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Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel GCE Advanced Level
in Further Mathematics
Paper 9FM0/3A

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Question 1

Most candidates understood what L'Hospital's rule was and realised that they needed to find the derivatives of the numerator and denominator. Errors were fairly common in the derivative of the numerator, in particular errors in finding the derivative of $e^{\sin x}$ and not realising that the derivative of e is 0. A significant number of candidates did not show sufficient evidence of substitution of $x = \frac{p}{2}$ into their derivatives to demonstrate that the limit was the given answer. Candidates need to show the line with their $\lim_{x \to \frac{\pi}{2}} \frac{f'(x)}{g'(x)}$ with x replaced with $\frac{p}{2}$, as this is a show question.

Question 2

This question was approached well in the majority of cases with most candidates having a good idea of what was expected. The vast majority divided the interval from – 1 to 1 into 6 intervals, calculated *y* values and applied Simpson's rule to find the area of the cross section. The most common errors were attempting to use 6 ordinates rather than 6 intervals, getting the coefficients the wrong way round in their application of Simpson's rule and errors involving the units when finding the volume of wood required from their cross-sectional area. There was also a very small number of students who attempted to use a formula for a volume of revolution, possibly seeing that a volume was required and jumping to the wrong conclusion.

Question 3

This question was a routine application of the vector product and scalar triple product and there were few candidates who were unable to achieve a good proportion of the marks available. Errors were mainly sign errors and arithmetic errors with an occasional Cartesian equation given in part b rather than the required vector equation, and vector OD being used as the third vector or a missing factor of 1/6 in part c.

Question 4

There was a significant proportion of students who did not know how to find the 8th derivative of f(x) in this question. Of those that did know what was expected most were able to find the required derivatives accurately, there were very few errors seen in establishing all 8 derivatives of sin 2x and the derivatives of x^4. Candidates then went on to use their derivatives in an accurate application of Leibnitz's rule which included the correct binomial coefficients. There were some students who appeared to be confused by the fact that the derivatives of x^4 vanished after the 4th derivative and only found the first four derivatives of sin 2x, attempting a combination of these derivatives. The vast majority of candidates who found an 8th derivative went on to find $f^{8}(\pi)$ and divide by 8!

Question 5

Most candidates achieved full marks in part a.

There were a good number of candidates who did not attempt part b. Of those that did, choosing a general point in parametric form was the most common approach though these candidates generally then found it difficult to manipulate the trigonometry to find correct expressions for PS and PS'. There were students who chose to use either (0, 4) or (6, 0) as their point P without any justification that the length of PS + PS' would be the same for a general point P. Very few candidates, even those that had found the perimeter correctly, concluded that the perimeter was constant for any P on E.

Question 6

This was a good context for the use of inequalities and nearly all the candidates interpreted the question well, setting up an inequality and attempting to solve it. Most candidates found critical values by considering regions and solving two quadratic equations, a smaller number of candidates squared both sides to obtain a quartic equation which they then solved using their calculator. Accuracy marks were lost using the second approach as exact values were not obtained. There were many correct time intervals formed using the four critical values but some candidates struggled with the context here, giving various combinations of incorrect time intervals or not appreciating the need for 0 rather than – 1 as the minimum value of t. There were a large number of accuracy errors in part a; arithmetic errors leading to incorrect quadratic equations and incorrect critical values and miscopying $5t + 31$ to $5t + 3$.

A large number of candidates did not attempt part b. Of those that did make an attempt, many struggled to interpret their solution to part a within the context of the question, considering whether $t = 4$ was within their intervals rather than calculating a total time from their intervals.

Question 7

Part a was easily accessible to most candidates. The main reason that some candidates ran into difficulties was that they did not simplify their expression for the gradient before substituting it into an equation for the line and then either made algebraic errors or could not see how to simplify their significantly more complicated expressions to obtain the given answer.

Most candidates had a good appreciation of the process required in part b, attempting to find the gradient of the normal at P and then the equation of the normal at P, writing down the equation of the normal at Q and then solving the two equations simultaneously. There were algebraic errors but the most common source of loss of marks was in not showing sufficient working to obtain the given answer. Many candidates went from $9p^3 - 9q^3 + 18p - 18q = x(p - q)$ or similar directly to the given expression for x without justification.

Candidates struggled with part c, there were many responses where part c was not attempted at all and many more where the candidate had put their x coordinate from part b equal to 12 and their y coordinate equal to 0 and struggled to make any progress. Only a very small proportion of candidates reached the correct relationship between x and y.

Question 8

Again, part a was easily accessible to most candidates and most correctly substituted the correct t – formulae for cos x and sin x. Most candidates were able to manipulate their expressions to reach $\dfrac{3\left(1+t^2\right)}{18t^2+12t+8}$ but then wrote down the given answer in completed square form with no further justification, losing the final accuracy mark. It should be reiterated to students that though it is relatively straightforward to check that the two denominators are equivalent, as the answer is given, they should be showing intermediate working to reach the given answer or writing down some other form of justification.

Part b was generally well done with some arithmetic errors leading to an incorrect quadratic and so incorrect values of t. Some candidates either did not continue to find values of x or used an incorrect method to find values of x from their values of t.

Part c was attempted by a good number of candidates but no-one got full marks. Candidates were so focussed on the process of integration that they did not consider the limits carefully enough and did not spot that this was in fact an improper integral. A significant number of candidates did not make a complete substitution, omitting the substitution for dx, and so struggled to make any further progress. Of those that did make a complete substitution most obtained an integral of the correct form $K \arctan M\left(3t+1\right)$ but there were many errors, the most common being to forget to apply the reverse chain rule and so have additional factor of 3. Candidates using a further substitution of $u = 3t + 1$ generally avoided this error.

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