Examiners' Report

Principal Examiner Feedback

Summer 2023

Pearson Edexcel International GCSE

In Mathematics B (4MB1)

Paper 02R

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Introduction to Paper 02R

In general, this paper was well answered by the overwhelming majority of students. Some parts of questions did prove to be quite challenging to a few students and centres would be well advised to focus some time on these areas when preparing for a future examination.

In particular, to enhance performance, centres should focus their student's attention on the following topics:

- Showing clear working particularly when it is requested in the question
- Correct use of percentage profit formula
- Drawing and recognising line equations of the form $x = a$ and $y = b$
- Correct terminology for describing transformations
- Properties of quadrilaterals and problem solving skills with vectors
- Domain and range of a function
- Probability and conditional probability

In general, students should be encouraged to identify the number of marks available for each part of a question and allocate a proportionate amount of time to each part of the question. In addition, students should also be advised to read the demands of the question very carefully before attempting to answer. It should be pointed out that the methods identified within this report and on the mark scheme may not be the only legitimate methods for correctly solving the questions. Alternative methods, whilst not explicitly identified, earn the equivalent marks. Some students use methods which are beyond the scope of the syllabus and, where used correctly, the corresponding marks are given.

Report on Individual Questions

Question 1

This question proved to be an accessible start to the paper with the majority of candidates scoring 6 or more marks on this question; as each part was independent of the other candidates who made a mistake on part (a) and/or (b) could still access marks in part (c). Parts (a) and (b) were rarely answered incorrectly with the most common errors being to divide by 8 rather than multiply by 8 for part (a) and to find 60% of all 600 watermelons for part (b). Students should note (600 – 200) × 60% is not acceptable to gain a method mark, whereas (600 – 200) × 0.6 would be. For part (c) almost all students gained the mark for using the currency conversion correctly. It was clear that some candidates did not take into the context of the numbers into account, as some took away one cost from another rather than finding the difference between income and expenditure. Others omitted the transport cost. Another commonly seen issue was percentage profit calculated as profit / income × 100 rather than profit / cost × 100 and this resulted in a maximum of two marks being awarded for the part (c).

Question 2

This question proved to be more demanding. Most students gained the mark in part (a), showing an understanding of complementary and the intersection of sets. It is important to note that the students needed to list the sets and so a completely correct Venn diagram did not gain any credit without the elements *p* and *t* being stated. Part (b) proved to be more challenging with a variety of incorrect answers; some could not find all four sets and usually just stated the two sets of *p*, *t* with *q* and *s* which gained them 2 marks provided they listed no incorrect sets. Others listed every possible set containing *r*, including those that did not have a total of 3 elements.

Question 3

A straightforward question with many students gaining full marks. In part (a) very few errors were seen with the main errors being subtracting 3, instead of adding 3, from both sides or writing their answer as an equation and not an inequality. Again, in part (b) there were very few errors, those who multiplied both sides by 2, rather than splitting the fraction, were often more successful and some lost the accuracy mark as they reversed the inequality then subtracting 8. Although well answered, most marks were lost in part (c) often with inaccurate lines drawn for $y = 2x + 1$ or for $x = -2$ and $y = 3.5$ drawn instead of $x = 3.5$ and $y = -2$

Question 4

A well answered question with most students achieving 6 or 7 marks. In part (a) most students gained the mark with the most common incorrect answer being 4 200 000. Most students gained at least one mark for part (b), where an incorrect answer was given students invariably picked up a method mark for 25.2×10^{-95} or 2.52×10^{-96} although a few students gave an answer of 0. A similar picture was seen in part (c) with most students gaining at least one mark. Common errors included 0.7×10^{105} or 7×10^{-95} and again some gave an answer of 0. Part (d) proved to be the most challenging part of this question, invariably those that only gained one mark usually had $\sqrt{y}$ before *y* in their ordered list but some students over relied on their calculator and thought both $\sqrt{y}$ and *y* were 0

Question 5

For many candidates this question proved to be a good source of marks. In part (a)(i) the vast majority of students gained all three marks. The majority of students used Pythagoras, although some used this incorrectly and found the sum of the squares of 8 and 2.5 or of 3.5 and 2.5. Part (a)(ii) was even more successfully answered with most students choosing to find $\sin^{-1}\left(\frac{2.5}{8}\right)$. Those that chose to use their values from part (a)(i) were invariably caught out by using inaccurate values. It would be sensible for students to use values given in the question wherever possible rather than use found values from earlier parts of the question. As expected, part (b) was found to be the more challenging part of the question with the main error being that students did not read or understand the meaning of *DE* being perpendicular to *AB*; some thought that *E* was the midpoint of *AB* or that *DE* bisected *ADB*. Another error included using tan as they mistakenly didn't realise that *AD* (or *BD*) was the hypotenuse.

Question 6

The responses to this question varied significantly. In part (a) most candidates gave a correct transformation of reflection but failed to give the line of reflection or in a few cases gave the wrong line usually $x = 1$. It is important to note that if 2 marks are given for the description of a transformation then 2 points should be made by the students. In part (b) most students gained both marks although some students transposed the triangle 2 units horizontally. Part (c) was less well answered but a number were able to pick up two of the marks for having 2 correct points, usually (2, –2) and (5, –2). Considering the grade that part (d) was set at, this was not well answered and students would benefit from asking for tracing paper in the exam in order to answer questions of this nature. However, a significant number of students did gain at least one mark usually as they had correctly rotated the triangle 180^0 although they had used an incorrect centre usually with their triangle having one side touching either the *x* or the *y* axis. Part (e) had an extensive amount of working carried out by some students, usually involving simultaneous equations, and with varying degrees of success. While this is a correct method it is not likely to be effective in terms of the time required. Those that had correctly recognised that the transformation was a reflection in the *y* axis and recalled the matrix that carries out this transformation were able to pick up 2 marks relatively quickly.

Question 7

Candidates struggled with this vector question. In part (a) most candidates scored the mark but it was not uncommon for arithmetic errors to be seen and hence the mark lost. Part (b) was not well answered as whilst a significant number were able to apply the ratio correctly to find AC many were unable to make any further progress. A number of students benefitted from the special case and were awarded 2 marks for have one coordinate correct, this was usually awarded for a correct *x* co-ordinate of –3. It was disappointing the number of students that gave an answer of (1, –3), with the coordinates swapped round. Students generally only made any progress in part (c) if they had made a good attempt at part (b), although part (c) was marked independently and so a student who had an incorrect answer to part (b) could still gain marks in part (c). A number of students failed to gain any marks as they were clearly considering just lengths rather than vectors. A few gained the first mark, usually for finding the position of *B*, although many thought that this was the position of *D*, misunderstanding that the vector *AB* = vector *AD*. Various attempts at Pythagoras and trigonometry were often unsuccessful. It was clear than many students had little understanding of vector arithmetic, preferring to try more complicated calculations involving intersecting circles for which only a few very good students were able to achieve full marks using this method.

Question 8

This function question targeted high grades and it was pleasing to see most students make a good attempt at this question with over a fifth gaining full marks. Part (a) was where most students lost the mark, showing little understanding of domain and range, the most common incorrect answer being $x = 1$. Part (b) showed varied responses with a number of students proceeding no further than stating what was given in the question. Many students multiplied both numerator and denominator by 16 when expanding the bracket. Even more failed to multiply all terms by *x* when eliminating the fraction. This often meant they had a linear expression, so could not get the third (independent) method mark either. The most common error amongst those that gained the first two method marks was a sign error with either $+8x$ or –16 and a few added the 8 and 16. Most of these students earned the 3rd method mark for a correct substitution into the quadratic formula; students were still able to gain this mark if they gained a three-term quadratic and showed their working when solving the quadratic equation. Those who failed to show their working need to be made aware that they are not going to gain marks. The quadratic formula was given, and so few candidates attempted to complete the square, while this is a viable method using the formula is usually simpler in a case like this. Part (c) posed one of the biggest challenges of the whole paper. Whilst many were able to clearly show that ff(*x*) was equal to $\mathrm{f}^{-1}(x)$, others found one expression and then used it in their calculations to 'prove' the other expression, or tried to manipulate an incorrect expression to match. A small number of students mistook the notation ff(*x*) and attempted to square f(*x*) rather than find the composite function. As with the previous part of the question there were a number of issues with some of the responses, many related to dealing effectively with the algebraic fractions. Part (d), compared to part (a) was answered much more accurately with a good number of correct answers seen. Part (e) was well answered with many extensive calculations as in the majority of cases students sensibly found f(2) then f(1/2) then f(–1) so that they were not penalised again if they should have an incorrect composite function.

Question 9

For part (a) only about half of the responses featured differentiation and only about half of those responses led to fully correct answers. Those students who realised they needed to differentiate usually managed to gain one mark at least, the most common mark being for differentiating x^2 to $2x$. Two marks could be instantly awarded for differentiating $\frac{24}{x}$ correctly but this proved more demanding. The third method mark was for recognising that they needed to equate their derivative to zero and solve for x which caused difficulties for some students as they could not solve the equation with x^2 in the denominator. Disappointingly some students did not attempt to find the y coordinate of the stationary point and this cost them, 2 marks in part (a) and invariably 1 mark in part (c) as they did not have a stationary point to plot. There were a few students who unnecessarily found the second derivative. In part (b) almost all students scored at least one mark, with the most common cause of not gaining 2 marks being for giving one or two values to 2 decimal places. For part (c) the vast majority of candidates gained the three marks for plotting the points and drawing a smooth curve. Of those who made an error the most commonly seen issue was inaccurate plotting usually of one of the first three points or failing to plot the last point. It was uncommon to award the mark for plotting the stationary point as many students had not found one. For part (d) the demand of the question was to use the curve and a line. Where candidates clearly did not use the curve to gain their answer they did not gain any marks here. While it may well be sensible to use their calculator to check their answer it should be obvious to the examiner that this is not where the answer originated. Of those who were successful in finding the required equation of the line, it was occasionally poorly drawn and so both of the last two marks were lost.

Question 10

This question worked well to differentiate between candidates. Many students gained the mark for part (a) although some verified rather than show that the probability of Hugo losing the first game was 2/3. The vast majority of candidates scored well on part (b), with errors seen appearing to be slips rather than being evidence of lack of understanding. Part (c) was well completed by the majority of candidates, a standard application of probabilities from a tree diagram should be well within the capacity of the majority of candidates. Students that failed to gain these two marks usually added rather than multiplying the two fractions or multiplied their product of probabilities by 2. Part (d) proved considerably more demanding, as expected, although many gained 1 or 2 marks for correctly finding the probability of lose then draw or the probability of lose and draw in either order. Very few candidates showed any understanding of conditional probability, although I would expect this question to prove difficult, candidates should be aware of the basic idea of conditional probability and the necessity to divide probabilities when calculating one.

Question 11

Despite being a challenging question, many students showed resilience and picked up at least some marks on this question. In part (a) many substituted the values into the given Cosine rule although some failed to recognise the demand of ‘show’ from the question and failed to show their manipulation of the surds. Those who attempted to solve the given equation, again failing to recognise the demand, gained no marks. In part (b) a variety of approaches to completing the square were seen and some students, with varying levels of success, started by expanding the $(x - k)^2$. The most frequently seen errors were failing to apply the negative sign to both terms of k when removing the bracket around them. Part (c) was often the only correctly answered part of this question, with just careless slips costing the students marks. In part (d) many did not use their answers to parts (b) or (c) at all, with some using the cosine rule that they should have used in part (a). It is important for students to note that attempts in part (d) that would have been awarded marks in another part of the question will not be awarded marks retrospectively. Some students used their incorrect answer to part (b) and to which follow through method marks were awarded. Only a minimal number of candidates took time to justify their final answer based on the information that angle *ABC* was obtuse. Those that did showed a good understanding of the underlying geometry.

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