Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE

A Level Further Mathematics (9FM0)

Paper 3A Further Pure Mathematics 1

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Question 1

This question proved to be accessible with most learners achieving full marks.

Part (a) The majority of learners scored this mark, an easy start

Part (b) Very few errors were made in identifying the step length, however a few implied

$h = 1$ gaining no marks. A confusion of the "odd" and "even" ordinates roles in the use of Simpson's Rule was seen. As usual, there were also cases of missing brackets. A lack of showing working was also noted in some learners.

Part (c) was more challenging.

The most common error was identifying the right identity, then mis-applying it, either by getting a sign wrong initially or - a surprisingly common one - writing the correct thing but then multiplying by e instead of dividing. Another sign of lower number-sense, as their integral became nearly 3 times the size instead of nearly 3 times smaller, and they didn't notice.

Very occasionally learners applied Simpson's again, gaining no marks.

Question 2

A slight twist on this type of question as the function to be expanded was given within a differential equation involving the product of the function and its variable leading to using the product rule efficiently, most learners coped well with the question, with inaccuracies in part (b) being the main cause of loss of marks.

Part (a) was straightforward for most candidate, used the product rule correctly leading to the correct third and fourth derivative of y.

Part (b), most learners deduced the correct value of $\left.\frac{d^2y}{dx^2}\right|_{x=2}$ but most mistakes happened when evaluating $\left.\frac{d^4y}{dx^4}\right|_{x=2}$ as student substituted the wrong value of x.

There were a few with sloppy notation when it comes to forming the Taylor series, but the large majority recognizing the need for $(x-2)$ terms (which shouldn't be surprising given the wording of the question), but still one or two leaving in terms of $(x-a)$or simply x. One or two who, after achieving a correct expansion, proceeded to expand out all their brackets to rewrite as an expansion in powers of x. Even those who got some of the earlier numbers wrong generally had a Taylor series consistent with their values for y'', y''' and y''''.

Unfortunately many learners lost marks for not including $y = \ldots$ or $f(x) = \ldots$, the other most common error was an incorrect y_0 term, either omitted completely or using 2 instead of 1. Also few learners used $f(x-2) = \ldots$

Question 3

This question required the learners to first find the critical values of the given expression and then to express the sets of solutions as inequalities.

Using graphical calculators was not allowed due to the wording of the question. No evidence was seen of their use and the requirement to show all stages of working was well understood.

The identification of $x = 5$ as an asymptote, or the equivalent $x \neq 5$, was often omitted throughout the solution or did not appear until the final answer.

A variety of correct approaches were seen. The most common was to consider the cases $x > 5$ and

$x < 5$ separately to reach two quadratics which, when solved yielded three critical values. Another common approach was to multiply through by $(x-5)^2$and $(5-x)^2$ to proceed in the same way.

A less common approach was to square both sides of the given expression which led to a quartic in x. It was permissible to use a calculator to solve this although factorisation was also seen.

A very common error was only considering $(x-5)^2$ to find three of the four critical values but did not consider $(5-x)^2$ to find the final critical value. Having found all of the critical values, learners who ignored $x = 5$ being an asymptote lost both marks for the inequalities and only achieved half marks for the whole question.

It was very common to see sketches used to help learners identify relevant regions, but unless the asymptote at 5 was identified it did not help them gain full marks.

Question 4

Part (a) of this question required learners to differentiate the given expression to obtain the second derivative. Most learners either used the product rule twice or after differentiating once using the product chose to rewrite the function as a quotient and then used the quotient rule.

An alternative rarely seen was to square to get y^2 and then to use implicit differentiation twice.

There were errors seen particularly in powers which prevented reaching the printed answer correctly. However, this part proved a source of three marks for most learners.

Part (b) required the use of a Maclaurin series to reach a series expansion for y. The method was well known but learners should be advised to write down the Maclaurin formula first before using it. Some learners lost both marks because they wrote down an incorrect expansion with no working. It was not possible to know if the error was in the values of the derivatives or in the formula. Learners should be advised to show all their working.

The last mark was often lost because the answer did not refer to $y =$ …. as the question asked for.

Part (c) required the use of the small angle approximation for $\sin 3x$ which was usually correct although there were slips in powers.

Part (d) required a correct and rigorous proof using the answers to (b) and (c) including the correct use of limit notation. Again, learners should be advised to show all working when an answer is given. Slips in powers particularly in the denominator lost the final mark.

A few learners used ether answers to (b) and (c) and then used l'Hospital's rule correctly.

Question 5

Part (a) Many learners used the given substitution in the correct *t*-formula of cosec *x* and moved forward with a correct change of variable within the given integral. Weaker responses exposed some inability to expand/multiply brackets correctly. Some did not place d*t* after the integrand.
Part (b) Many learners did not use the correct for of the partial fractions, often incorrectly using $\frac{A}{1+t^2}+\frac{B}{(1+t)^2}$ which did lead to the correct expression but followed incorrect work so lost 4 marks. Learners were still able to score the method mark for reversing the substitution. Learners who correctly used $\frac{At+B}{1+t^2}+\frac{C}{1+t}+\frac{D}{(1+t)^2}$ often went on to successfully answer the question. A few struggled to find the correct values of the constants as it involved solving multiple simultaneous equations.

Question 6

Part (i)

Most learners understood what L'Hospital's rule was and realised that they needed to find the derivatives of the numerator and denominator twice. Common mistakes included incorrect second derivatives of the denominator with a slip in the sign or coefficient, incorrectly achieving $\frac{d^2y}{dx^2}=cos\,9\,x+9\,cos\,9\,x+81x\,cos\,x$ or $cos\,9\,x+9\,cos\,9\,x-9x\,cos\,x$ instead of $\frac{d^2y}{dx^2}=cos\,9\,x+9\,cos\,9\,x-81x\,cos\,x$. This still lead to the correct answer but losing the final accuracy mark as an incorrect line of working in their proof. This question would still yield the correct result with various errors, so perhaps learners assumed the 'show-that' meant they didn't need to check their working as carefully.

Correct limit notation was required with the majority of learners using the correct notation throughout.

As this was a show question learners need to show where the final answer of $\frac{49}{18}$ can from, either $\lim_{x\to 0}\frac{49\,cos\,7x}{9\,cos\,9x+9\,cos\,9x-81x\,sin\,9x}=\frac{49}{9+9}=\frac{49}{18}$ or $\lim_{x\to 0}\frac{49\,cos\,7x}{18\,cos\,9x-81x\,sin\,9x}=\frac{49}{18}$

Part (ii) a & b:

This proved to be more difficult for learners with most able to achieve the first two marks. Most learners were familiar with Leibnitz Theorem but many learners find it challenging to use the theorem to evaluate the k^{th} derivative of the function challenging. While most learners were able to differentiate correctly $u=x^2$and $v=e^{3x}$three times and then acknowledging that $\frac{d^ky}{dx^k}=0$for all values of k greater than 3, unfortunately some candidate were not able to evaluate the k^{th}derivative of $v=e^{3x}$ as $\frac{d^kv}{dx^k}=3^ke^{3x}$, which led them to rely on a trial-and-error approach, manually calculating the 2nd , 3rd , and 4th derivatives of y to attempt to spot a pattern. This approach often led to the loss of 3 out of the 5 marks allocated for Part (ii)(a), as it by passed the use of the theorem.

Most learners who used the theorem correctly were still prone to a common error when computing the binomial coefficient of the third term. Some incorrectly evaluated it as $\binom{k}{2}=k(k-1)$. Some got their binomial coefficients wrong, or just got muddled when trying to factorise out the power of 3. Following errors many learners did manage to achieve a correct answer as the structure of the answer was given but scored A0

Part (ii)(b)- This part served as a valuable opportunity for learners to secure a method mark, even if their final expression in part a-ii was incorrect, as long as they recognised that the solutions of the resulting quadratic equation must be real.

Question 7

Part (a) was a common type of question requiring the use of a given transformation to transform a given differential equation into one that could be solved.

Learners know how to proceed but it was frequently difficult to follow the steps being performed with much crossing out and changing of work.

Having reached the stated differential equation, most learners used the integrating factor method to proceed. There were few instances of an incorrect integrating factor being obtained and how to proceed using integration by parts was well done. A few learners omitted the constant of integration and could not proceed correctly.

Occasional learners incorrectly use $IF = e^{2t}$ or e^{-2x} instead of $IF = e^{-2t}$

Some learners attempted to find the complementary function, solving $m - 2 = 0$ but quite a few had the incorrect form $y = Ae^{2x} + B$. They then commonly had an incorrect form for the particular integral using $y = \alpha t$ instead of $y = \alpha t + \beta$. Both of these led to the lose of marks.

In part (c) it was necessary to use the value $t = 3$ to find the value of P and to compare that to the given value 0.034. It was then possible to make a statement about the reliability of the model. Most learners could perform these steps successfully, with many using the percentage error

Some chose to evaluate P^2 rather than P. This was allowed for the M mark provided that they compared it with 0.034^2. The final mark was lost by those who did not proceed to then find P.

Question 8

Part (a) was accessible to almost all learners. Weaker responses displayed an inability to expand $(mx + c)^2$ correctly or the understanding that correct placement of "=" is important.
(b) Some learners struggled to identify the need to use the discriminant. Other learners used the discriminant correctly but could not cope with the algebraic manipulation that followed.
This part confused learners who were expecting to use some conic section skills. Many assumed, incorrectly, that the given point was also on the ellipse. Some learners tried to use parametric equations together with differentiation

Question 9

Part (a) The need to form two appropriate vectors and form the cross product was generally well understood.
Some did not take enough care with signs in their calculation and so forfeited the third mark.
Part (b) Many identified the correct vectors and placed then correctly. Some did not include = 0 and failed to gain the accuracy mark.
Part (c) Many learners found this part challenging although some offered a very precise and correct solution. Sometimes the solution failed because there was too much generalisation and individual components of a vector were not fully identified. On occasion there were simple arithmetic errors or sign slips. It was not uncommon for a position vector or direction vector to be incorrectly identified.
Learners used a wide variety of methods. The most efficient was to calculate the vector between point

E and the point on the plane and then use the answer to part (a) to form the vector triple product. Learners were able to get the correct result in a few lines. Those who attempted more complicated methods were often incorrect, either getting their vectors confused or forming the equations of the wrong planes. Some learners were quite poor at explaining their methods so some of these attempts were very difficult to follow.

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