Examiners' Report
Principal Examiner Feedback

Summer 2019

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

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Introduction to Paper 02

On the whole, a small number of the students sitting this examination seemed unprepared and lacking knowledge in many subject areas that were being examined. This was across all areas but particularly noticeable with probability, matrix transformations and sets. Most students seemed well prepared and were able to demonstrate their knowledge and understanding across most of the questions covered. Problem areas that should receive special attention by Centres are as follows:

- Set working out logically so it is able to be followed by examiners
- Read questions carefully
- Read answers from calculators carefully and make appropriate use of more advanced facilities
- Do not use premature rounding as it may lose final accuracy marks
- Where answers are given ensure full and clear working is seen
- Knowledge of intersecting chord and related theorems (Q3)
- Correct order and layout for matrix transformations (Q4)
- Relationship between area and linear scale factors of similar shapes (Q5)
- Ability to list subsets of a given set with specific properties (Q6)
- Combining probabilities (Q7)
- Combining inequalities and dealing with quadratic inequalities. (Q8)

Report on individual questions

Question 1

This proved to be an accessible start to the paper with the majority of students scoring full marks.

In part (a) the most common errors were either, interchanging 360 and 200, i.e. calculating $(48/360) \times 200$, or using the midpoint of 45 rather than 48. A small number of students calculated the percentage rather than the angle as the demand of the question required.

In part (b) students who attempted this mostly gained full marks. A small number made minor arithmetic errors which generally cost them 1 or two marks. A significant number struggled to use mid-points correctly. In some cases values 0.5 higher than the correct values were occasionally seen, possibly due to misunderstanding the significance of $<$ and $\leq$, which at least allowed these students to gain 2 method marks. More concerning were those using the class width or even half the class width, as this is clearly an error in their methodology and these students scored no marks.

Question 2

Another accessible question, most students managed to score at least 6 out of 8 marks here.

In part (a) most students showed an appropriate method and gave a correct answer. Students should be reminded that 48% of 2.35×10^7 or $48\% \times 2.35 \times 10^7$ is not sufficient to gain a method mark for a question like this, we need to see an understanding of what 48% represents numerically, ie 0.48 or equivalent.

Part (b) found students losing marks with 2 common issues. The first was failing to give their final answer in standard form as required, a very small number doing this after giving the answer to part (a) in standard form, this cost these students 1 mark as they could at least gain the method mark. More seriously some students reverted to the total population rather than using their answer from part (a) as this showed a fundamental misunderstanding of the demand of the question which cost these students both marks.

In part (c) a large number of students found 12.5% and then added this to their starting value, this is marginally more complex than directly finding 112.5% and correspondingly more students who took this root made small numerical errors and lost the final accuracy mark. As with part (a) students showing working such as “12.5% of…” only gained marks if they demonstrated that they understood how to calculate these in a later expression.

Part (d) clearly targeted the misconception that an increase of a particular percentage followed by a reduction of the same percentage leads back to the same original value. Students who gained the same answer as their starting value, 2.5×10^7, failed to gain full marks, although those who showed the correct calculation did still gain the method marks. A small number of students increased and decreased the original amount by 2.4% usually giving the result of the decrease as their final answer, this shows a fundamental misunderstanding of the nature of multiple percentage changes and students would be well advised to avoid errors like this.

Question 3

This question used a relatively straightforward example of the tangent-secant theorem which along with the related intersecting chords theorems was generally poorly answered under the previous 4MB0 specification. This still seems to be the case with a little over a third of students failing to gain any marks on this question. Those who did answer the first part of the question correctly often used a more complex methodology based on forming a Pythagoras's Theorem equation using triangle *AOT*.

Even if students had not found a correct length in part (a) correct use of their values would have allowed them to have gained the method marks in part (b).

Finding angle *AOT* should have required a relatively straightforward application of trigonometry, however a significant number of students overcomplicated this using either the sine rule or cosine rule with varying degrees of success. Students should be reminded that it is advisable to use the simplest methodology available to solve a particular problem. Those who demonstrated a correct methodology to find angle *AOT* generally went on to gain the second method mark for the correct formula for the arc length, this formula does seem to be well understood by the majority of students.

Question 4

We saw some very good responses to this question, but also a large number who did not have the necessary skills to gain a large number of marks across the question.

The mark in part (a) for plotting the points and joining them to give triangle B was sometimes the only mark gained by a student for this question. It was unfortunate that a few students could not plot all the points correctly; students must be taught to check this first stage very carefully as it is the key to the other parts, and while follow through marks are available, an incorrect initial triangle can lead to problems such as a shape not fitting on the grid.

In part (b) some students failed to describe the transformation as a single transformation and hence gained no marks. Those who did describe the transformation generally used the correct terminology of translation and managed to give the translation in the correct vector form. It is important that students realise that we are testing their knowledge of correct notation and terminology in these sort of questions.

Part (c) was generally well done by those who attempted it. Mistakes generally manifested as either a single incorrect point plotted or an enlargement with a scale factor of -2 seen.

In part (d) we allowed students who showed an incorrect order of matrix multiplication to score full marks if they clearly drew the correct triangle. However, we do expect to see matrices put in the correct order for multiplication and it must be stressed to students to show this correct order as it may result in a loss of marks on another occasion.

In part (e) very few students realised that the required matrix was the inverse of matrix **M**. Those who did usually managed to find the correct answer easily. Significantly more students used their co-ordinates to form a series of simultaneous equations and solve these to find the individual element of **M**. As this method required considerably more work many of these students had numerical errors in their method and so failed to gain full marks. The majority of students did however fail to attempt this last part of the question.

Question 5

In this question the first two parts proved to be accessible with the majority of students scoring at least six marks on this question. Part (c) proved to be more discriminating.

Part (a) required a straightforward application of the cosine rule. Many students attempted this well often gaining the correct answer and scoring full marks. However, a number of students either forgot to square root the value they found or failed to appreciate the importance of order of operation in evaluating the expression with many even writing down "9 cos 30" within their working, these students scored only the first method mark. These students would have realised their mistake if they had considered the reasonableness of their answers.

Those who attempted part (c) mostly realised the importance of calculating the area of triangle *ABE* which provided many students with one additional mark. Those who realised they needed to use the similarity of the triangles often either failed to appreciate the connection between area and linear scaling factors or used the areas of triangle *ABE* and the quadrilateral *BCDE* rather than the areas of the triangles *ABE* and *ACD*.

Question 6

A surprising proportion of students attempting this question listed only subsets of 2 elements or only subsets of 3 elements. The majority missed either {b} or {a,b,c,d} or both, so very few students scored all 4 marks. Repeating subsets, either in the same order or including different permutations, was common. Most concerning, though, was the significant proportion of students making no attempt at the question at all, leaving a completely blank page. It would be advisable to ensure students are better prepared for these sort of questions for future series.

Question 7

Despite having some relatively straightforward aspects most students scored either zero or one across this question. A surprisingly large number of students gave results for probabilities greater than 1, thus demonstrating a fundamental lack of understanding of this topic.

For part (a), there was a minority of students scoring full marks. The majority gained 1 mark for mentioning $\frac{2}{5} \times \frac{3}{5} \times \frac{3}{8}$ or $\frac{2}{5} \times \frac{2}{5}$. A worryingly large number of students added probabilities, often yielding results greater than 1, in part (a).

Many students were thrown by part (b). Where attempted, a reasonable proportion were successful, many did not appear to interpret the $\frac{3}{4}$ as the overall probability of passing test B, often treating it as the probability of passing test B on the second attempt having failed the first and thus just multiplying it by $\frac{2}{5}$. Many students made unsuccessful attempts at using the formula for conditional probability incorrectly. Most students with the full correct method had the right answer, too; however significantly more students only scored one mark for a partial method.

As for part (c), a discouraging number of students either considered the probabilities for each test entirely separately, comparing each to 0.5 individually, or attempted to combine them by adding them together (again, often yielding results greater than 1). Of those who knew to multiply, quite a few followed through incorrectly form earlier parts – for example, multiplying their answer to part (a) by their answer to (b) rather than to the ¾ given in (b). It was very rare for students to score only the method mark this usually only happened if they had got part (a) wrong.

Question 8

This question elicited a wide range of responses. Not surprisingly the earlier parts of the question were generally well attempted but the final part caused more problems. Despite this a significant number of students still managed to score full marks on this question.

Part (a) was relatively straightforward and students mostly managed to gain full marks here.

In part (b) a number of students did not show clear enough working, given that the demand for this question was to "Show that" students need to ensure their working is clear and easy to follow and contains no incorrect statements if they hope to gain full marks.

Part (c) of this question set a combination of inequalities which included one quadratic, in context this is a good example of what students should expect for the very highest demand questions on the new specification. Students were instructed to show "clear algebraic working" and were able to gain 2 marks for just stating the inequalities given by the limitations stated in the question. This highlights the importance of using correct notation as the majority of students failed to gain these relatively easy marks. While it would be permissible for students to calculate critical values, the mark scheme did award up to 3 marks for just this, students would not be able to access the remaining marks without demonstrating a sound understanding of the solutions as inequalities.

Quadratic inequalities is a new topic to this specification and relatively few students showed a sound understanding of the solution of these. Students hoping to gain the top grades should be prepared to solve these showing full and appropriate working. A small number of students lost marks as their working showed clear evidence of using the features available on the more sophisticated calculators to solve their quadratics. Students should always show full working and would be advised to avoid using these facilities of their calculators for anything other than checking purposes.

Question 9

A small number of students solved the quadratic in (a) rather than in (b)(i), scoring no marks for the work unless using or quoting the value in (b). For those who did tackle the question correctly, much good algebra was seen resulting in many students achieving full marks for part (a). However a significant number made no real attempt at part (a). Throughout (b) and (c) a disappointingly large proportion of students tried to use decimal rather than surd values, missing the significance of (or simply misunderstanding) the instruction to use exact values in (b)(i) and (c) and missing the need to use the exact surd values to show an exact surd result in (b)(ii). A failure to use surds throughout their working in parts (b) and (c) led to such students achieving, at most, 3 marks for these three parts of the question. Despite the requirement in part (c) to expand squared expressions involving $\sqrt{5}$, much good work was seen with a significant number of students achieving full marks here.

Question 10

Most students were able to access this question and there were a significant number of good responses seen.

Most students gained the mark available in part (a). Those who failed to gain this mark generally failed to gain any other mark in this question.

Those who realised they needed to find the derivative of the curve C to relate to the gradient generally succeeded in gaining marks in part (b) of the question. A surprising number either attempted to find a gradient using difference of co-ordinates or attempted to find the equation of the gradient, neither of these gained any marks. As the demand for this part of the question was “show that” it was important that students did clearly show what their intention was at each stage in order to gain full marks.

Part (c) was still accessible to those who did not succeed in part (b) and a significant number of students did not make any attempt at part (b). This was a particularly simple simultaneous equation and those students using one of the standard methodologies for solving these were generally successful in obtaining the correct answers. A small number did however lose accuracy marks, usually due to sign errors in their working.

Fully correct solutions to part (d) were rare with a number of different errors seen. Very few managed to equate the substituted differential to -4. Several just equated it to the equation of the straight line $y = 7 - 4x$ failing to recognise the significance of the gradient of −4. Some others equated the differential to −8 (from section b) or to zero. In a number of cases solutions were clearly found using technology, cases where this is the only viable way to proceed should indicate to students there is an error in either their working or methodology.

Question 11

This question tested a number of different skills and as such responses were very variable with a number of students scoring well in some parts but failing to gain marks in others.

Part (a) was generally very poorly answered with few students demonstrating any real understanding of what was demanded. Also a number of students completely failed to take any notice of the instruction to "Give a reason for your answer." Students need to realise that having this included in the demand of the question means answers based purely on numerical or algebraic working without any supporting statements are unlikely to score full marks. The vast majority of students seemed to interpret this part of the question as a bound based on accuracy of measurement, since no level of precision of the values was given this is wholly inappropriate and showed a fundamental misunderstanding of the context. Other students seemed to think values must be integers which also generally precluded the award of any marks.

Part (b) was generally answered well by those who attempted it. The most common mistake was to fail to halve the volume of a sphere, which was given to the students, however, these students were still able to score one mark for substituting the value of h into their volume formula. As the demand of the question was "show that" it was essential that students showed full clear working throughout, a small number made errors and then attempted to correct their working when they failed to gain the final correct response, this at times led to inconsistent and confused working which often failed to score any marks.

In part (c) the table was often completed correctly, although a number lost a mark for ignoring the rounding instruction.

In part (d) most students were able to plot the points correctly although in a number of cases this was inferred from a correct curve. Students would be well advised to clearly plot points with a cross that will still be visible after their curve is drawn. Most attempts at a smooth curve through the points were well executed.

In part (e) most students gave values consistent with their curve although a few did lose marks for giving values more accurately then reading from their graph would allow.

Part (f) was rarely attempted. A few students managed to pick up the first mark. Only the more able students managed to plot the line effectively. Unfortunately, some good responses only scored 2 of the 3 marks because of the final accuracy requirement (nearest integer). Students need to be much more careful when reading the question, perhaps by rereading it again once they have completed it.

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