation of the line, though some did not get a linear equation as they used an algebraic version of dy/dx. Simplifying the $\sqrt{a^2}$ in the expressions was not always done, though such simplifications are expected to be made in work.

(b)Success in this part depended on whether progress had been made in part (a), and those who did achieve an answer for (a) (whether correct or not) usually proceeded to attempt both the necessary coordinates. The x and y coordinates were sometimes exchanged, but this was not common. The same lack of simplification as in part (a) was often repeated in (b), but otherwise if a correct answer to (a) was reached then correct answers in (b) usually followed.

(c)Again, success depended on progress earlier in the question, but the majority of those who had a pair of coordinates from part (b) accessed the method mark in (c). Most of these found the area correctly, but many did not state that the answer was independent of k with only about 25% scoring the final mark, after 67% scored the M.

Question 7

This proved more approachable than question 6 with 30% scoring the modal mark of 8/9. However, full marks were rare with the mean mark at 6.5/9. The final mark was the most challenging, with other marks often lost for not knowing the correct matrices to use in (i).

(i)About 50% of candidates scored full marks for this part with errors spread across the first three marks. Though the first B mark for the correct matrix in (a) was most successful of these, some stated the elements only in trigonometric form as cos …, etc., while others made sign errors. The matrix in (b) was more problematic, with the most common errors of enlargement rather than a vertical stretch or a stretch along the wrong axis. For (c) there were many candidates who multiplied in the wrong order.

(ii)This part was done better than part (i) except for the final mark. Over 90% candidates had a correct method for the determinant, but there were a few slips in simplification with 85% achieving the correct simplified expression Some thought they needed to have 1/det rather than det.

Most were able to proceed to find at least one positive value of k, with about 85% scoring the method, and 75% with one correct value. There were a few misreads but most understood the strategy. However, fewer than 25% were successful in finding both 3 and 15. A few candidates turned their correct answer in (a) to its negative, and then used that version in (b), getting 15, but for most the value of 3 was the one that was found. Those who scored nothing usually did so through putting the quadratic equal to zero before solving. Only very few discounted the negative roots (although this slip was not penalised).

Question 8

Parts (a) to (c) were generally well done, with the main difficulty in this question coming in the final three marks. Indeed, the modal mark was 10/10, scored by a third of candidates with 75% scoring 7 or more marks.

(a)There were a few slips in differentiating, but most successfully navigated the first two marks for a correct method leading to an equation for the tangent. A few stated the result without showing intermediate working, however, and so forfeited the A mark. It is important to show justification for given results.

(b)+ (c) Success rate for both these parts was around 90%, with non-attempts accounting for a portion of the lost marks. Algebraic slips were made in some cases to lose one or both marks.

(c)The 2 equations were mostly found correctly, but not always used successfully, though over 75% scored the first two marks. As noted, the final three marks provided a challenge with a variety of approaches taken by candidates. The two methods shown in the scheme were both common, with variations in the expressions or equations. Another variation was to multiply the 2 equations $y = 2x/p$ and $y = p(5 - x)$ together but were not always successful in reaching a solution. When using the alternative method, many were able to find the expressions for x and y, but completing the proof was troublesome for many of these as there needed to be a convincing argument. Once again the need to exercise care in showing the justification of a given answer was apparent.

Question 9

Overall these were done better than in previous exam sessions with part (ii) the more successfully completed. There was a wide spread of marks across the question with the mode of 7 being scored by 17%. The mean scored was 5.7/10, meaning this was proportionally the worst answered question on the paper so well placed as the last question. Induction continues to be a difficult topic for candidates to do well in. A precise conclusion was required in both parts and the main loss of the final mark tended to be a lack of precision and specifically the conditionality (if… then…) being omitted.

(i)The two step induction causes difficulties with many candidates either only showing the result is true for $n = 1$ and others attempting to prove it for $n = 3$. Even in successful attempts it was more common to check the cases $n = 1$, $n = 2$ and $n = 3$, rather than just the two cases required.

The next three marks, substitution and manipulation, were done well in most instances allowing that any consecutive indices could be used, with over 60% scoring these marks. However, some mixed up the values of n, and there were some algebra slips which still managed to reach the "correct" result, showing the candidates knew what to aim for.

The conclusions were often lacking in the required aspects, with statements such as "True for $n = k$, $n = k + 1$, $n = k + 2$" being used. There needs to be evidence of implication in the conclusion. If the final mark was not lost through lack of conditionality the main cause was omitting $n=k+1$ in the statement if…then. It all suggested a general lack of familiarity with this style of induction or that this question exposed those who were approaching induction mechanistically without being fully secure in the technique. Only 20% scored full marks in this part.

(ii)Securing the first mark when only one cases needs checking was a more sure foundation, with nearly 90% scoring the B mark for this part, compared to less than 60% for part (i).

As shown by the scheme, there were many variations on the approach to the next few marks with all the methods and other variations seen. Though 75% were able to start the process, less than 50% were successful in scoring the second M, with just of 30% scoring full marks for the part.
Using $f(k + 1) - f(k)$ was probably the most common approach, but working with just $f(k + 1)$ was nearly as frequent, more so than previous series. Those who spotted multiples of $f(k)$ soon reached correct expressions, but $f(k + 1)$ was often not made the subject and it was rare for there to be a convincing argument for divisibility if that was not done, losing the second M.

There were also many variants of the ALT 3 method, and it was sometimes difficult to determine the basis for the choice of α. In general, the algebraic manipulation was careful and accurate, leading to a correct result and a conclusion stated in suitable terms. Variations with $\alpha = 0, 5, 16, 27$ and even 72 were all seen.

If all other marks had been achieved, then the final mark was often lost due to precision of the conclusion as was the case with part (i).