Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE
In Mathematics (9MA0)
Paper 02 Pure Mathematics (Modified version)

Summer 2025
Publications Code 9MA0_02_2506_(Modified version)_ER*

General Comments

This paper proved to be a good test of learners' ability on the 9MA0 content and plenty of opportunity was provided for them to demonstrate what they had learnt.

Most learners accessed marks throughout the paper and there were many fully correct solutions to the earlier questions. The later questions offered more of a challenge with questions 13 and 14 being found the most difficult. The majority of learners produced robust proofs in question 11.

Question 1

Part (a) was an accessible start to the paper with almost all learners realising that they needed to set the modulus bracket equal to zero and so obtained the correct coordinates.

In part (b), learners appeared familiar with a method for solving modulus equations with most attempting to solve both $x-4+10=3x$ and $-x+4+10=3x$. Most learners solved the equations correctly, but many did not realise that $x = 3.5$ was the only solution, so did not gain the final mark. This indicated that they had possibly not referred to the diagram as they might have realised that there could only be one solution.

Question 2

In part (a), most learners drew the correct shaped graph in the correct quadrants with the correct y intercept labelled. However, a few responses included a horizontal asymptote which was not the x-axis which meant they could not score full marks.

Part (b) was well answered, with most learners being successful. The most common mistake was to multiply the -5 and $\frac{1}{2}$ rather than adding e.g. $\frac{1}{32}\sqrt{2}=2^{-5}\times 2^{\frac{1}{2}}=2^{-\frac{5}{2}}$ rather than $\frac{1}{32}\sqrt{2}=2^{-5}\times 2^{\frac{1}{2}}=2^{-\frac{9}{2}}$.

Question 3

This question was well attempted with most responses stating the correct terms of the sequence and setting the sum equal to 12. Most were also able to obtain and solve a correct quadratic in k, and identity the correct value. A small minority appeared unfamiliar with the sigma notation and set the 3rd term equal to 12.

Question 4

The majority of learners answered part (a) successfully with the most common omission being not stating that the function was continuous.

In part (b), many responses did not differentiate 2^x correctly and did not obtain $p = \ln 2$ but often incorrectly obtained $p = 1$ or sometimes $p = x$. This could not gain the mark in this part and the subsequent accuracy marks in the rest of the question.

Part (c) was usually carried out correctly using their derivative from part (b), but the accuracy mark was often not awarded because of an incorrect derivative.

The equation in part (d) was usually solved correctly but again the accuracy mark was not awarded following an incorrect derivative in part (b).

Question 5

In part (a), learners appeared to be familiar with the trapezium rule and the majority were able to obtain a correct answer to the required degree of accuracy. A small minority of responses incorrectly used $h = \frac{1.5}{7}$ or had bracketing errors leading to an incorrect final answer.

Part (b)(i) was generally well answered with most responses doubling their answer to part (a). In part (b)(ii), although most responses added the area of the rectangle, a few appeared unsure how they should use part (a) and so attempted to use the trapezium rule again.

Question 6

This question was a good source of marks for the majority of learners. Generally those that could take out $\frac{1}{2}$ from the bracket to give $\left(1+\frac{3}{2}x\right)^{-2}$ tended to go on to score full marks for the expansion. Part (b) was less well answered although many correct ranges were seen.

Question 7

In part (a), learners appeared familiar with the order of composite functions, and most were able to substitute e^2 correctly to obtain a correct value for $gf\left(e^2\right)$.

Part (b) proved to be challenging for many learners. Most responses used the quotient rule to find $g'(x)$, and most did so correctly, but then seemed unsure as to how to proceed. Some responses did not effectively show that the function was decreasing, so made no further progress. A significant number did not reduce the numerator to a constant and so were unable to proceed. This was sometimes due to arithmetic or algebraic errors, and sometimes due to not realising that this was what was required. A number of responses just substituted various values of x into g, which was not sufficient to complete the proof.

Part (c) also proved challenging, with many learners not attempting this part, or unsure as to how to attempt to find a range for this composite function. Only a small minority were able to find the correct limits.

Question 8

Most learners were able to identify a suitable strategy to find the area required. The vast majority were able to integrate the function correctly and then subtract the area under the curve from the area of a rectangle. The main error that occurred were using the limits of 0 and 16 rather than 3.5 and 16 when finding the area under the curve and there were sometimes errors with the coefficient when integrating.

Question 9

Part (a) was very well answered. Many fully correct and complete proofs were seen in this part.

In part (b) only a minority realised they could use a simple proof by counter example. The majority attempted an algebraic proof, usually attempting to find the difference between $(2n)^2$ and $(2n+2)^2$ and reaching $8n + 4$. Some responses simply stated that this was not a multiple of 8 but did not give a valid reason why.

Question 10

In part (a), a significant number of learners struggled to differentiate $(4x-k)\times e^{-x^2}$ correctly. As a result, this often made the rest of the question difficult to access.

In part (b), responses frequently did not demonstrate clearly that the only other turning point was when $x=-\frac{1}{2}$. Most simply substituted $x=-\frac{1}{2}$ into their derivative to verify that this gave zero rather than using appropriate algebra to show it was the only other turning point.

Part (c) was found very challenging, and responses commonly did not find either of the appropriate limits. For those who did attempt $\text{f}(1)$ and $\text{f}\left(-\frac{1}{2}\right)$, some did not realise that $p = 0$ needed to be excluded from the range of values.

Question 11

This question was very well answered with many learners presenting a fully correct proof. Learners seemed to be familiar with the proof by first principles for the trigonometric functions. Almost all responses demonstrated good progress in the initial steps of setting up the correct fraction and applying the correct compound angle formula. Most were then able to isolate the $\frac{\cos h-1}{h}$ and $\frac{\sin h}{h}$, replace these with 0 and 1, and then proceed to $\cos\theta$. Responses demonstrated good use of limit notation and often stated that $\cos\theta$ was the derivative. A small number of responses worked the solution entirely in terms of x rather than θ and did not gain the final mark.

Question 12

There were a few learners who did not attempt this question but those that did often showed a good understanding of 3D vectors and scored full marks in part (a). Those who struggled with this part, tended to add vectors when they should have been subtracting e.g. when finding $\overrightarrow{MN}$.

Part (b) required learners to realise that the **j** component needed to be 3, so they needed to find the correct scale factor. Some realised this but then found the reciprocal of the required scale factor. For those with a correct method, some managed to obtain a correct vector $\overrightarrow{OQ}$ but did not make the final step of converting this into coordinates as required by the question.

Question 13

This question proved to be one of the most challenging on the paper.

Many learners made a good start with part (a), usually by attempting $\frac{u_2}{u_1} = \frac{u_3}{u_2}$. Most then realised they needed to use the double angle formulae to obtain an equation in single angles. A significant number of responses did not make further progress after applying the double angle formulae, either due to arithmetic or algebraic slips or simply not knowing how to proceed to the required form. Responses often included bulky expressions that were not simplified by cancelling down some of the terms. Some responses demonstrated the alternative method on the mark scheme, attempting to get their equation in terms of a single trigonometric term, but very few were able to reach a correct cubic or quartic equation in sin θ.

Part (b) proved challenging as it appeared that some were unsure as to how they should prove that the sum to infinity existed. Few learners realised they needed to find *r*, or an expression for *r*, and then conclude $|r| < 1$. Many learners attempted to find a sum to infinity and then stated that it existed, and many struggled to find a value for *r*, as they struggled to manipulate their expressions.

In part (c), although many attempted to find the difference between the sum to infinity and the sum of the first 10 terms, only a small minority were able to find a correct value. Though many responses demonstrated the attempt to apply their value for *a* and *r* to correct formulae, many struggled to find correct values for the component parts.

Question 14

This question was also found very challenging and only a few correct answers were seen. Most responses obtained the correct value for *A* however very few found the value of *b*. The subsequent required integration of $A\cos(bt)$ was done well, but those without a numeric *b* were unable to make any further progress.

Question 15

For part (a) learners appeared familiar with working with models and applying the units correctly, and most obtained a correct equation for the model. Only a few used the incorrect $x = 4000$.

For part (b) most responses stated the correct value.

In part (c), learners were adept at splitting the expression into partial fractions and the majority found the correct values for their A and B and stated the correct partial fractions. A small minority changed $(6 - x)$ to $(x - 6)$ before finding A and B, which sometimes led to sign errors.
Most responses demonstrated familiarity with the type of differential in part (d) equation and the integration of the partial fractions to logarithmic form. There were many fully correct equations seen following the separation of the variables and subsequent integration. A minority of responses did not include a constant of integration so could not make further progress, and a handful ignored this constant altogether when they were unsure as to how to deal with it. Learners found the algebra and manipulation of the expression to the required form quite challenging and only a minority achieved the given equation with no errors.
Most learners that attempted part (e) stated the correct value.

Question 16

In part (a), the majority of learners realised they needed to find y when $\cos t = \frac{1}{2}$ but did not realise that y needed to be negative and used $t = \frac{\pi}{3}$ rather than $t = -\frac{\pi}{3}$. It was therefore clear that many did not use the graph as a guide that showed y should be negative.

In part (b), many learners could at least make a start by finding $\frac{dy}{dx}$ using parametric differentiation and setting this = $-\frac{3}{2}$ to obtain an equation connecting sin t and cos t. Many learners were then unable to proceed. Of those who made progress, the majority opted for a squaring approach rather than finding the harmonic equation for the trigonometric function. There were very few fully correct answers to this part.

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