Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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In Further Pure Mathematics (4PM1) Paper 01

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Question 1

Many candidates were able to engage in part or full with this question and were gaining more marks than has been the case recently with similar questions. Virtually all were able to write down a starting equation using the area of the triangle.

The slightly more popular method involved multiplying out the brackets to find an expression in a and b. Errors in multiplying surds proved costly as candidates sometimes found only one integer term, meaning that they did not have simultaneous equations and scored no further marks as this simplified the demand of the question. A good proportion of candidates were often able to identify two equations, solve them simultaneously and find values for a and b.

The alternative but slightly less seen methods was to divide the area by the known side, and this proved to be a more successful approach for many. However, as this question clearly asked for work to be done without a calculator, students who did not show sufficient working to explain how they rationalised the denominator of the resulting fraction, were not awarded the last two marks.

Question 2

This question was answered well in parts (a) and (b). Most candidates were able to correctly complete the square, with a low proportion of errors in finding the value of ‘c’. They usually then correctly interpreted their values for part (b), the mark scheme allowing ‘follow through’ of incorrect figures from (a). For part (c) a much smaller proportion correctly determined the value for x at which the minimum occurred. This part was often the same as the answer to (b) (ii) or simply omitted.

Sometimes students incorrectly completed the square after the 2 was factorised out. This might have been either a misconception or a lack of proficiency working with fractions. Others struggled with how to relate their work in (a) and (b) to part (c).

Centres could perhaps offer greater practice in completing the square with fractional coefficients and linked/hidden quadratics. A focus on solving these problems without a calculator would help as it will deepen understanding.

Question 3

This question concerned the relationship between functions and their factors as well as knowledge of integration. Most candidates knew how to approach this question and the steps required. However, it was evident that candidates did not always read the given question, particularly the requirement to show their working in part (b).

In part (a), many correct responses were seen. A very high percentage of the candidates were able to integrate the given function, with fully correct integration often seen. Infrequently, candidates forgot to include the constant of integration, which simplified the demand of the question, meaning only the first two marks could be attained.

Most candidates were also able to substitute (1,20) correctly. The majority were also able to show understanding of the factor theorem by substituting $x = 5$ and equating to 0 to form a second simultaneous equation.

Part (b) required candidates to demonstrate an algebraic solution and thus use of a calculator to achieve the solutions with little to no algebra yielded no marks. A calculator is a good checking tool for these types of questions but should not be used as the primary way to answer them. Those candidates who attempted using algebra almost always used polynomial division to solve. Unlike recent years, there were very few errors seen in the polynomial division, factorising to a linear and a quadratic term. Most candidates were able to algebraically solve their quadratic and arrive at the correct solutions.

A small number of candidates either did not include the solution $x = 5$ or occasionally, did not provide values for x after reaching the correct factorisation. Some candidates had clearly worked backwards from a calculator solution, most easily detected by a factorisation which did not include the coefficient of the x cubed term being 2.

Question 4

Overall, candidates did well on this question.

The overwhelming majority were able to tackle part (a) successfully and knew how to find the gradient of a perpendicular line and the equation of a line. However, a proportion were not able to find the coordinates of *X*. Further work on dividing a line in a given ratio could be a useful focus for centres. A few students missed scoring the final mark as they did not present the final answer in the correct form.

Question 5

A mixed set of responses were seen to this question. Perhaps this is understandable given that it required a multi-step strategy, with no 'scaffolding'.

The line, not given in the form $y = mx + c$, caused some candidates confusion. When candidates were able to correctly rearrange and set equations equal to each other, they sometimes struggled to proceed correctly. A number were unable to process the square root from the curve when solving or could not successfully expand the squared bracket. Though a sizeable proportion of candidates were able to solve the simultaneous equations to show that the lines intersected at $x = 15$ and -3.

The next step in the question required candidates to know how to set up the volume of revolution for either the curve and/or the line. The most effective approach seen dealt with these two expressions separately and subtracted at the end and the most efficient was combining and calculating the integral. Although there were a number who tried this approach with errors, often using a simplified equation from the solution of the two simultaneous equations from finding the limits at the beginning of the question, though some credit was awarded for this. The issues surrounding expanding the double brackets persisted here. Very few candidates found the volume of the cone as an alternative strategy but, when this approach was seen, it usually scored highly.

Some students had difficulty in selecting appropriate limits, but the integration itself was generally done well. Candidates in this question and throughout the paper understood more than has been the case recently, the need to show their substitution of limits into their integral to gain the penultimate mark if their final answer was incorrect. Please remind candidates of the importance of this method mark.

Question 6

Most candidates were able to gain early marks on the question in parts (a) and (b) but many students struggled to identify the required angle in part (c). Part (d) saw lots of good attempts.

In part (a), almost all attained the first mark by finding AC correctly using Pythagoras' Theorem. Most then went onto find the required length of VO in terms of x. Centres could remind students of the need to show sufficient working in a 'show that' question.

In part (b), the angle required for this part was identified correctly by most students. Some students found half of the required angle but then failed to multiply by 2. Others tried the cosine rule but could not rearrange properly to find the required angle.

Part (c) proved most challenging for this cohort, with many students unable to identify the required angle between the two planes and then failing to gain any marks. A variety of methods were used by those who did know what angle to find, including the Cosine Rule and right-angled trigonometry. A greater focus on practice in identifying the angles between two planes could be useful.

In (d) it was encouraging to see that most candidates attempted the final part of the question, even when working in previous parts was muddled or incorrect. Mistakes were often made in the formula for the volume of pyramid, despite it being given in the question. Errors were also occasionally seen in the rearrangement of the equation and the power of x was sometimes lost, but most candidates were able to collect the final mark for an accurate value from a correct solution.

Question 7

Parts (a) and (b) were answered well by the majority of candidates, with occasionally the negative value of r missed. Some misconceptions included treating the two given terms as consecutive or to find the 2nd term and interpret that as their answer for r. A small number of candidates modelled as an arithmetic series and made no progress.

Part (c) caused a few problems, a common one being failure to change the inequality sign appropriately, when dividing throughout by a negative number. This was condoned for a correct answer with otherwise correct working. Interpretation of the final inequality $n > 7.04$ or $n < 7.04$ as $n = 7$ was quite common. Candidates using trial an error were unable to gain marks as the question directed that logarithms must be used.

Candidates could benefit from centres explicitly teaching problems involving inequalities with logs where the value of the log is negative, how to identify this and how to deal with the reversal of an inequality sign when division or multiplication throughout is by a negative number.

Question 8

Part (a) was a familiar area for many candidates. Most used the given quotient rule formula, occasionally misquoting it, with a significant minority of students using an addition rather than subtraction sign. Differentiating the power of e was generally done well.

A few errors were seen in simplification, but there were many fully correct solutions displayed for part (a). The Product Rule was sometimes attempted, and could gain full marks, though it tended to be less successful than use of the Quotient Rule as the algebraic simplification and differentiation was more demanding. Candidates should be encouraged to use the Quotient Rule in a question such as this.

Part (b) was significantly more challenging. Many candidates had no real idea what was required, and this is an area that many centres could benefit from giving a great focus. Some candidates knew that they needed the derivative multiplied by delta x but could make no further progress. Some identified the steps needed and introduced them on successive lines of working; others produced a single correct expression. A very small number of candidates gained a fully correct answer from correct working.

Interpreting the 2% increase as $x = 1.02$ was not uncommon, as was writing delta x = 0.02 rather than $0.02x$. Others considered delta x / x, which worked well.

Question 9

Part (a) saw many fully correct expansions, with fewer candidates than recently using the incorrect binomial expansion for natural *n*. Almost all candidates could construct the correct structure, beginning with 1 and with the correct denominator. A significant minority used $8x^2$ rather than $(-8x^2)$ in the expansion, which led to no marks, as this eased the demand of the question.

Part (b) was a reasonably common follow up question to an expansion of the type in part (a), but there were a surprising minority of candidates who could not start this part of the question. The marking of the expansion of the brackets was quite lenient and there were a significant number of correct values calculated. Some candidates did attempt to compare the coefficients of terms that were not of the same order.

Part (c) was generally well completed where candidates had made significant progress in part (b). Almost all candidates who attempted to integrate did so correctly. Given the opportunity to make slips throughout parts (a), (b) and (c), there were few fully correct answers. However, there were opportunities to pick up four out of five marks for method.

Question 10

Part (a) was a good source of marks for almost all candidates and completed much more successfully than on most recent papers. Nearly all were familiar with the proofs, with only a few making basic errors.

The most common incorrect work involved simply writing out the double angle formulae with A and B rather than A and A. For the second proof candidates need to remember that this is a 'show that' and that they must show sufficient steps. Some moved from cosAcosA - sinAsinA straight to $\cos^2$(A) - 1 + $\cos^2$(A) without stating the $\cos^2$(A) - $\sin^2$(A) step.

Part (b) often began well, with most candidates familiar with tanx = sinx/cosx and comfortable with substituting this in for the first mark. A significant number then went on to perform the necessary algebra and use the fact that $\sin^2(x) + \cos^2(x) = 1$ to get the required result. A minority of candidates seemed unsure of how to proceed and therefore couldn't attain any further marks.

Part (c) was generally poorly attempted with many candidates unable to make the link between the expression in this part and the previous results. Some candidates did not attempt to answer the question while some expanded out the right hand side and produced many lines of working but not reaching a stage where marks could be awarded. Those that recognised the need to rearrange and use the identities in part (a) and (b) made progress, but it was common to see the minus sign missed or ignored on the right hand side. Tan2A = 2/5 was not uncommon.

Those that got this far were usually able to follow through to a successful conclusion but errors in getting the additional angle in the range were frequently seen.

Part (d) saw more successful attempts than part (c), with many candidates able to successfully integrate the last two terms of the expression. Those that changed the expression into the required one usually also dealt with the 2sin2x correctly. A significant minority of candidates couldn't evaluate the integral effectively with a common error being an assumption that substituting 0 would give 0.

Question 11

This question proved challenging to a majority of students. The question could be answered in many different ways, and a wide variety of approaches were seen. The mark scheme was structured to award marks positively for correct uses of the addition law, power law, change of base and a simplification such as $\log_2 4 = 2$ etc for the first four marks.

Of these, it was quite common to see good attempts at the last two, often seen simultaneously or combined. The addition law was less often used correctly, and there were frequent misconceptions involving the power law, such as moving the power of the log $(3y^2)$ to become a coefficient.

If the first four marks were awarded, we could reward successful attempts to work with resulting simultaneous equations. Those who got this far were often able to 'de-log' their resulting equations to gain the final method mark, but a minority managed to achieve complete correct solutions to this challenging question.

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