Examiners' Report
Principal Examiner Feedback

Summer 2024

Pearson Edexcel GCE
In Further Mathematics (8FM0)
Paper 21 Further Pure Mathematics 1

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Introduction

This paper proved to be a good test of candidates' ability on the 8FM021 content and plenty of opportunity was provided for them to demonstrate what they had learnt. Marks were available to candidates of all abilities and the questions that proved to be the most challenging were 1, 4 and 5.

There did appear in some cases to be an over-reliance on calculator technology. It does need to be stressed that candidates should take careful notice of the warnings in bold, when given, at the start of a question, to show all stages of their working and not to rely entirely on a calculator. This was clear in Question 1 where many candidates did not show all stages of their working and in some cases just used a calculator to solve the inequality.

Report on Individual Questions

Question 1

In part (a), the quality and accuracy of the sketches was very varied. Many candidates could at least score the first mark for a recognisable branch in quadrant 1 or 2 although there were many cases where the branch clearly curved away from one axis or both axes or clearly stopped at an axis rather than being asymptotic to it. There were a significant number of cases where candidates sketched $y=\frac{1}{x}$ rather than $y=\frac{1}{x^2}$.

In part (b), the majority of candidates knew how to start and multiplied both sides by x^2 or sometimes x^4. A small minority multiplied one side by x^2 and the other by x^4 and made little progress. Of those who started correctly, most obtained a 3 term quadratic equation in x^2. At this point many candidates just used a calculator to quote roots and then, realising all working needed to be shown, tried to show the factorisation, which more often than not, did not match their equation. Some candidates only obtained a 2-term equation which often resulted by evaluating $x^2 \times x^{-2}$ as 0 rather than 1. Some who solved their equation for x^2 forgot about the negative values of x. The majority of those who obtained the correct critical values selected the correct regions although some had extra regions or incorporated $x = 0$ as a critical value.
Many candidates used set notation even though this was not required.

Question 2

Part (a) of this question proved to be very accessible to most candidates and there were many fully correct solutions. The most common error was to use an incorrect value for x_0. There were a few instances where candidates tried to use the approximation entirely in x and could not proceed.

Part (b) was not well answered and the correct answer of 0.8 was rarely seen. It was clear that the majority did not know how to deduce this value from the differential equation.

Question 3

With the details of the vector product given in the formula book, most formed the vector product in part (a) correctly although there were a significant number of sign errors.

In part (b) the majority started again and had another attempt at the vector product, rather than use their answer from part (a). Interestingly some candidates obtained a different vector than their answer to part (a). Most knew and applied the formula for the area and the majority made a good attempt at the modulus although there were some bracketing and algebraic errors. Nearly all remembered to square the "15", although there was some confusion with the $\frac{1}{2}$ in the area formula and the "2" with the vector AB. It was pleasing to see that many could navigate their way through the algebra correctly and obtained the correct values for a. A few opted for a non-vector approach in part (b) and made little progress.

Question 4

Part (a) was probably the least well answered part on the paper and many candidates did not know how to prove this result using suitable double angle formula. Of those who attempted this part, the majority simply quoted the standard results for tan x and sin x to obtain the expression for cos x. Such attempts were given a special case of 1 mark.

In part (b), nearly all substituted to obtain a correct initial equation in t, but the attempts to rearrange it were very variable. There were many sign errors which might have been avoided by careful bracketing of the numerators of fractions before multiplying up. Sometimes these errors prevented them from reducing the equation to a cubic, so they could not proceed to the required result. The most efficient solutions rearranged to $3\tan x = 10(1 + \cos x)$, which gave a much simpler expansion. Candidates who found the correct cubic nearly always factorised it as required although many forgot the "= 0" at the end and so forfeited the final mark in this part.

Part (c) was a very good source of marks for many candidates. Most could at least use a fully correct procedure for finding x from the given factor and even without a correct quadratic factor, could score the next method mark. Some additional incorrect solutions were obtained by adding or subtracting 180° after doubling their solution of $\arctan\left(\frac{x}{2}\right)$. There were also some solutions which were not accurate to 3 significant figures because the candidate had used a solution of the quadratic rounded to 3 significant figures.

Question 5

Part (a) was usually answered well. The main difficulty which arose in this part was that some candidates who were used to using the parametric equations of a parabola found it confusing to use p as the given y-coordinate. There were also a number who used $\frac{8}{y}$ as the gradient in their equation and were often unable to recover.

The mark in part (b) was often scored with a few giving just the point (−4, 0) or the equation $y = -4$ or the equation $x = 4$.

Part (c) proved to be a very demanding part of the paper and success was varied. There were only a minority of fully correct solutions. The unstructured nature of the problem meant that candidates often didn't know where to start. By far, the most significant error, was to assume that the gradient of l was the negative reciprocal of the gradient in part (a). Without this misconception, many attempts would have been more successful. There were several attempts using circular arguments. Some tried to use distance from focus = distance from directrix, resulting in $p^2 = p^2$. Others used the intersection of l with the directrix and l passing through the focus to obtain the gradient of l, but then tried to use again the fact that it passed through the focus. There were some very neat and efficient solutions for this part such as alternative 3 on the mark scheme.

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