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Examiners' Report
Principal Examiner Feedback

Summer 2022

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

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Question 1
The vast majority of candidates understood how to approach this question, with the most common approach to be multiplying both sides by $(2x+3)^2$, rearranging, simplifying and factorising. In most cases this was successful, although there were some arithmetic errors. Amongst candidates who expanded to a cubic only a very few showed an algebraic method to locate the critical values, and lost marks as a result. Almost all candidates located $-\frac{3}{2}$ as a critical value but only a minority recognised that the function was not defined at this value. Most candidates with 3 critical values went on to correctly identify the inequalities needed to solve the inequality, however most used weak inequalities throughout, rather than the strict inequality needed for $-\frac{3}{2}$. A significant number of responses did not use set notation in their final answer and lost the last A1 as a result.

Question 2
Again, almost all candidates knew how to approach this question and achieved some if not all method marks. A common error was with identifying the initial parameters, with confusion between months vs years leading to use of $h = 2$ and $t_0 = 6$. In most cases, candidates had clearly shown their methods and were able to follow through both iterations successfully. A few candidates rounded values early and lost accuracy marks, and some omitted a final integer answer to the question, also forfeiting a mark.

Question 3
In most responses, the correct *t*-formulae were used for both $\sec\theta$ and $\tan\theta$, which usually allowed candidates to reach the desired final result in part (a). In cases where incorrect formulae were substituted, most candidates demonstrated the right techniques to simplify the resulting expression and were able to access the method marks. Correct simplified quadratics in numerator and denominator were seen in most cases, but the factorising was often less rigorous, with the factor of two not being cancelled consistently. In part (b), where a proof was required, this was more of an issue, with fully correct working being less common. Marks were lost in (b) for not showing the factor of 2 when cancelling e.g .going from $\frac{20+42t-20t^2}{50-8t^2}$ to $\frac{(2t-5)(5t+2)}{(2t+5)(2t-5)}$ and not completing the proof with a statement of LHS= RHS o.e. seen. The most successful candidates were those who were most logical in the presentation of the stages of their algebraic manipulations.

Question 4
Almost all candidates were able to state the coordinates of the focus in part (a). In (b), some candidates worked with the generic form of the parabola and failed to include $y = q$ or $x = \frac{q^2}{10}$ in their attempt to reach the equation. In some cases, this was recovered later on in the working, but made the algebra more difficult to work with. Most who found the gradient as $\frac{5}{q}$ were able to complete the question.
In part (c), a surprising number of candidates tried to derive the equation of the line *AP* again, rather than using the tangent given in (b), which resulted in a large amount of complex and unnecessary working which was not creditworthy. Some attempted to prove the result by using the midpoint of *BF*, but this produced a circular argument which, again, did not earn full marks. Some candidates tried to find a specific value for *q*, usually 5, which missed the point of the

general result. Those who found an equation for *BF* often went on to either substitute into the equation for *AP* or to use the *y* intercepts. The latter approach was more likely to earn full marks if the conclusion was stated clearly. In the former, whilst most successfully eliminated *y*, not all reached an equation of the form $x\left(50+2q^2\right)=0$ or equivalent, in order to draw the required conclusion. Those that did often did not reject the possibility that the expression in terms of *q* could be equal to zero, meaning that the final conclusion was incomplete.

Question 5

Those candidates who were able to find the coordinates of *M*, *N* and *P* often went on to complete the rest of the question correctly. However, a surprising number of candidates did not seem to understand how to do this and having found vectors for *AB*, *AC* and *AD*, just replaced the *z* value with a zero. Poor arithmetic hampered a number of candidates in this part of the question, and responses with 1 or 2 incorrect points were common.

Only 2 responses were seen in which candidates used the first method shown in the mark scheme to find the area of the triangle. Most attempted to use the cross product and were able to earn a method mark, although a few tried to find an angle using dot product or cosine rule and then ½*ab*Sin*C*.

Similarly, no responses were seen using the $\frac{1}{3}\text{area base}\times\text{height}$ method to find the volume of *NMPA*. However nearly all candidates who attempted part (c) knew how to use the triple scalar product and attempted to use it twice for *NMPA* and *ABCD*. In a few cases, candidates tried to apply this to find the required volume directly, using 4 of the 8 vertices. Small slips with negative signs or arithmetic were not uncommon but did not prevent candidates earning method mark(s). Using the discriminant of the 3x3 matrix was the most common approach to evaluating this and was usually correct.

Lack of labelling of vectors led some candidates to use the wrong vectors in their subsequent calculations and again, those who made their working clear and methodical were more likely to achieve success in this question.

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