Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE
In AS Mathematics (8MA0)
Paper 01 Pure Mathematics

Summer 2025
Publications Code 8MA0_01_2506_ER*

General Comments
Overall, this paper tested most aspects of the Pure content of the AS Level specification and gave prepared candidates the opportunity to demonstrate what they knew and understood. Candidates were presented with a variety of questions which required problem-solving and many of these had multiple routes that they could pursue to reach the answer.

There were particular instances where it was clear that candidates were not aware of common errors highlighted in previous series. A particular case was in question 2(b) where many candidates expressed the region in terms of R e.g. $2x^2 + 5x + 3 \leqslant R < 4x + 12$ and scored no marks in this part.

Candidates are also advised to draw diagrams to help them visualise and solve problems. It was clear that candidates who drew a diagram for question 3(b) and question 4(b) were more successful that those who didn't.

Reports on individual questions

Question 1

For part (i), $y = \mathrm{f}(x + 2)$ was generally drawn well, with most candidates achieving the correct horizontal translation with correct points and the correct asymptote labelled. The most common mistake was to translate the curve to the right, and therefore only scoring the first mark. A few students added 2 to the y-coordinates of each point, attempting an upwards translation.
While there were many good sketches with many candidates scoring full marks on this part of the question, there were also a lot of careless sketches with the maximum not clearly being on the y-axis and curves crossing or curving away from the asymptote. Most wrote their coordinates and the equation of the asymptote correctly.

Part (ii) was not answered as well as part (i) with a variety of different mistakes for the curve $y = -\mathrm{f}(x)$, the most common being to reflect the curve in the y-axis. Some candidates correctly reflected the curve in the x-axis but did not change the asymptote from $y = 3$ to $y = -3$. Sometimes this mistake lost all 3 marks because the curve was partly drawn in quadrant 1.
Others translated the curve or found incorrect coordinates. Again, some curves were drawn poorly, so that the main features were not clearly identifiable and the coordinates unclear. The point $(2,-7)$ was often not at the minimum point and frequently the curve did not tend towards the asymptote.

Question 2

Part (a) was generally answered well by the majority of candidates. Most were able to correctly calculate the gradient and went on to correctly form the equation of the line. The most commonly used method was the point-gradient form $y - y_1 = m(x - x_1)$ which was usually applied successfully to arrive at the correct equation $y = 4x + 12$.
Others used the form $y = mx + c$, substituting coordinates to find c.
Common errors included:

- an incorrect gradient method of $\dfrac{x_2 - x_1}{y_2 - y_1}$
- sign errors when substituting coordinates
- slips when expanding brackets or rearranging
- finding the equation of a perpendicular line

Despite these errors, most candidates achieved full marks for this part.

The performance in part (b) was much more varied. Whilst many candidates who correctly completed part (a) were able to identify and write the inequalities describing the bounded region, e.g. $y < 2x + 12$ and $y \geqslant 2x^2 + 5x + 3$, a significant number misunderstood the question and presumably seeing the shaded area, attempted to find the area between the line and the curve. Of those who interpreted the question correctly, as in previous series, there were a large number of candidates who defined the region using R instead of expressing inequalities in terms of y. This usually resulted in the loss of both marks. Of those who did attempt inequalities, common errors included

- writing inequalities the wrong way round or using inconsistent inequality symbols
- using set notation incorrectly
- defining the region purely in terms of x e.g. $-3 < x < \dfrac{5}{2}$

This part of the question highlighted a significant gap in understanding how to describe regions using inequalities.

Question 3

In part (a), a good proportion of candidates arrived at the correct value for $\left|\overrightarrow{OB}\right|$ as $\sqrt{40}$ or $2\sqrt{10}$, either in part (a) or (b). Some candidates mistakenly found $\overrightarrow{OB}$ as $\overrightarrow{OA}-\overrightarrow{AB}$ rather than $\overrightarrow{OA}+\overrightarrow{AB}$ whilst others found $\overrightarrow{OB}$ but not its magnitude, although they were allowed recovery if they subsequently found the magnitude in part (b). A few just found $\left|\overrightarrow{AB}\right|$ in this part and others slipped up on one of the components of $\overrightarrow{OB}$.

In part (b), many drew a diagram to help and there were many correct answers. Those who did not draw a diagram found this more challenging. The vast majority achieved at least one mark for finding the length of $\overrightarrow{OA}$ or $\overrightarrow{OB}$. Most understood the need to use the cosine rule, and this was often the rearranged form with cos(*OAB*) as the subject. A surprising number of candidates found the wrong angle of the triangle by substituting their vector lengths into the wrong places in the cosine rule formula, especially those without a diagram. Others made slips in the rearranging. Some candidates incorrectly assumed that the triangle was right-angled and attempted to find angle *OAB* using trigonometry in a right-angled triangle. For those with a good diagram, the $\tan^{-1}$ approach worked well, and many successful strategies were seen.
A few students used the scalar product approach, but again those without a diagram often used incorrect vectors and found the wrong angle.

Question 4

In part (a), most candidates showed good understanding of how to write the equation of a circle in a suitable form to extract the coordinates of the centre and the radius. There were occasional slips with the centre coordinates given as any combination of $(\pm 5, \pm 2)$. It was more common to see errors in manipulating the constants to get the correct radius. Candidates should be reminded to leave answers in the exact form, unless prompted by the question to round to a certain degree of accuracy.

In part (b), a variety of approaches were seen, many attempting an algebraic method using the equation of the circle and discriminant rather than a geometrical approach. The geometrical approach was generally much more successful and succinct. Many candidates would have benefitted from drawing a diagram illustrating a circle and a horizontal line with equation $y = k$ to enable them to visualise the situation. Some diagrams with $y = k$ drawn as a diagonal line were seen. Algebraic methods were generally less successful, with errors in the algebra and errors in identifying the coefficients to apply to the discriminant. Without the context, candidates often chose the wrong range of values since the quadratic inequality obtained contained a negative x^2 term. Many candidates did not provide a final answer in set notation despite identifying the correct range of values. Use of “union” instead of “intersection” was seen quite frequently.

Question 5

In general, this question was a good source of marks for many candidates.

In part (a), many scored at least 2 out of the 3 marks. Some candidates were unable to eliminate the denominator at all and scored no marks. Others tried, but ended up with, incorrect coefficients. The most common mistake was to multiply each of the coefficients in the numerator by $4x^{-1}$ instead of $\frac{1}{4}x^{-1}$ resulting in correct indices, but incorrect coefficients and this error would cost them both A marks in this part. Some achieved the correct answer and then multiplied through by some value to achieve a different expression. ISW was not applied in these cases. A successful approach for many students was to split the fraction into two separate fractions (some using division signs) and simplify each one. However, separating an algebraic fraction was problematic for some candidates.

In part (b), most candidates were able to integrate at least one term correctly, even if they had the wrong expression from part (a). Many students scored full marks here, especially those with full marks in part (a). 2 marks was common if their answer to part (a) was incorrect, with the first A mark often awarded as a follow-through. Common mistakes included:

- forgetting to include "+ c"
- achieving $\frac{5}{4}$ or $\frac{4}{5}$ instead of $\frac{1}{20}$ when simplifying fractions
- obtaining an incorrect power for the second term when attempting add 1 to $-\frac{1}{2}$

Again, some candidates achieved the correct answer and then attempted to multiply through by some value to achieve a different expression, but this was not penalised in part (b). Those who had done less well on part (a) often managed to pick up the first two marks (M1A1) despite earlier errors with their fractions or indices. However, even amongst those scoring well, there was some poor notation e.g. spurious integration signs, though these were not penalised.

Question 6

The large majority of candidates were able to access part (a). The most common and most successful approach was to use the factor theorem though there were some (often unsuccessful attempts) at algebraic division and inspection. It is still concerning that candidates are not evidencing they appreciate their substituted expression should = 0, as a result of this a number of candidates lost the A mark.
Although the skills involved in part (b) were quite fundamental, the understanding of the demand of the question differentiated the candidates. Pleasingly the majority were able to differentiate correctly, substitute 2 into their derivative and set equal to 14, then solve the two equations simultaneously. On occasion those candidates who solved algebraically, as opposed to using their calculator, lost the final accuracy mark. Arithmetical errors were also seen in rearranging the second equation. A number of candidates achieved the first two marks for correctly differentiating however they then went on to set $f'(2) = 0$. Other candidates achieved no marks as there was no attempt to differentiate and instead attempted $f(2) = 0$ or $f(2) = 14$ or integrated instead of differentiating. In all cases there was very minimal evidence of candidates checking that their solutions to a and b satisfied the given conditions.

Question 7

Part (a) was typically answered well, with the majority of candidates attempting the substitution of 175, including reasonable explanations to secure both marks. Some responses included erroneous brackets around -175, resulting in losing the negative sign when squaring.

Part (b) of the question was completed less successfully. A common error saw candidates replacing P with 200 000 instead of 200, leading to incorrect solutions and loss of three marks. While some candidates annotated the figure with a horizontal line at 200 to enable them to visualise that there were 2 possible solutions that gave $P = 200$, the word ‘highest’ in the question prompted some pupils towards an optimisation approach, differentiating and setting = 0, ignoring the minimum profit. A large number of candidates lost the final mark due to either losing the £ sign from their final answer or not giving the answer to two decimal places as is expected when working with money.

It was pleasing to see many candidates successfully completing the square in part (c). However, there were also a large number who struggled with the negative coefficient of x^2 and some candidates multiplied the whole expression by -1 and many incorrectly incorporated it into the bracket resulting in various combinations of signs. Many made errors finding the constant and a large number of candidates confused this part with part (b) and attempted to complete the square on the wrong quadratic expression. There were a number of responses which did not simplify the final answer, resulting in a loss of the final mark.

On the whole part (d) was quite well done. Candidates who didn’t see the connection between (c) and (d) often used differentiation instead to get the correct answer. Some marks were unfortunately lost due to lack of units or misunderstanding of the units.

Question 8

This question was designed to test candidates use of trigonometric identities and solving trigonometric equations and most candidates attempted this question, with a significant number achieving at least one mark. Only a small minority of candidates did not attempt this question. Most candidates were able to recognise the use of one of the three trigonometric identities. Errors were generally in substitution where some candidates used x instead of $3x$.

Where candidates correctly substituted the trigonometric identity correctly they usually rearranged to the correct format, thus gaining the first two marks. A common error from this point was to miss out the square rooting and use the arcsin/arctan/arccos with the constant, thus scoring no further marks. A small number of candidates square rooted, however did then not proceed to the required format by missing out the division by 3, scoring no more than two marks. For candidates who correctly square rooted and then solved for $3x$, a large majority did not achieve the final A mark as they did not consider both roots and/or change the scale for the question. It was common for candidates to achieve one or two solutions, rather than all three. Only a very small number of candidates found, additional wrong solutions within the range provided. A few gave additional solutions outside the range although this was not penalised.

Question 9

By far the most common approach to this question was to use the discriminant. Many candidates showed a good understanding of the discriminant and its effect on the roots of a quadratic equation though some candidates started to form the discriminant with the "= 0" only appearing later in the solution. The most common error seen was in an incorrect expansion of $-4(5q+4)$ resulting in the loss of a negative sign and subsequently an incorrect attempt at the difference of two squares. Some candidates struggled to correctly identify a, b and c in b^2-4ac and some included x's in their attempt. There were a small number of other approaches, completing the square being the next most common. There were also a large number of candidates who tried to rearrange the given equation or manipulate the given relationship between p and q with no obvious strategy. Candidates should be reminded that this was a 'Show that' question which requires the solution to reach the printed answer precisely, ensuring that the condition that $b^2-4ac=0$ is clear from the start. Students who find that their working is leading to an incorrect result might spend a little time checking their working, particularly when there are so few steps as here and they know the result they should be getting.

Question 10

This question was generally well answered, with many candidates demonstrating a solid understanding of the laws of logarithms. Most were able to apply the key rules, such as the power law and the subtraction law, to progress effectively through the problem. The majority of students gained the first mark for correctly applying the power law and many successfully used the subtraction rule to combine logs into a single expression and then correctly equated it to a constant. Most candidates were able to solve the resulting quadratic equation and correctly identified the roots $x = 5$ and $x = -4$ although a significant number of candidates failed to reject $x = -4$ and ss a result, lost the final accuracy mark.
Several candidates incorrectly expanded $2\log_3(x+1)$ as $2\log_3 x + 2\log_3 1$ or displayed other misconceptions such as $\log_3(x+1)^2 - \log_3(x+7) = \frac{\log_3(x+1)^2}{\log_3(x+7)}$, showing a misunderstanding of logarithmic laws. In terms of algebra, mistakes were seen in expanding expressions such as $3(x + 7)$ which was sometimes incorrectly expanded to $3x + 7$. A few students attempted polynomial division after correctly combining logarithmic terms, showing confusion in handling the rational expression. Generally candidates who demonstrated a secure grasp of logarithmic laws and followed a logical, structured approach were generally successful. However, persistent issues with rejecting invalid solutions and applying basic algebra correctly meant that some otherwise capable candidates lost marks unnecessarily. The question effectively discriminated between those with strong conceptual understanding and those with only procedural fluency.

Question 11

A small minority of candidates did not attempt this question at all. Some candidates attempted part (a) and then did not go on to attempt the remaining parts (generally when they were unable to complete part a)).
In part (a), a common error in the first B mark was to miss out the π for 90000π. Some candidates used an incorrect formula but most who wrote the correct formula, rearranged this into a different format to use later. For the second B mark, this was less well scored. Some candidates had the formula for a complete cylinder and some candidates did not write down this formula (it was often implied with later working but this resulted in the loss of both the second B mark and the A mark as this was a proof question). Where candidates had gained the first three marks, they often went on to simplify the formula and gain the final accuracy mark.

Most candidates who attempted part (b) were able to differentiate correctly to gain the first mark. A common error was to miss out the π, thus resulting in the wrong value for r. Most candidates who attempted to differentiate often achieved the correct value for r from a cubic expression.

Part (c) was less well answered and some candidates made errors with the differentiation. A small minority of candidates differentiated the r^{-2} correctly but did not include the differentiation of the $2\pi r$ to get 2π. Most candidates recognised the need to substitute their value from part (b) into the second derivative to achieve a number greater than zero. A common error was to mix up parts (b) and (c). Some candidates found the first derivative (often correctly) then found the second derivative and put this equal to zero (rather than the first derivative), thus losing marks from parts (b), (c) and (d).

In part (d) most candidates were able to correctly identify the need to substitute their r into the formula for A, and a good number achieved the M1 mark as a result. Fewer candidates were able to achieve the A1 mark. Some candidates multiplied or divided by 30 (or 100), but fewer recognised and used the correct conversion for centimetres squared into meters squared. Some candidates used an approximation so didn't achieve this mark. A small number did not put their answer in the correct format for money.

Part (e) was attempted by a good number of candidates. The most common correct answers related to waste and ability to buy the exact amount of material. Incorrect answers tended to relate to the width/thickness and rounding errors.

Question 12

This question was met with mixed success. Whilst many candidates made a reasonable attempt at sketching the quadratic graph in part (a), part (b) proved more challenging, particularly in selecting the correct gradient function and providing adequate justification.

Part (a) was generally better attempted, with many candidates recognising the need to draw a U-shaped (positive quadratic) graph. Common errors included:

- drawing a cubic curve rather than a quadratic
- drawing a straight line
- sketching a quadratic that did not cross the x-axis or with incorrect roots, such as crossing the positive x-axis instead of the origin and negative x-axis

Some candidates left the sketch blank or attempted part (b) without completing part (a). Despite these issues, most candidates gained at least 1 mark for showing some correct features, such as a U-shape or one correct root.

Part (b) was less well answered. While some identified the correct function, many failed to justify their choice clearly or accurately. Common issues included:

- no justification or vague explanations such as "it's a cubic" (which applies to all the given options)
- stating that it was correct because of the roots, but without explaining the link between the function and its derivative
- attempting to integrate each option instead of recognising it as a derivative
- incorrectly assuming a connection between the coefficient of x^2 being 3 and the original curve being cubic

Some selected the correct function but gave ambiguous or incorrect reasons, which prevented them from accessing full marks. A wide range of incorrect gradient choices were also seen.

Stronger responses either correctly linked all the required aspects or ruled out the incorrect options through logical reasoning, demonstrating good understanding. Overall, this question differentiated well between candidates.

Question 13

Candidates' performances in this exponential modelling question were varied with some able to obtain full or nearly full marks, whilst others made very little progress. Candidates who did fail to score marks in (a) were often able to gain credit later in the question. Units were required in the answers to (b) and (c)(i), and the omission of these were penalised the first time it happened in an otherwise correct answer. In this way, marks were frequently withheld for missing units.

In part (a), candidates who had the necessary algebra skills successfully used the given equation and information to set up simultaneous equations in A and k and correctly solved them to reach $h = 31 - 31.3e^{-0.0223t}$ or a similar acceptable equation. Candidates often, however, made major algebraic mistakes after initially setting up the correct equations, often involving the use of incorrect log or indices work, and made no progress in (a). Others failed to appreciate that the question was asking for an exponential model and attempted to use the given information to set up a linear model instead. A number of candidates failed to write down the complete equation of the model and just gave the values of A and k, losing the final mark in (a).

Many candidates realised that in (b) the required limit to the height of the tree was 31m, although many omitted the units losing the mark. For some candidates this was the only mark scored in this question.

In (c)(i) many candidates were able to use their equation for the model, even if it was incorrect, to find a value for the initial height of the tree. Again, missing units were common. In (c)(ii) explanations were allowed to follow through on the answer to (c)(i) provided that answer was negative. Acceptable explanations were often given either stating that the model was not suitable as the initial height of the tree could not be negative, or that the model was suitable because the tree had been planted below ground level.

In (d)(i) candidates were generally able to differentiate their equation of the model to obtain an expression of the correct form, earning the first mark. Many did not obtain the correct answer so were not awarded the second mark. A number of candidates incorrectly differentiated to obtain expressions like ate^{-kt} which gained no credit in (d)(i). The first mark in (d)(i) was again aften awarded to candidates who made little progress elsewhere in this question. In (d)(ii) candidates knew they needed to set their $\frac{\mathrm{d}h}{\mathrm{d}t}$ equal to 30cm, but often confused the units and used $\frac{\mathrm{d}h}{\mathrm{d}t} = 30$ rather than $\frac{\mathrm{d}h}{\mathrm{d}t} = 0.3$. Having set up an equation using $\frac{\mathrm{d}h}{\mathrm{d}t}$ candidates were often able to use appropriate log rules to progress from a suitable equation to obtain a value for t. The final correct answer of 37.9 was obtained by some, but errors often appeared during the course of this long question, causing the final answer to be incorrect.

Question 14

Although there were a small number of blank responses to part (a), most candidates found this question accessible. There was a fairly even split between M1A0 and M1A1 being awarded. When A0 was awarded it was generally due to candidates omitting brackets and thus not squaring k. A large proportion of candidates produced the full expansion of the first three terms (and more in cases) even though this was not necessary. As well as not being as efficient it also resulted in it being less likely to extract the coefficient of x^2 resulting again in A0.

Part (b) was much more demanding with very few candidates achieving full marks and many blank responses seen. The majority of candidates failed to identify the necessary terms to set up the two required equations or made errors in expanding the brackets. The equation resulting from the constant term appeared the more accessible of the two and resulted in the first M1 at least. Where candidates were able to identify the two correct equations they generally went on to score full marks. For these more able candidates who were able to find a solution it was pleasing to see them pairing a and k correctly.

Question 15

Many candidates made a start to this proof question in (a) and/or (b) but very few candidates were completely successful throughout. The second mark in part (a) was awarded relatively infrequently, whilst the final mark in (b) was rarely awarded. Candidates either did not know the correct way to approach the proofs required or were unable to include all of the rigorous steps and conclusions needed.

In part (a) candidates approached the question in a number of ways. Most attempted to substitute values of n into $n^3 + 4n$. Attempts using two natural numbers for n were required to obtain the first mark this way. Many candidates, however, used negative integers and made no progress. Candidates did often use $n = 1$ to obtain $n^3 + 4n = 5$ alongside the substitution of another value of n to obtain a composite number, but failed to conclude which case gave a prime number and which case did not, losing the second mark. Other candidates attempted to factorise $n^3 + 4n$, gaining the first mark, but then failed to test the $n = 1$ case or missed the necessary conclusions. A third strategy was to attempt an odds/evens approach by substituting $n = 2k$ or $n = 2k + 1$ which scored the first mark. Candidates often then again failed to show that $n = 1$ gave a prime number or did not include the necessary conclusions, losing the second mark. Some candidates were, however, completely successful in (a) and correctly established that the statement was sometimes true.

In part (b) candidates' attempts to show that the statement was never true, again employed varied methods. Many candidates attempted no form of algebraic proof and simply tested values of n, failing to appreciate that this approach would not prove the result in general, and this gained no credit. Other candidates attempted a 'descriptive' approach, again without algebra, considering the cases when n was odd and even (e.g. when n is even $n^3 + 5n$ = even + even = even etc.). When done accurately this approach could score the first mark in (b), but unless a full explanation was included of the results used, the second mark could not be scored. The most successful method was to factorise $n^3 + 5n$ to show it was composite (for $n > 1$) and then test the $n = 1$ case separately before drawing the correct conclusion. Some candidates attempted to consider the even and odd cases algebraically. Attempting both cases like this earned the first mark, but candidates then often failed to test the $n = 1$ case or made mistakes in their algebra or factorisation of the cases, losing the second mark. Few candidates earned full marks in (b) regardless of the way they approached it.

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