Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

Summer 2022

Pearson Edexcel International GCSE

In Further Pure Mathematics (4PM1)

Paper 01

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Question 1

Almost all candidates found this question accessible, and it was well answered. A very small number made processing errors, but only lost the final mark. It would be advisable for students to check their answer at the end on their calculator to try to avoid this problem. A smaller number of candidates only employed their calculator with little attempt to "show" the working required and gained no credit.

Question 2

Candidates usually made good progress with this question and understood what needed to be done.

Almost all candidates gained the mark available in part a. The most common approach was to state their expression as a product of the length and width of the flag. A few candidates found the sum of the component parts of the flag. There were a small minority of candidates who then went on to incorrectly manipulate their expression and although this did not have an impact on the awarding of this mark, it did have a negative impact in later parts of this question. The very small number of candidates who did not gain this mark, attempted to form the perimeter of the flag or made errors revealing misconceptions such as $8xy \times 6xy$ instead of $(8x + y)(6x + y)$.

Candidates generally did well again on part b. A relatively small number chose to subtract the sum of the shaded areas from the total flag area as given in the main scheme. The vast majority followed an alternative approach, finding the sum of component areas, where a variety of different combinations were seen. Most candidates showed sufficient work for the 'show that' demand of the question, but it is worth reminding candidates that ample working must be shown. Errors were rarely found, but if observed, the square *FQMU* tended to be counted twice.

In part c, virtually all candidates understood that the solution of a pair of simultaneous equations was required. Those that eliminated y to solve a simple quadratic in x, generally made good progress, finding the required values. However, a significant number of students used the alternate scheme with very little accuracy seen in generating the correct or acceptable quartic in y, as the algebraic manipulation proved too demanding, making further progress rare. Very few candidates included the negative solutions, but when they did, these were almost always appropriately rejected.

As stated, the assessment of this specification involves 20 – 30% of marks allocated to AO2, *"apply a knowledge of mathematics to the solutions of problems for which an immediate method of solution is not available"*. Therefore, in teaching, candidates should be encouraged to look for alternative approaches or carefully check their work, when they encounter algebraic manipulation as difficult as this second approach involved.

Question 3

This question provided a significant level of challenge for all but the most able candidates, though many candidates were able to make some progress and a full range of marks was awarded. Few candidates spotted the most straightforward way to answer the question, the first method presented in the mark scheme.

Students used a variety of methods, usually using sine and cosine rule and virtually all attempts using the cosine or sine rule were accurately processed, albeit with rounding errors or premature rounding often seen. The majority of candidates focused on triangle *AED* initially, using the sine rule. However, few responses achieved full marks. Many candidates used the acute angle found for angle *AED* rather than the obtuse angle, though students doing this were able to gain all but the last 2 marks if further working was correct. A small number of candidates assumed some symmetry or used Pythagoras and/or right-angled trig in triangles that weren't right-angled.

A significant number of candidates who presented an otherwise fully correct solution, lost accuracy marks due to premature rounding.

Question 4

Most candidates attempted this question and there were many good, clear, well-structured solutions seen. However, a significant number of candidates made little progress beyond substitution of 80 for S_4 and 81 for the sum to infinity. A very small number of candidates quoted equations for arithmetic series or attempted to use an equation for the fourth term instead of the sum of four terms.

Candidates often successfully found a route to eliminate a, although many candidates did not spot that $(1-r)$ could be cancelled from both terms, which then led to numerous processing errors. A small number of candidates worked with S_n not S_4. Candidates who failed to notice $(1-r)$ could be cancelled arrived at the equation $81r^5 - 81r^4 - r + 1 = 0$, rather than $r^4 =$, and then found it difficult to make further progress. Although rarely seen, some candidates did attempt to eliminate r and solve to find a first – this approach was seldom successful.

Those candidates who correctly found r usually found a correctly and completed the rest of the question successfully. When these were incorrect, only a few candidates used their values for a and r to substitute into the sum to 7 terms.

It was rare to see the alternative approach.

Question 5

Part a, intended to scaffold this question, help candidates in further parts and in style, not uncommon on this paper, was often not completed correctly. Most candidates found the correct value for q, but frequently p was stated as 2 or otherwise incorrect. Follow through was often see with this incorrect value and credit appropriately awarded as shown on the mark scheme.

Parts b and c were generally completed well, with most candidates scoring all marks available to them, depending on their value of p. It was decided that candidates who used the binomial expansion of $(a+b)^n$, incorrect as only valid for positive n, would be given credit in line with the published scheme. Candidates choosing this method were rarely successful in gaining any of these marks though, because of the complexity of each term to be formed. Any errors seen in part b included forgetting to multiply by $\frac{1}{2}$ and in part c, missing one of the multiplications required to form the correct expression.

In part d, almost all candidates attained the marks for a minimal attempt to integrate, and often for substituting in the correct limits. Most gained 3 of the 4 marks available for also correctly integrating their expression. However, there is still a sizeable proportion of candidates not showing substitution of limits and failing to gain what is a very straightforward mark.

Question 6

In part a, most candidates were able to complete the table of values correctly, although there were some problems with rounding the value 1.41. Most of these candidates then earned 2 marks in part b. A small minority plotted points inaccurately, struggling with the scale. Other errors seen in part b, though relatively rare in occurrence included, joining the points with straight lines, missing their points when sketching the curve and failing to connect the curve to the point (0, 4),

A sizeable number of candidates made no attempt at part c, but when attempted, candidates were often able to obtain the required line $y = 3x + 1$, either by deduction or using one of the methods given in the mark scheme. Those who had the correct line went on easily find the required value of x, but a significant number lost the final mark, not giving the answer, as the question specified, to one decimal place.

A very small number of candidates made progress with part d, often gaining all 4 marks. Many, who attempted this part and did not score full marks were not successful in transforming the logarithm equation to reveal the appropriate linear equation. Often, students who attempted part d manipulated to $\ln(x - 1) = -x$ and then stopped. Those who found the required line, plotted and drew it accurately to obtain the required estimate. Once again, some candidates failed to gain the final mark due to an answer to the wrong degree of accuracy

Question 7

Candidates often did not answer this question in the correct section. For this reason and to break from usual exam conventions, parts b i and b ii were marked together and where valid working was used in further parts, it was given credit. It had to be used to be given this credit though.

In part a i, almost all candidates recognised that integration was required, and this was usually completed correctly. Many candidates were then successful in attaining all marks available by including a constant of integration and substituting the given coordinate to show that this was 0. A smaller number successfully assumed the constant of integration was 0 and then showed that (4, -104) satisfied that equation. A minimal conclusion was required. The most common reason for not gaining full marks in this part of the question was simply assuming there was no constant of integration, with no further work or substituting $x = y = 0$, into their integrated expression, without this constant of integration.

Candidates rarely gained all three marks available in part a ii. Almost all realised they had to show the second derivative was positive or that the first derivative was 0, solutions which included both of these were rare to see. Candidates were also given credit for alternative, valid approaches.

Where part b was completed, it was often well done with a good, structured solution presented. Common errors included using the coordinate given and a surprising number of candidates found the correct values of x but then failed to find y, using a straightforward substitution, as required.

Of those candidates who had progressed this far, almost all knew how to test for maxima and minima, most gaining full marks for part b ii.

The alternative method in the MS was rarely seen.

Question 8

Although most candidates scored 2 marks in part a, a few did not use the correct formula for the volume of a sphere, given on page 2 of the question paper. Drawing attention to the formula sheet and encouraging candidates to reference it throughout the course as well as during the exam, would be advantageous to candidates' performance. The common incorrect formulas used were $V = 4\pi r^3$ and $V = 4\pi r^2$. A few candidates found the square root instead of the cube root.

Only the most able candidates were able to attempt part b. It was often left blank or candidates chose to ignore the instruction, "*Using calculus, find an estimate for…*" and gained no credit for correct answers rounded to 0.16cm, found by evaluating the increased radius from the increased surface area.

It is worth pointing out that, although not penalised, there were very few candidates who used the correct notation of δA. It was evident that a large proportion of candidates were unaware of this notation and proceed to write a solution using $\frac{dA}{dt}$ etc.

Candidates who used calculus generally scored full marks. Very occasionally candidates gained one or two marks for stating or attempting to use $\delta A = 20$ or stating the formula for and correctly differentiating the area of the sphere. The chain rule was not often stated or used by many candidates.

Question 9

This proved to be a challenging question for a large proportion of candidates and attempts at part a only were not uncommon. It was often apparent that a candidate didn't see any connection between what they were asked to do in part a, and later parts of the question.

Although it wasn't completely uncommon to see no attempt at this question, most candidates who attempted part a generally scored well. Algebraic division by a quadratic was the most commonly seen successful method. Dividing by a linear factor twice was also seen, but this method was often abandoned after division by the first linear factor. The comparing of coefficients was not often seen, but when used, candidates were usually successful. The correct values of a, b and c appearing was awarded full marks as the demand of the question wasn't "show".

For those candidates who attempted part b, most knew to find the area under a curve by integration and this integration was often completed correctly. Most identified the limits for the bounded area correctly, often reached the allowed value of $\pm\frac{16}{3}$ and equated this to the expression permitted, as shown in the mark scheme. Few candidates gained the final 2 marks of part b, requiring the correct sign of the area to be used and fully correct manipulation.

Part c was attempted by only a few candidates, reinforcing that many did not see the connection between the different parts of the question. Those that realised that all that was required was to solve the equation that was given in part b usually scored full marks.

Question 10

It was not uncommon to see no response to this question, despite this being a very traditional style of question on this specification. However, many candidates successfully achieved simplified expressions for the required vectors in part a, with a full range of marks awarded. Where a mistake was made, this usually concerned the direction of the vectors; negative and position directions were occasionally confused.

Fewer candidates made good progress with part b. Candidates attempting this often picked up one or both of the first two marks but then stopped. Those that progressed beyond these marks, usually progressed to a full, clear, correct solution.

Candidates who did not realise that two parameters were required, or that these had to belong to different routes for the same vector, scored few marks. A small minority tried to use an extension of MN to give MC, even though MN and MC were not colinear. More successful candidates realised they could use either of their answers from part a to help find, for example, vector AN. Candidates gaining the third mark almost always went on to a fully correct solution. The main method on the MS was the one most often seen.

Part c was frequently not answered, with only the most able candidates succeeding. Solutions seen were generally fully correct and elegantly presented. It was also possible to compare relative sizes using a “determinants” approach, calculating areas from the “coordinates” of the vertices, though the assignment of the “coordinates” sometimes caused a problem. This was given credit in line with the published scheme.

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