Examiners' Report
Principal Examiner Feedback

Summer 2023

Pearson Edexcel International GCSE

In Further Pure Mathematics (4PM1)

Paper 01R

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Examiner’s Report

It appeared that the majority of candidates were familiar with the content of the specification as generally all questions were attempted. Candidates generally attempted all questions on the paper, with many making good progress across the breadth of the specification covered.

Candidates should be encouraged to read questions carefully to ensure that they follow instructions such as ‘hence’ or ‘use algebra to’. They should also pay attention to any requirements relating to the form for the solution. Candidates should also maintain the accuracy of their answers by using more accurate figures in intermediate calculation steps.

Question 1

The majority of candidates attempted the question by forming an expression for the area, comparing coefficients and solving simultaneous equations using the ALT method in the mark scheme. Only a small number wrote AB as the area divided by BC, showing it as a fraction and then attempted to rationalise the denominator as in the main method.

The manipulation of surds and solution of simultaneous equations required for this question was not particularly challenging, however many candidates struggled to make much progress beyond forming the initial expression or equation (depending upon the method used). In many cases candidates did not showing sufficient working in either solving the simultaneous equation or rationalising the denominator in their fraction. Most who found 2 equations solved them successfully, but only received full credit if they showed correct method using either substitution or elimination. There were also those using the quotient who did not show the full multiplication by the conjugate. Full working by either method is essential here as examiners needed to see that candidates had not just divided the area by BC on a calculator.

Question 2

In part (a), the more efficient methods were sometimes missed by candidates who started to try and solve the equations simultaneously rather than identifying that the equation with no p could be used to find the value of q straight away.

In part (b), candidates who had found values in (a) were generally aware of the need to substitute the value of p and the linear equation into the quadratic equation to form a 3 term quadratic in x. Candidates should be encouraged to show their method of solution for the quadratics that they obtain as there was often a lack of working shown, this is particularly important if an incorrect quadratic has been obtained as credit can still be awarded for correct method of solution. There is additional guidance provided in mark schemes that describes what constitutes an attempt at solving a quadratic.

Some students failed to score in part b as they rearranged the quadratic to get y the subject, but then didn't know what to do next to solve simultaneously. A common error was the candidate not substituting for $(4x + 9)$ but using their $q = 7$ value. Those achieving the correct quadratic equation usually solved it by factorising, obtaining the correct x value required but forgetting to calculate the corresponding y coordinate for the final A mark.

Question 3

In part (a) the majority of candidates were able to apply the cosine rule correctly and achieve final answers that rounded to 13.8.

In part (b) however, many candidates lost the accuracy of their answers by using their rounded value from part (a). Most candidates found angle ABC to be 34.8 instead of 34.7. Follow through from this was allowed for finding angle ACB in the second part, but a significant minority of candidates started again at this point, again with rounded values and so, again lost accuracy.

There were many good attempts at part (c) with at least three different but equally valid approaches taken, identifying other angles as required and calculating either BM or CM or both to find the area using the sine of one of these angles. However, many candidates erroneously assumed that M was the midpoint of AC and that MC was 4cm gaining no marks although occasionally they found the angles required. Some who could do this part lost the accuracy of their final answer due to using rounded values.

Question 4

This was a fairly standard question on use of a graph to find roots of an equation, although the equation given in part (c) was relatively complex.

Part (a) was generally done well. Where marks were lost it was because the student failed to round their values to 1dp as instructed.

Part (b), where the candidates were required to plot the graph, was also generally done well. There were some candidates who used a ruler when joining their points or made errors in plotting both of which lost them marks.

Part (c) proved to be challenging. There was very varied success was seen in this question, from many non-starters with no attempt made, or else making a mistake when combining the logarithmic terms. Candidates often incorrectly rearranged the equation making little progress. Those candidates that scored well on this part often showed all of the steps clearly and with precision.

A small number of candidates managed to get the correct equation of the straight line but then failed to draw this accurately on the graph, hence their solutions were then incorrect. The more successful candidates plotted a few key points to ensure their straight line was correct.

Question 5

This question required candidates to use the factor and remainder theorems in part (a), factorise the cubic in part (b) and find the points of intersection of the curve with the x-axis in part (c). They were then expected to use algebraic integration to find the shaded area. This question proved very much to the liking of most candidates with many fully correct answers seen for parts a, b and c.

In part (a), the majority of candidates produced fully correct answers with a few exceptions where they could not apply factor and remainder theorems or they assumed a=-3 and did not solve simultaneous equations.

Parts (b) and (c) were successful for most candidates, with many gaining full credit. In (b) some just wrote down the factors with no working which was not credit worthy – working is expected. Those doing the polynomial division by (x -1) often gained all marks.

In part (d), quite a few candidates did not deal with the area under the axis appropriately and thus they subtracted the two areas instead of adding the modulus of the second shaded region. A clear approach setting out from the start the intention to add the modulus of the area below the axis generally worked better than attempting to correct signs later. While most candidates made sufficient attempt at integration to gain the second mark available, too many who failed to go on to correctly evaluate the exact area of the shaded region, also denied themselves the third mark by not clearly showing the substitution of their limits into their integral, in line with the standard approach across the marking of these papers.

Question 6

Part (a) of the question required candidates to show that, for the container given, $V = \frac{1}{9}\pi h^3$. Candidates who applied trigonometry to this were generally successful. Where marks were lost it was because they didn't know how to get an expression for r in terms of tan and therefore could not get started. Valid attempts were seen using Pythagoras' theorem also. Occasionally candidates did not fully complete the proof, as they omitted the V = ….

Part (b) required candidates to use connected rates of change. There were lots of excellent attempts at this question, but very few scored the final mark for realising that the rate is negative due to the surface area decreasing as the oil escapes. Candidates who struggled to make significant progress often failed to get an expression for the surface area in terms of h by substituting in the expression for *r*. Others attempted to use the wrong formula for surface area – using a cone formula instead of realising it was referencing the circular part visible at the top. Candidates could either work in terms of *r* or in terms of *h*, however working in terms of *h* was more common.

Candidates were often able to find the derivatives of A and V. The chain rule when attempted was usually correct, and an impressive number of candidates were able to state a correct chain rule to reach dA/dt even if mistakes were made elsewhere. Though there were many excellent answers to this question, less confident candidates found it challenging.

Question 7

This was a good question for candidates and many gave fully correct answers.

In part (a) candidates needed to differentiate the equation given and use the information about the stationary point in order to find the value of two unknowns – *m* and *n*. Most differentiated the given equation correctly, set dy/dx = 0 and went on to find *m* and then *n*. There were a few candidates who were unable to cope with differentiating a square root and inevitably arithmetic errors when solving to find the value of *m* and *n*.

In part (b) candidates were asked to determine the nature of the stationary point. This was generally done well by evaluating the second derivative at the point and making a suitable comment based on this.

Question 8

This question required candidates to work with geometric series and their summations. In part (a) candidate were asked to find the value of U_5, which most were able to do successfully. Those that didn't appeared to have mistyped their numbers into their calculator – a common incorrect answer was gained from using 24/4 instead of 25/4.

The 'show that' in part (b) was found to be demanding by most candidates. Many began by writing down the first term, but made no further progress to show the required result. Most candidates misinterpreted the question and used the given form to find the values for A and B, hence very few pupils managed to truly 'show' the required answer here and score full marks. Many solved an equation using the given sum to find r and then restated the answer.

In part (c), many candidates were able to find the sum to infinity correctly, as well as the sum of the first n terms. Often those scoring no marks incorrectly used the nth term instead of Sn. Setting up the inequality was handled by many candidates very well. Some did not successfully deal with the inequalities signs both when rearranging and when solving using logs. The most successful approach appeared to be to change to an equation in *n*, solve this and then identify the appropriate inequality direction at the end.

Question 9

In part (a) candidates were expected to use the binomial expansion. Almost all candidates were able to do this correctly. Where errors were seen this was often in finding the coefficients or in dealing with the 2*x* (rather than *x*) required within the expansion.

Part (b), where candidates were asked to state the range of values of *x* for which the expansion was valid, had surprisingly few correct answers of $|x| < 1/2$ or equivalent, as many wrote down incorrect answers like x<1/2, $-\frac{1}{2} \leq x \leq 1/2$, $|x| < 1$.

In part (c) most candidates realised that they needed to multiply their expansion from (a) by the binomial given. Some candidates made arithmetic errors or did not put the terms in ascending powers of *x* as was required.

In part (d) candidates were told the coefficient of x^3 in the expansion and asked to use this to find the value of the unknown k. There were a significant number of errors seen here with the most common being missing out the negative sign outside the bracket of the coefficient of x^3.

In part (e) candidates were asked to use algebraic integration to find an estimate of a given integral. The first stage of this was to substitute the value of k found in (d) into their expansion from (c), some candidates did not show the substitution of their incorrect value of k in f(x), or did not using the given coefficient of x^3. Almost all candidates were able to integrate their polynomial expression correctly, but again many did not show the explicit substitution required which was only condoned if the integral and final answer were correct.

Question 10

The final question on the paper was on vectors. In part (a) candidates were required to find simplified expressions for two vectors, AB and MY. These were found successfully in many cases. Common errors were incorrect simplification, or division of by a common factor. In part (a)(ii) ssuccessful candidates generally used MY = MA + AY. Common errors in this method were made using -a instead of a due to not marking the direction on their diagram. Some candidates decided to use MY = MO + OY which was also seen successfully. However, mistakes in this method were often made in the OY = OB + BY where they did not change the sign of their AB when substituting in for BY.

In part (b) candidates were told that the points M, Y and X were collinear and asked to find the ratio OB:OX. Successful candidates generally found OX in two ways introducing their own scalar unknowns and solving by comparing coefficients. This was by far the most efficient method, although may other approaches were seen. A number of candidates successfully solved their simultaneous equations, but then interpreted the question incorrectly and gave the incorrect ratio at the end, often simply the wrong way round.

Part (c) asked candidates to find the ratio of the area of two triangles seen within the diagram. Candidates found this difficult on the whole, with a minority able to find the correct final answer. Some candidates were able to make a start by writing down the relationship between the area of the triangles BYX and ABX, but didn't go onto find the required ratio correctly. Other successful approaches looked at comparing the relative areas of two triangles and multiplying them together (ALT 1). Unsuccessful responses looked at the ratios of the sides but did not apply this to what the areas of the triangle would be. Some tried to use their scale factor (area is SF^2) knowledge and were unable to compare the two triangles directly.

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