Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel International GCSE
In Mathematics B (4MB1) Paper 02R

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Introduction

This paper provided many opportunities for candidates to demonstrate their problem-solving skills.

The questions were designed to give candidates a starting point such that almost all candidates could attempt at least the first parts of each question. Unfortunately, the lack of prescribed method for some of the latter parts proved to be challenging to some candidates as they could not identify an appropriate method to solve the problems. Whilst the mark scheme identifies some of the key methods to solve these problems, it should be noted that any alternative correct strategies were also given credit even if they used methods beyond the scope of the specification.

To enhance performance, candidates should be encouraged to:

- Show clear working using brief annotation to identify what they are finding.
- Utilise the diagrams (or draw their own quick sketch) as labelling the known dimensions can help to see missing data and help to identify a strategy for solving geometric problems.
- Practise using the 3-letter angle notation.
- Take note of any given formula as these are likely to be useful.
- Carefully reread the question at the end to check that they have answered what has been asked.
- Make use of the available pages and avoid squashing their working into a small space.

In general, candidates should practise solving more open-ended questions to improve their problem solving skills and explore alternative methods.

Question 1

Given a pair of linear simultaneous equations in two variables, candidates were required to find the solution showing clear algebraic working. The majority of candidates were able to accurately solve the equations and provide the results either in decimal or fractional form. Candidates who did not find the correct answers were able to gain a mark for preparing the equations ready to eliminate a variable and could gain a further mark for eliminating a variable. The given form of the equations was perfect for an elimination method by multiplying to make the coefficients the same. Of those candidates choosing this approach, it was most common to make the coefficients of x the same in preparation to eliminate x. Arithmetic errors sometimes prevented candidates reaching the correct results but just one arithmetic error was accommodated such that the correct method was awarded 2 marks. The most common arithmetic error involved subtracting negative values. A more unexpected but equally common approach was to rearrange one of the equations to make either x or y the subject and then substitute into the other equation to eliminate the other variable. More algebraic work was required to reach the results using this approach and candidates appeared to make more errors than with the previous approach.

Question 2

This construction question proved to be very accessible and was done well by many candidates.

(a)

The first task was to draw the locus of all points that lie 4cm away from point C which was a corner of a quadrilateral. An attempt at a circle of the correct radius was made by many candidates. Unfortunately, a significant proportion only drew the quarter of the circle which was inside the quadrilateral rather than the whole circle which represents the locus of all points, highlighting the need for candidates to carefully read the question.

(b)

The second task was to construct the perpendicular bisector of the vertical line AD, using only ruler and compasses, showing all construction lines. The majority of the candidates recognised what was required although a few did attempt to bisect the angle at A. To accurately construct the line two pairs of intersecting arcs were required which could then be joined to produce the line. Accurately completing this gained 2 marks. There were some inaccuracies in the arcs which generated lines which either did not bisect AD or were not perpendicular to AD. These were generally able to gain 1 mark for their attempts at the arcs. The most common award of 1 mark was for an acceptable perpendicular bisector which lacked the supporting construction arcs. Some only showed one pair of intersecting arcs which was not sufficient. A common assumption was that the quadrilateral was a rectangle, although this was not stated, leading to some inappropriate arcs being drawn.

(c)

Candidates were then required to use the circle and the bisector to form the region containing the points within the quadrilateral that were 4cm away from point C and nearer to point A than point D. This mark was available to those with an attempt at a partial circle and the bisector. Many candidates successfully identified the correct region. There were some who shaded more than the required region either ignoring the bisector or ignoring the boundary of the quadrilateral.

Question 3

Candidates were given a diagram of part of a regular 20-sided polygon which showed 6 of the sides.

(a)

The first task was to find the size of the angle ABC which was one of the interior angles of the 20-sided polygon. This was very well answered by most candidates, with most scoring the full two marks. The common approach was to calculate the sum of the interior angles and then to divide by 20 to find one angle. Candidates could achieve one of the two marks if they could make partial progress and find the sum of the interior angles. Although a formula for the sum of interior angles was given on the paper $\left[(2n-4)\text{right angles}\right]$, many candidates used the alternative formula $\left[(n-2)\times 180\right]$. Centres could consider using both formulae during their teaching so that candidates are familiar with both. Mistakes were rare but the most common one was to use $n = 6$ within the formula. It was also possible to work with the external angle, but this approach was much rarer.

(b)

The second task was to find the size of the angle EGA within the shape. This angle did not use the sides of the irregular 7-sided shape and therefore provided much more opportunity for creativity in the solution. The openness of the problem proved to be quite challenging for the candidates with many not attempting to provide an answer. However, there were many varied and correct approaches which formed the angle EGA within a sub-shape of the 7-sided shape, worked with the symmetry and the known angle ABC to identify missing angles in their chosen shape and then find angle EGA. Each of the approaches involved working with the sum of the interior angles within their shape and/or the angle FGE, so either of these starts gained a mark. Many of the candidates who attempted a solution, started by finding angle FGE and this was often seen in the diagram. Annotating a diagram with known angles can help to identify a strategy to find the required angle. When diagrams are provided in a question candidates should be encouraged to use them or to provide their own sketch within the solution. It was also observed that candidates are getting confused with the 3-letter angle notation and so it would be prudent to practise using this.

The most efficient solutions worked with the sum of the angles in a 7-sided shape to find angle FGA and then subtracted angle FGE to find the required angle or considered a trapezium using alternate points on the polygon, which enabled candidates to use properties of angles related to parallel lines. More complex solution methods involved finding the sum of the angles in multiple shapes to determine a range of angles before being able to find angle EGA.

Question 4

(a)

An expression was provided for the nth term in a sequence and candidates were required to find the difference between the 3rd and 7th terms. This required a simple substitution into the expression to find the two values and then subtracting (either way round) to find a difference. Most candidates achieved the correct value. There were some who found the value of the terms and did not follow through to find a difference; these candidates were awarded one of the two marks. Others correctly substituted into the expression but were unable to evaluate it correctly, they too gained one of the two marks. A small minority of candidates failed to score due to substituting incorrect values of n.

(b)

The rule of a second sequence was described in words and the first three terms were given as linear algebraic expressions. Candidates needed to interpret the rule to form algebraic relationships between the terms generating two equations in two unknowns. Eliminating one of the variables led to a quadratic equation that could be solved and used to find the required value.

As expected, this part of the question proved to be a lot more challenging due to the level of algebra required. However, many candidates were able to gain one mark for forming the correct initial relationships and preparing to eliminate a variable. Some candidates failed to make any progress with the problem as they ignored the given rule and attempted to find the product of the three given terms or incorrectly assumed that the terms were part of a geometric or arithmetic sequence. Some candidates attempted to apply the rule to a term but did not equate this to one of the given terms so no progress could be made as they did not form any equations.

Those who did form the equations often went on to prepare to eliminate a variable. The resulting algebra manipulation was done to varying standards. Those who manipulated the algebra correctly to form the correct quadratic equation, generally followed this through to obtain the required value. Unfortunately, there were algebraic errors in the expansion of brackets and errors with negative values so that the correct quadratic was not achieved. Those who went on to demonstrate a correct method of solving their quadratic were able to gain a mark. A few candidates wrote down solutions to the quadratic without showing how these had been obtained. Candidates must be encouraged to clearly show their working.

Candidates who had eliminated x and worked with an equation in d sometimes failed to consider the given inequality and determine that the positive value of d was the only viable solution. Candidates who had eliminated d and worked with an equation in x, sometimes failed to use this value of x to find a value of d.

Question 5

(a)
It was pleasing to see that a large proportion of candidates were able to interpret the given information to find a total cost of hiring a minibus and select a correct process to find the percentage discount. There were three components to the cost and correctly working with two of these gained the candidates the first mark. Those who correctly worked with the three components generally proceeded correctly to find a percentage discount, although some failed to gain the final mark as they found the discounted cost as a percentage of the non-discounted cost.

(b)
Two values were presented as the product of prime factors and the task was to find the highest common factor. This was generally answered well and credit was given to responses given as a product of prime factors or those given as an ordinary number. A common error was to find the lowest common multiple. Some candidates misinterpreted the notation and found the sum of the prime factors rather than the product.

(c)
This question required candidates to recognise the properties of numbers and understand what was meant by a remainder. The most common correct response was to find the LCM of the two given divisors and to add 7. Some candidates found the LCM but neglected to add the 7. Many candidates gave incorrect responses as they did not appreciate the relationship between N and the remainder. It was common to see the divisor multiplied by the remainder. A significant number of candidates did not attempt to find an answer.

(d)
Given information about the ratio of different vehicles and the proportions of these different types which are hybrid, the task was to find the percentage of the total that were hybrid. The successful candidate could work with ratios, fractions and percentages to manipulate the numbers. A common error was to ignore the ratio and only consider the fraction and percentage. A misunderstanding that occurred was not recognising that the number of vehicles stated was the total number of all the vehicles combined rather than just one type of them.

Question 6

This question provided information about cat, dog and horse ownership including one unknown variable representing cat ownership, x. Candidates were required to work with Venn Diagrams and set notation and seemed to find accessible as most attempted to answer all three parts of the question.

(a)
This question required the given data to be transferred to the Venn diagram. The majority of candidates were able to gain at least one mark for recognising the numbers that were only in a set and in the intersection of all three sets. Two marks were gained by those candidates who could calculate the numbers in the intersections of two sets. No explicit information was given about the intersection of dog and horses but this could be determined in terms of x using the total number of owners for the full 3 marks.

(b)
Given that there were 37 more cat owners than horse owners, the candidates were tasked with finding the unknown variable x. This question proved to be challenging as many ignored the relationship between cats and horses and so could not set-up a correct equation and therefore were not able to score any marks. Similarly, those who had left any blank spaces on their diagram could not access any marks in (b). Of those who set-up a correct relationship, the majority correctly found the value of x.

(c)
Candidates were required to understand set notation for complements, unions and intersection. Marks could be gained from understanding the notation even if their diagrams were incorrect. Most showed a good understanding of the notation although some tried to list or state the number of elements in the intersections and unions of the sets rather than state the sum of the elements within the subset.

Question 7

Triangle A was transformed under a translation to give triangle C and triangle A was transformed through a reflection in the vertical line to give triangle D. The task was to draw both triangles C and D on the grid. Both of these transformations were performed well with equal success.

Those candidates that showed some knowledge of the translation by translating correctly vertically or horizontally were able to gain one of the two marks. Similarly, those who demonstrated reflection in an incorrect vertical line were also able to gain one mark.

The diagram showed triangle B which was the image of triangle A under an enlargement followed by a clockwise rotation. Candidates were required to calculate the angle of rotation to 4 significant figures. A significant number of candidates did not attempt to calculate the angle. Some candidates clearly measured the angle of rotation, but this was not sufficient to gain any credit. It should be emphasised with candidates that questions which state "show your working" generally require clear working for the marks to be awarded. Correct responses were in the minority but generally used the tan ratio in the right-angled triangle, although sin and cosine were also used. The use of the rotation matrix was attempted by some candidates but there was some confusion regarding whether the angle was clockwise or anticlockwise.

Question 8

This question considered the probabilities of biased 6-sided dice and was done well, although there was some confusion between when to add or when to multiply probabilities.

(a)
Initially just one biased dice was considered. The first task was to find the probability, from the table, of one of two outcomes. The second task was to find the probability of an outcome that was an odd number. Since there was only one even number the most efficient method was to calculate $1 - P(even)$ but many did not spot this method and went with the longer alternative that meant finding the value of the unknown x first. The third task required finding the value of x which needed the fact that the probabilities of all possibilities sum to one. This was a surprising omission in a lot of the candidates' work.

(b)
The dice was rolled twice and the probability of a particular combination was required. About half of those who made a correct start to the question, failed to recognise that there were two ways the combination could be achieved.

(c)
Finding the expected number of times the event occurs was done very well with the majority finding the correct frequency. Those recognising how to find an expected frequency by multiplying the number of trials by the probability were able to gain one of the two marks even if they used an incorrect probability assuming that it was between 0 and 1.

(d)
A second biased dice was introduced, and a conditional probability was required given a constraint on the outcome. This proved to be the most challenging part of the question with very few scoring full marks.

Question 9

The question was based around a solid made from joining a half-cylinder to a prism.

(a)
The task was to calculate the surface area of the solid. This proved accessible to most candidates with marks being available for the area of a relevant rectangle, trapezium or the surface area of the cylinder or half-cylinder. It was common to only find two of the different types of the components. A common mistake was to find the volume of the cylinder rather than surface area. Of those who found the correct components, some failed to score full marks as they added in the area of the adjoining rectangle which was internal to the shape. The majority of those who correctly added all relevant components went on to find the correct surface area with few arithmetic errors seen.

Some candidates made extra work for themselves by applying Pythagoras to find the height of the trapezium. This was unnecessary since the height had been given.

(b)
This required finding an angle that a diagonal through the shape made with a specific point in the shape. This could be achieved through considering a series of right-angled triangles and applying Pythagoras and the trigonometric ratios to find the angle. The clearest approach to this was to draw diagrams to identify an appropriate strategy. It was also possible to apply the cosine rule to a non-right-angled triangle. Again, this approach was often easier to work with if there was a supporting diagram. It was common to see candidates use Pythagoras to find a correct length but then not make any further progress, scoring one mark.

Common errors involved working with incorrect lengths, incorrectly identifying the triangles and using trigonometric ratios on non-right-angled triangles.

On the whole, candidates who clearly labelled distances and correctly identified angles were the most successful. It was pleasing to see that a significant number of candidates worked with exact values and avoided early rounding. This should be encouraged.

Question 10

(a)
A diagram of a triangle was given which was sectioned into some smaller triangles. Two vectors were defined and the task was to find the vector that described a route through the triangle. There were two possible routes through. The majority of candidates were able to manipulate the vectors to describe the path. However, there were arithmetic errors, especially with the signs. There were also errors applying the given ratio to the vectors, with some candidates using an incorrect part of the ratio.

(b)
Given the area of one of the smaller triangles and a ratio of two of the lengths, the next task was to find a length in one of the smaller triangles. This was very poorly answered. A significant number of candidates assumed that they needed to work with the vectors and made no attempt to transition to working with the given dimensions or formula. Those that recognised that they needed to use the area to find a useful angle, usually used the correct formula but some did assume it was a right-angled triangle and others used cos rather than sin within the formula. This was particularly disappointing given that the formula for the area of a triangle had been provided. The award of 2 and 3 marks was less common as it appeared that those who could see a strategy to find the lengths needed were able to do this correctly and obtain the correct answer and hence gain all 4 marks.

This was another question where diagrams could be invaluable. Marking on lengths and angles as they are found can be useful to track progress and form a successful strategy. The 3-letter angle notation can cause confusion if it is not used correctly and so candidates should be encouraged to practise using this.

Question 11

This was a large 19-mark question that involved finding the key features of a cubic curve, plotting the curve and then using the curve to find the gradient and to solve a related cubic.

(a)
Candidates were required to use the factor theorem to show that $(x - 2)$ was a factor of the cubic. This was answered very well. It was unusual to find an incorrect attempt. Those that did not score marks here had generally used polynomial long division rather than the factor theorem. One mark was available to those who used -2 rather than +2.

(b)
This question required candidates to find the x-intercepts of the curve. It was not acceptable to use a calculator to solve the cubic since the question dictated that they must show clear algebraic working and said "hence". Most candidates recognised the significance of the word "hence" within the question and worked with the factor that they had just verified. The factor was used to factorise the cubic with the majority attempting either polynomial division or synthetic division to find the quadratic factor. The quadratic factor could then be factorised. A common loss of the final mark was due to stating the two roots of the quadratic and omitting the solution to the linear factor. Some candidates reached a factorised form but failed to state any roots.

(c)
A quadratic describing the position of the turning points was provided and the coordinates of the turning point were required. A common error here was misconception that "turning points" means that some differentiation was required. However, many candidates correctly attempted to solve the quadratic equation to find the x-coordinates, unfortunately relatively few correctly found the y-coordinates. This was either omitted or they substituted into the wrong equation.

(d)
The task was to complete two values in the table. This was the most commonly awarded mark of this question. Unfortunately, there were some sign errors seen.

(e)
Now with all this information, the task was to plot the points and sketch the curve. Two out of the four marks could be achieved by plotting the points in the table correctly and joining to form a smooth curve without knowledge of the x-intercepts and turning points. There were many good attempts at the curve which showed recognition of the shape of a cubic curve. Many of these scored 3 out of the 4 marks due to inaccuracies in their plotting or most commonly from missing the local minimum turning point.

(f)
The task was to use the sketch of the cubic to find the roots of a related cubic. The algebra work let some candidates down as they made an attempt to separate out the curve but could not correctly identify the line that would intersect with the curve. There were some candidates who did not link the two cubics and assumed that their task was to draw a second cubic graph.

Of those who drew the correct line on the graph, the majority found the 3 intersection points. Unfortunately, due to the inaccuracies in plotting the graph, some of the values stated were not within tolerance.

There were candidates who stated correct values without any relevant working or a line on the graph, presumably having used a calculator to solve the cubic equation. These responses scored no marks. It is important that candidates use the methods specified in the question so that they can demonstrate their ability to apply the techniques.

(g)
Finally, the candidates were instructed to draw a line to find the gradient. A good proportion drew an acceptable line on the graph to represent the tangent at the given point, but there were issues with the accuracy of the readings taken from the graph.

It was quite common to see candidates use differentiation to find the exact gradient. This only gained credit if a tangent was also drawn.

<u>Question 12</u>

Given an equation representing the displacement of a particle with respect to time, including an unknown constant and given the initial condition involving velocity, the task was to find a distance after a specified time.

It was pleasing to see that a significant number of candidates recognised that they needed to differentiate the displacement to find the velocity and this was generally done accurately. The velocity could then be equated to zero to find the time when the particle was instantaneously at rest. The success here was varied as candidates equated to 5 or used $t=2$ in an attempt to find k.

There were very few candidates who noticed that they needed to find the difference between two displacements, in order to find the value of k. Those who did, generally proceeded to find the correct value for k and then the distance.

It was noticeable that those candidates scoring full marks in this question, had a neat logical set of workings that often included brief annotation to keep the focus in the working.

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