Examiners' Report
Principal Examiner Feedback

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Mathematics A (4MA1) Paper 2HR

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International GCSE Mathematics
4MA1 2HR Principal Examiner's Report

This was an unusual examination series and we had a very varied group of responses with some of an excellent standard but others leaving out vast quantities of the questions on the examination paper.

This paper gave students, who were well prepared, ample opportunity to demonstrate positive achievement. Some challenging questions towards the end of the paper discriminated well and stretched the most able students.

Some students still need to heed the wording 'showing all your working' as on questions where this is requested no marks are awarded for merely seeing a correct answer.

Question 1
Very few candidates failed to score full marks on this question. A small number of candidates were helped by the special case B1 for obtaining the number of times that the spinner did not land on blue.

Question 2
The majority of students scored full marks on this question, with the choice of method split evenly between use of factor trees and continued division by a prime factor. If not fully correct, two marks were often awarded for a fully correct diagram with students failing to use index notation in their final answer. The score of zero was most commonly awarded where students gave a final correct answer from their calculator without two clear steps of working. Candidates occasionally thought that 4 was a prime number and failed to gain a fully correct expression.

Question 3
Most responses gained full marks in part (a), however a number of candidates made errors in part (b), mainly due to using the wrong power of 10. The final part of this question was also answered correctly by virtually all candidates, with the use of calculators providing a great benefit.

Question 4
Many responses gained some marks on this question, and fully correct answers were obtained by a good number of candidates. The most common error was to miss the mode, with candidates giving either 5 different values, or repeating one of the other values meaning that the mode was not unique.

Question 5
Many candidates were not able to demonstrate a good understanding of bounds. The lower bound of 33.75 was more successful but fewer managed to obtain the correct upper bound of 33.85. Candidates frequently gave incorrect values of 33.84 or 33.9 which demonstrate a poor understanding of this topic.

Question 6
Many candidates missed the instruction to use suitable approximations, and wasted a lot of time attempting to work out an accurate answer using written methods. Even when

rounding values, candidates often chose to round to 2 significant figures, which does not lend itself to mental calculation and hence did not earn method mark. The best responses came from candidates who rounded each value to 1 significant figure, worked out this as 140 000 and gave a correct conclusion.

Question 7
Most students appreciated the need to begin by using Pythagoras to find the length *AC*, thus picking up the first two marks. The question was generally completed well and many were awarded full marks. A significant number of candidates failed to round at all or rounded down, not realising that purchasing the steel in lengths of whole metres required them to round up to 19 m.

Question 8
This question was answered well by a large number of candidates, obtaining a correct answer from a fully correct method. Weaker candidates often simply averaged the two means, which was a commonly seen incorrect answer. A few candidates simply added the weights and divided by 40 to find a strawberry with a weight of only 1.2 grams!

Question 9
Correct factorisations in (a) were obtained by a good number of candidates, although many did score zero marks due to leaving this question blank. A common incorrect approach to factorisation led candidates to write $x(x-1)-42$.

In (b), for those students not thrown by the inequality sign, this was well executed and scored well. However, many preferred to replace the sign with an 'equals' sign and were awarded two marks for the correct value irrespective of the sign. A large proportion missed the final accuracy mark for failing to change the inequality when dividing by a negative. This error was avoided by those students who preferred to keep the variable on the right-hand side giving an answer of $2.4 < x$, which was accepted for full marks. A significant number lost the accuracy mark following a correct response by choosing to put just 2.4 on the answer line thus not answering the question. The fraction 12/5 was seen more commonly than 2.4, with both accepted.

Question 10
Good knowledge of indices was demonstrated by many candidates in part (a) by obtaining the correct value of *x*. Part (b) was also answered well in many cases, with candidates demonstrating accurate application of index laws. Some candidates failed to subtract indices correctly, giving 3^{-14} or divided the indices to obtain $3^{\frac{4}{3}}$ which gained zero marks.

Question 11
This question was not answered well by many candidates, and some students were unaware that they needed to draw the lines $x = 4$, $y = -2$ and $y = x$. Even though two marks could be awarded for drawing the appropriate straight lines, many struggled with drawing $y = x$, instead opting to draw a diagonal line from the origin to the top right corner of the grid provided. Candidates that did manage to drawn three correct lines often gained full marks as they were able to identify the correct internal region **R**.

Question 12
Responses to this question generally showed some correct algebra for a first step of working, rearranging the equation to $2y = 7 - 5x$, however a fairly large proportion were unable to complete the rearrangement to $y = \frac{7}{2} - \frac{5}{2}x$ and obtain the correct gradient of $-\frac{5}{2}$. Some candidates did not handle the constant term accurately and gave the gradient as $-\frac{7}{2}$.

Question 13
Candidates generally demonstrated confidence with basic trigonometry and this question was very well answered. The most straightforward and most commonly seen route was to use cosine to find the hypotenuse however it was interesting to see how commonly students preferred to use sine by calculating the third length in the triangle. Another approach seen was to use trig to find the length *BJ* then use Pythagoras to find the required length. By whichever method, the majority gained the first two marks and subsequently completed to be awarded full marks.

Question 14
Almost all candidates listed the numbers in order to earn the first mark in part (a). Many went on to correctly find the quartiles and IQR. Those who did not fell into two groups; those who tried to identify algebraically where the upper and lower quartiles were and those who identified the range i.e. 47 – 35. Part (b) was not answered well, even though follow through marks were available for those candidates who obtained an incorrect answer in part (a).

Question 15
A good number of students attempted this question and of those, many gained at least one mark for finding the volume of the cylinder. The most common cause for failure was calculating the surface area. The density formula was used confidently and correctly by most who tried the question. These students then generally went on to complete correctly. More rarely, the alternative method was used, comparing volumes rather than masses. A few candidates unfortunately failed to gain the final mark, following fully correct working, as they omitted a conclusion.

Question 16
Candidates generally found the correct angles, but had no idea of the reason, and incorrect attempts were varied and numerous. Most correct responses used the key words angles, same and segment. Other attempts were, generally, unsuccessful. Corresponding was probably the most common error.

Question 17
A small number of students failed to attempt this question but otherwise it was commonly awarded full marks. Most gained at least one mark for multiplying by n^2. Many then collected the n^2 term correctly but some failed to factorise. Those who correctly factorised invariably completed to gain full marks. It was unfortunate that those students who automatically gave ± when square rooting were penalised if they included it in their final answer, as the question stated that $n > 0$.

Question 18
The first two parts of this question were a good source of marks for most candidates. With nearly all scoring at least 2 marks on parts (a) and (b) and the majority scoring all 4 marks for correct values and an accurate graph. Curves drawn were, generally smooth and accurate and, thankfully, pencil lines were appropriate thickness with very few being thick and unconvincing. Part (c) was not well done with the significant majority not identifying the line $y = -x - 1$. A numerical value for the solution with no working gained no credit, due to this being easily obtained from a calculator.

Question 19
This was a very polarising question, with almost equal number of responses gaining full or zero marks. The most common response was the fully correct answer, with most students choosing to work in degrees but it was also common to see radians being used. Very occasionally, those students using radians incorrectly converted into degrees by multiplying by 180 but failing to divide by π. The angle at the centre was occasionally given as a final answer although most applied the correct circle theorem and divided by 2 to find the correct angle. Some candidates lost the final accuracy mark due to premature rounding.

Question 20
This question was a good source of marks for many candidates, earning full marks in both parts (a) and (b). Unfortunately, quite a number were thrown by the phrase 'inversely proportional' and simply tried to use the formula $T = km^2$ thus gaining no marks.

Question 21
For those students attempting this question, the method was split evenly between those who correctly used frequency density or area and those who incorrectly added the heights of the bars. A similar proportion did not even attempt the question.
Those who had clearly revised the topic generally showed good, clear working. Those who labelled their frequency density axis using 14/10=1.4 to find the height of the first bar were able to proceed more easily than those who counted squares.

Question 22
It was pleasing too see how many students can handle a fairly complicated question correctly and with confidence. Although many scored nothing, a large proportion got as far as the mid-points although some then added the *x* and *y* values rather than finding the distance between them using Pythagoras. Even those who obtained an incorrect quadratic were able to gain one mark for solving *their* quadratic with a correct method, which should encourage candidates to persist such questions rather than leaving a blank response.

Question 23
A fair number attempted this question and were able to gain one mark for finding the gradient of *PQ*. Unfortunately, many candidates did not realise the mid-point was required and many tried to find the perpendicular through one of the given points, suggesting they did not understand the concept of a perpendicular bisector. A good proportion were able to find the gradient of the perpendicular thus gaining only two marks if they could not find the mid-point as subsequent work was dependent on using

the mid-point. Those who succeeded in finding both the mid-point and the gradient of the perpendicular generally went on to successfully substitute into the general equation and were thus rewarded with full marks. Sometimes students lost the final mark by not giving the equation with integer values.

Question 24

This question was a good differentiator. Only a minority of students correctly took out -3 as a factor. Those who did, generally were proficient at completing the square and continued accurately to secure full marks. Some candidates did not recognise that they had to use the answer to part a to find part b.

Question 25

Most students found this question very challenging and many did not attempt it. For those who did, despite their best efforts and two pages of writing, the most common score was one mark for finding the vector **AB** or **MN.** The vector solution involved a high level of understanding of vectors and algebra. It should be noted that those students who answered the question using other means, most notably similar triangles, scored no more than the first mark mentioned above as the question asked for a vector method.

Question 26

Fully correct responses were rare for this question as most students found it very challenging. Only a minority correctly applied the intersecting chord theorem, candidates erroneously using $AB \times BC = ED \times DC$. Similarly those who started by early substitution of $p\sqrt{5}+q$ for AB struggled. More success was seen by those who considered AC rather than AB as lack of brackets in expressions meant that some candidates missed the necessary multiplications. Of those who started well, many failed to use the conjugate to rationalise the denominator and simply used a calculator, taking no heed of the advice to show working clearly.

Summary
Based on their performance in this paper, students should:

- Learn how to approximate calculations by first rounding each value to one significant figure.
- Develop understanding of upper and lower bounds
- Develop understanding of graphing inequalities
- Be able to find the interquartile range from a list of values
- Ensure that their working is to a sufficient degree of accuracy that does not affect the required accuracy of the answer.
- When asked, show their working out or risk gaining no marks for correct answers.

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