Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International GCSE
In Further Pure Mathematics (4PM1)
Paper 02

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Introduction

Many candidates found the paper challenging. However, many lost marks needlessly through not reading the questions carefully and/or not showing sufficient working. These are recurring issues that are reported year on year.

Generally, rounding instructions must be followed. Candidates should take care not to use premature rounding which can lead to an inaccurate final answer. Showing working, particularly when solving equations is very important to demonstrate the method that has been used. If the final answer is not correct no part marks can be awarded unless the method used is clear.

Question 1

Candidates scored well on this question. Any errors were generally to do with the final mark. Some candidates did not reject the "negative" time, providing an extra value for the distance with $t = -2$ substituted into the expression for *s*. Some candidates mistakenly attempted to find a displacement from $t = -2$ to $t = 4$ or from $t = 0$ to $t = 4$.

Question 2

Most candidates knew the correct formula to use and stated the correct limits from the start, perhaps surprisingly π was rarely omitted. Some candidates started correctly, but did not know how to square the function with variations in squaring e^{3x} incorrectly including e^{9x} and e^{3x^2}. Those that could square the function correctly could not always integrate and some, who thought they were integrating, gave $6e^{6x}$ instead of 1/6 e^{6x} which is differentiation. Most candidates are clear on how to substitute in limits, but some mistakenly used 0 as the value of e^0. The correct answer had various acceptable forms and it was rare to see candidates writing their answer as a decimal.

Question 3

Part (a) was very well answered by the majority of candidates. Most attempted the binomial expansion correctly and usually gained all three marks. The common errors were incorrect use of powers, for example instead of $15p^2x^2$ the term was written as $15px^2$.

Part (b) was answered fairly well with around half gaining the full two marks. Those who made errors in (a) usually gained the method mark here. Fewer candidates had issues with using the terms rather than the coefficients; instead, it was the solving, with the negative sign, which gave rise to the loss of marks here. Most candidates did not obtain $p = -1$, instead they had $p = 1$.

Question 4

(i) Many candidates attempted this question correctly either by changing to base *r* or base 4. Those that did this generally went on to solve an equation to get a value for log4 or log*r*. Fewer candidates were able to then get a value for *r* and very few candidates obtained both answers with 256 being the most common single answer.

(ii) Almost half of the candidates were able to use basic rules of logs correctly both on left-hand side and the right-hand side. Few candidates changed 1 into log5 with many choosing instead to evaluate the left-hand side and then subtract 1 or rearrange to equal 1 and then remove the log. The main mistake on the left-hand side was adding the numbers; this was seen far too often. There were a good number of candidates who, although able to deal with the left-hand side correctly, were unable to combine the logs involving x.

Question 5

The proof in part (a) of the question was answered well by most candidates. They could use one of the formulae for S_n for an arithmetic progression competently. Some lost final accuracy because they did not write the complete result and only wrote the RHS.
The majority did not read the question for part (b) carefully and missed ‘Hence’. Many reached the correct answer, but without using the result from part (a) and hence lost both marks. Very few candidates seemed to be aware of the technique required for part (b) of subtracting two sums. It was common to see the right method but the wrong value for the second sum due to using 35 terms.
Part (c) was very well answered by most candidates. They were able to set up the equation and solve the quadratic, gaining all three marks in almost all cases. A few candidates did not reject $n = -\frac{55}{3}$, hence losing the final A mark.

Question 6

In part (a) the majority of candidates started off well and correctly found the sum and the product of the roots of the quadratic equation. Sign errors were rare.

Most were able to obtain the expression for $\alpha^2 + \beta^2$ needed to find the new sum of the roots and used this correctly. Candidates were generally able to correctly find the product of the new roots. However a number incorrectly evaluated and obtained an answer of 2 rather than 4.

Even where candidates had made errors in finding the new sum and new product of roots they were generally able to use these correctly in writing an equation, however x^2 +(sum of the roots)x + product of the roots = 0 was common.
Candidates found part (b) of the question very challenging which was often due to confusion around the roots that they were working with. Many candidates only managed to score 1 out of 5 for a correct expression for the product of the new roots which was ready for substitution.

Question 7

This question proved problematic for many candidates, with less than half gaining full marks.
In part (a) About half of the candidates formed the correct equation and solved it.
In part (b) many candidates did not explain why the value of r meant that the series was convergent. There were many that gave $r < 1$ as a reason for convergence, which was not enough for the A mark.
Most quoted the sum to infinity formula correctly in part (c) and used their values for the correct method, but the values in the formula were not always correct so they lost the accuracy. It was common to see values of x being used instead of a value of r.
Many were able to score the first method mark in part (d), but most did not get to the required form to solve correctly for n. A significant number of candidates struggled with the algebra of dealing with $\left(1 - r^n\right)$ where r was negative.

Question 8

For part (a) nearly all candidates realised that the equations of the two curves had to be equated but there was a significant minority who failed to proceed further and factorise their equation. Those who did factorise usually managed to do so correctly and found both solutions. The majority of candidates recognised the need to eliminate the negative solution and went on to correctly obtain the coordinates of *A*. A common error was to fail to eliminate the negative solution. Some candidates who had correctly found the *x* coordinate then left the *y* coordinate as $e^{\ln 5}$ rather than evaluating this as 5.

There were lots of perfect solutions for part (b) and working was generally clearly shown. Some students seemed to find the differentiation of the given function difficult. Where the derivative was found successfully there were a significant minority of candidates who failed to find a numerical value for their gradient, substituting their derivative in their equation for the tangent at *A*, unfortunately gaining no more marks.

Candidates who had done well in part (b) were generally also successful in part (c) of the question. However, many candidates found this part of the question difficult with errors seen in differentiation, substitution for *x* in the derivative and finding the equation of the tangent. A variety of ways were used to calculate the area, with the determinant method seen most frequently and with a high rate of success. The second most common choice was to use 1/2base x height. Heron's formula, which was rather long winded in this case, also appeared but candidates following this method did not reach an accurate answer. A number of candidates resorted to decimals for the coordinates of *B* and *D*, losing accuracy when calculating the area.

Question 9

Part (a) was generally well done. The majority of candidates were able to rewrite the equation of *C* to the required form.

Part (b) was poorly answered with many candidates not knowing to use the discriminant. Many incorrectly chose a *y* value less than 2 or greater than 3, and substituted it into the equation in (a), attempting to show *x* is real, but gaining no marks.

The differentiation in part (c) was well done with the majority using the quotient or product rule correctly. Errors were commonly made when simplifying the numerator which meant that the correct stationary points were not found. Candidates struggled with solving $-2x^2 - 2x = 0$, often finding the incorrect *x* value *x* = 1 rather than *x* = -1.

The graph in part (d) was badly done by the majority of candidates. Only a few fully correct curves were seen. Many had found the equation of the asymptote but did not label it and did not draw curves which were asymptotic to it. A lot of candidates correctly found the *x* coordinates of the crossing points, but did not know what the shape of the graph was due to incorrect stationary points. Some candidates with correct values failed to match their values to a good sketch.

Question 10

As one might have expected, this was a challenging question for many candidates. It was common to see candidates only attempting some parts of the question, with many stopping after (a) and (b). Other candidates struggled with the 'show that' elements but had some success in applying these.

Part (a) was answered well with many candidates able to produce succinct and accurate working. Some candidates did not show full and accurate working, missing out the left-hand side of the result which was required for this ‘show that’ question.

Many candidates were familiar with what was expected in part (b) and could produce the standard solution accurately. Some candidates had an idea of how to start, but could not fully demonstrate the required result. Where incorrect attempts were seen these often included a series of stages attempting to rearrange the trigonometric expressions which were not correct.

Many did not attempt part (c) and few candidates earned all the marks. Those that used part (b) generally went on to get a correct equation, however $\cos 12\theta$ and $\cos(-\theta) = -\cos\theta$ were seen frequently and "= 0" was often omitted.
Where a correct equation was obtained, there were often errors in solving this, usually missing one of the solutions to $\cos 6\theta = 0$ or missing $\cos\theta = 0$ altogether. Stronger candidates who achieved the solutions rarely gave extra solutions within or outside the range.

Correct answers for part (d) were not common with many candidates unsure how to tackle it. Those that used part (b) usually combined cos8x and cos 4x and then used the correct double angle formula to reach the desired result. Some did not see the link with (b) and unsuccessfully tried using other methods.
A wide range of tools are available to use here: cos 8x = cos(4x + 4x), double angle formulae, as well as the more conventional approaches in the scheme.

In part (e) there were some candidates who were able to accurately use the results from earlier in the question, integrate and correctly substitute to give a fully correct answer. Some of those who struggled in earlier parts of the question were able to identify that this could be attempted by using the result from (d) and were often able to gain some marks. Missing the factor of ¼ was a common error. From there differentiating was seen on occasion, along with sign errors. Inevitably some tried to apply basic rules of increasing powers etc in an inappropriate way. Some thought they had integrated but were still using cosine when they substituted in the limits. Many candidates were able to correctly substitute the limits.

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