



Examiners' Report Principal Examiner Feedback

Summer 2024

Pearson Edexcel International GCSE
In Mathematics A (4MA1) Paper 2HR

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IGCSE Mathematics 4MA1 2HR Principal Examiners Report

Students who were well prepared for this paper were able to make a good attempt at all questions. It was encouraging to see many students clearly showing their working. Students were less successful in using set theory, indices and working with prime factors.

On the whole, working was shown and was easy to follow through. There were some instances where students failed to read the question properly such as Q8 and Q14.

A striking weakness in students was solving problems with areas, writing a number as a product of prime factors in index form, applying trigonometry and using median, mode and range in context. On the whole, problem solving questions and questions assessing mathematical reasoning were not tackled well, this was particularly apparent, for example, in questions 10, 15, 21, 22 and 25

Elsewhere students are reminded of the importance of clear, legible presentation of their reasoning as too often mistakes are made through untidy and disordered work. This point is particularly pertinent in those questions requiring several steps to reach a solution or those that require detailed algebraic processes.

Question 1

This question was answered well with the majority of students gaining full marks, usually with the use of a prime factor tree, or a table showing division. There were also a significant number of arithmetical errors in attempts to find the prime factors. Some students failed to express their final answer in index form, as requested. Others gained a mark by recovering from one incorrect stage in prime factorisation. A few students showed no working and gained no marks, despite the instruction in the question.

Students are reminded that for this type of question working must be shown, as many modern calculators have a FACT facility that produces answers directly.

Question 2

(a) The word “translation” was reasonably well known and related to this question though it was also common to see general descriptions such as “down five and right three”. Some simply wrote about the shape moving. Perhaps more guidance needs to be given to students about the meaning of “describe” in a question of this kind, and also to the instruction that it should be a *single* transformation.

The vector component of the required answer proved a little more popular but many students gave their answer as a correct (or incorrect) pair of coordinates; others gave the values of the column vector the wrong way round $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$ and some simply had a vector but with no correct values. Consequently, fewer students scored full marks on this early question than was expected.

(b) The large majority of students rotated the given shape correctly through 180° but not always with the given centre. A minority of students gave their answer as a reflection.

Question 3

Students are gaining confidence in questions of this kind. An understanding of the range enabled most to score at least 1 mark. Some then decided that the second x had to be different, usually choosing 12 before wrongly concluding that $y = 13$. There were a few cases of mistaking the median for the mean.

Question 4

(a) Those who could remember the difference between the union and intersection symbols usually scored full marks.

(b) Too many students wrote vague answers saying that there were common numbers in A and B but not stating what they were. This scored 0. It is a teaching point that needs to be emphasised. Also, the understanding of prime numbers as those with exactly 2 factors, needs reinforcing. Too many responses stated that 1 was a prime number and many students wrote $A \cap B = \{1, 2, 3\}$ or $\{1, 3\}$.

(c) There were many correct answers. Partially correct answers that scored 1 mark usually included 5, 6 and 7, with 2, 3 or 9 as the fourth element, instead of 1. Occasionally, just the three elements 5, 6 and 7 were given, which also scored 1 mark, and even more seldom were answers with 5 elements. A common incorrect answer was $\{4, 8, 9, 10\}$.

Question 5

Finding the length of a square's side was mostly done reasonably well. Those who did not, tended to divide 81 by 2 or 4. Some candidates equated 81 to the area of the circle rather than the square, using $81 = \pi r^2$ to get the radius. Having found the correct radius most successfully recognised the perimeter of the square was 36 and were able to use $2\pi r$ or πd for circumference. Some, however, failed to understand the difference between perimeter and area. Considering the units, cm or cm^2 , and whether a given formula gives results of the correct type may assist.

Question 6

(a) This was answered quite well and the layout of working was often good. Multiplying both sides by 3 was the preferred option to get started. Common errors came from expanding $3(4f - 17)$ incorrectly or failing to multiply all three terms by 3, though some signs were lost in rearranging terms after this expansion. Follow through marking helped some students who had made the most common mistakes when clearing the fraction. Those who tried to rearrange the equation before removing fractions tended to be less successful.

It might help some students to be more willing to use brackets in the first stage of this sort of working.

(b) This part was answered well.

(c) The question was answered well, often showing no intermediate steps, though a significant number of students made no attempt. Laws of indices were applied well for the most part. Some attempted to find a common factor of both the numerator and denominator and then cancelled. This method was not as successful in general. Some responses simplified the algebraic elements correctly but not the numerical part. Another common error was to mix up the indices on the variables in their final answer. There were also a lot of transcription errors on this question.

(d) The majority of the students did very well with this question, and those that did not achieve full marks were often awarded one mark for a partially factorised expression, usually $2x^3y(10x^2 + 6y^3)$.

Very few students did not attempt the question, although some tried adding the expression, leading to an incorrect answer of $32x^8y^5$.

This is a question where it is quick to check an answer, first by ensuring that there are no more common factors in the bracket, and then by mentally multiplying it out.

Question 7

Most students gained full marks here but it is worthy of note that many did so without showing any steps of working. It was common to see candidates correctly simplify the numerator to 3^3 but then subtract the wrong way around and end up with $n = 7$. Those who had shown their working picked up the one method mark but those without gained no marks at all. A minority tried to simplify the numerator by multiplying the powers rather than adding them. Some students tried using their calculator to express each power of 3 as a number, which was not a very successful strategy, while others simplified the first step incorrectly writing $3^{-2} \times 3^5 = 9^3$, sometimes going on to state $\frac{9^3}{3^{10}} = \left(\frac{9}{3}\right)^{3-10} = 3^{-7}$, leading to a correct answer from incorrect working.

Question 8

Many students performed very well on this question as they recognised the reverse percentage and applied a sound method correctly. Most chose to divide the sale price by 0.83 or $\frac{83}{100}$ in a single step method, rather than equate 6225 to 83% and then find 1% and 100% in stages. A small minority of students attempted to solve through trial and improvement with limited success. Some students gained 1 mark for finding 0.83 but then multiplied by 6225. The most common error was to increase the sale price by 17% or find 17% of 6225 and reduce it by this value, showing a lack of understanding that the 17% was calculated from the original price. Some students misinterpreted the question and used 1.17 as their 'multiplier' rather than 0.83. It should be noted that (1 – 17%) did not receive a mark for 0.83 or 83% until further correct progress had been made, such as (1 – 0.17).

Question 9

Parts (a) and (b) were answered this part well.

(c) The vast majority of students were able to successfully give an answer of the form 2×10^n or, at the very least, had the correct integer value of 200 000. A significant number then went on to give the correct answer. Of those who went wrong from the start, many attempted to simply calculate $(7.6/(4-2) = 3.8)$ and followed this with an incorrect calculation of the powers of 10 (10^9 was not uncommon as a result of $\frac{10^{10}}{10^5 \times 10^{-4}}$). Other miscalculations by students led many to 3.8×10^n where $n \neq 5$, scoring no marks at all.

Question 10

This question saw varying degrees of success but did provide students with multiple routes to gaining marks. Many students found the area of the lower rectangle but made no further progress. Students who realised that the height of the trapezium was needed and used trigonometry correctly, generally went on to gain full marks; although few applied the area of a trapezium formula, despite it being on the Formulae sheet. A significant number of students treated the trapezium as a composite shape, with resulting mixed fortunes.

Question 11

(a) The majority of the students drew the correct graph. A small number drew a line of best fit rather than joining the points. A small minority drew an incorrect cumulative frequency graph, usually using interval midpoints, or a bar chart using the cumulative frequencies or the frequencies.

(b) The interquartile range was relatively well answered but it was surprising that a lot of students did not draw the lines at 15 and 45. Although the mark scheme did not require this, it is good practice and should be encouraged. The time scale was frequently read incorrectly to give quartiles of 9 and 23 instead of 9.5 and 21.5, which scored the method mark but lost the accuracy mark.

(c) Students often made the mistake of reading a value at 25 on their graph rather than subtracting 25 from the total and taking a reading at 35. This led to the common incorrect answer of 14.

(d) The last part was a good differentiator, with more able students earning the mark. The information could be obtained directly from the table and did not rely on an accurate graph. Some students correctly identified 11 students but did not express their final answer as a probability.

Question 12

Part (a) was mostly well answered. Students should be encouraged to look at the diagram and decide whether the answer should be bigger or smaller, and consequently whether multiplying or dividing is appropriate. A fair percentage of students did this correctly but failed to read the question properly and supplied the length of AD rather than ED .

Part (b) was answered less well. Many were not able to correctly construct an equation to find x . Some understood that AB was $\frac{2}{3}$ of AC but then proceeded to use the ratio $2 : 3$, which led to errors. Others equated $AB = BC$ or $AB = 15$ from part (a). A few even multiplied $AB \times BC$. Of those who did get a (more or less) correct initial expression, brackets were often missing, and no further progress was made.

Question 13

This was not a high scoring question. The majority of responses gained one mark for an expression for the arc length AB using either $\frac{60}{360}$ or $\frac{1}{6}$ as their multiplier with $2\pi r$ for the circumference. Those who remembered to add $2r$ usually managed to simplify the arc length and factorise to give an answer in the required form. A mark was sometimes lost for failing to write down the full formula, starting with $P =$. Some of those who did not add $2r$ still tried to factorise their single term to contrive the given result. A common error with the expression for arc length was to use the area of a circle instead of the circumference.

Question 14

This question seemed to discriminate well between those who understood probabilities related to independent events and those who did not. The latter category tried calculations such as $0.8 - 0.24$ or $0.24 - 0.8$, and $1 - 0.24 = 0.76$ was also seen regularly.

Question 15

Most students successfully found the interior angle of a regular pentagon which they used to identify angle DCE correctly. They then used $0.5ab\sin C$ to find the area of triangle CDE . A smaller number of students opted to find the exterior angle of a regular pentagon before proceeding in the same way. A minority of students chose a longer approach of using trigonometry to find the perpendicular height from D to CE and then $0.5 \times \text{base} \times \text{height}$ to find the area of triangle CDE . This method was done well by those who chose to use it.

The most common mistake was to find the interior or exterior angle of a hexagon. Students did not read the question carefully enough and just considered the diagram where they decided the polygon section $ABCD$ resembled the bottom half of a hexagon. These responses generally scored one mark for the correct use of their 60 degrees in the area formula. A few students made up an angle for CDE , which was not always acute. Students also lost marks by misplacing their angles on the diagram so that they contradicted the working. Some students assumed the triangle was right-angled or isosceles and attempted to halve the base of 3cm and use trigonometry or Pythagoras to find the perpendicular height.

Question 16

There were no obvious patterns, though *E* and *A* were more often answered correctly; those who didn't get full marks often got the second graph correct. One thing that became difficult to mark was when students changed their minds and wrote a letter over the top of their initial thought ... this should be avoided as markers cannot usually decipher which letter it is meant to be. The best way forward, is to cross out completely the one a student thinks is wrong and replace it.

Question 17

There was a reasonable number of good, clear answers which showed each stage of working. Those whose working lacked this detail were much more likely to make mistakes. After starting correctly, a common mistake was to simplify $2(6k - 2)$ incorrectly, usually to $12k + 4$ or $12k -$

2. There were also numerous instances of students reaching $9k = 5$ but then giving $\frac{9}{5}$ as their answer, a misconception of reading figures in the equation from left to right to form the fraction. Some tried to cancel $\frac{3k+1}{6k-2}$ to give $\frac{k+1}{2k-2}$ which they then wrote as $\frac{1}{2}k + \frac{1}{2}$ or $\frac{1}{2}k - \frac{1}{2}$.

A frequent incorrect answer was 0.7 after evaluating $fg(2)$.

Question 18

This question saw the full range of marks awarded. A significant number of students gained no marks by either failing to use algebra, despite the instruction, or failing to identify two correct algebraic equations to subtract. Of those who did, many lost the second mark by implying division from $999x = 306$ to without showing the intermediate step $x = \frac{306}{999}$.

It was not uncommon to see values for x , $10x$, $100x$ and $1000x$ written down with the wrong pair chosen for subtraction. A few students muddled the recurring decimals with statements like $x = 0.3063636$

It is worth emphasising to students that questions that involve proving a given statement require every step of working to be shown clearly, ending with the required answer.

Question 19

Most students were able to show at least one correct error bound for speed and time; many showed both upper and lower bounds. $19.49\dot{9}$ was sometimes used rather than 19.5 but teachers should emphasise the use of 19.5 since terminating decimals such as 19.499 were not accepted. The correct formula for distance was well known, but some errors were made by using a mixture of upper and lower bounds in the product. Some students multiplied 19 by 1.5 and then found bounds for their answer.

Many who were successful on this question wrote the unrounded answer 30.225 and didn't round to 3 significant figures, as the question asked. In this series this was not penalised, but students should be advised to give answers to the degree of accuracy, as stated in the question.

Question 20

This question was answered well with a good number of students awarded full marks. Some were penalised for failing to show clear algebraic working, as instructed. This means that they had to show details of their method to find the critical values, usually correct factors of the given inequality or correct use of the quadratic formula. Simply using a calculator to find the values $-\frac{4}{3}$ and $\frac{5}{2}$ was not enough, nor was the factorisation $\left(x + \frac{4}{3}\right)\left(x - \frac{5}{2}\right)$.

The most successful approach to using correct critical values to solve the inequality was to use a sketch graph. Those who tried to reason the correct inequalities from the algebraic working frequently made mistakes, often stating $-\frac{4}{3} < x < \frac{5}{2}$ or $-\frac{4}{3} > x > \frac{5}{2}$

Question 21

This was a challenging question, especially for those who felt that they could answer it without reference to any kind of diagram. Indeed, regarding diagrams, students need to be informed that the convention for labelling polygons is to name the vertices by working around the perimeter in the order that the letters are given. Some diagrams showed the square $ACBD$ instead of $ABCD$.

A surprising number of mistakes were made at the beginning with the gradient of AB . Some divided x values by y values; some subtracted x values from y values; many signs were lost and there were plenty of numerical errors. There were also attempts to find the gradient by using points A and B to form two simultaneous equations in m and c . This was a longer method, but it was not without success. Attempts to find the perpendicular gradient were often good, though the negative sign was sometimes lost. In order to find the constant for the equation of BC , most used substitution but numerical mistakes were quite regular. Those who did find their way to a correct equation sometimes overlooked the instruction to give their answer in a form with integer coefficients.

Question 22

Most students correctly used the substitution of $y = 3x - 1$ into the quadratic equation. Some attempted to substitute for x but these were clearly in the minority. The students who scored no marks for this question either did not attempt it or simply were unable to eliminate one of the variables.

For those who made a good start, most were able to pick up at least four marks. The main error tended to be reducing the quadratic in x to 3 terms. One source of errors was the expansion of $(3x - 1)^2$ which was often given as $9x^2 + 1$ or $6x + 1$. Allowing for one error in the coefficients here enabled students to pick up this method mark and the remaining method marks when clear algebraic working was shown, as instructed in the question.

Question 23

(ii) This was answered well. (16, -3) was the most common mistake.

(ii) This was answered well. (18, -3) was the most common mistake, with (6, -3), (2, -9) and (6, -9) occurring from time to time.

Question 24

Part (a) was a challenging question and as a result the full range of marks were seen. Many students misinterpreted the height of the cone as '4x' and hence were not going to score more than M1. Careless use of brackets also prevented correct expressions for the volumes. Of those who did form a correct equation for the volumes, errors were then made in expanding brackets and/or rearranging the resulting equation. Incorrect formulae were applied, often for the volume of the hemisphere.

Part (b) This was answered well with many students understanding the relationship between length, area and volume scale factors and reaching the correct answer of 64.

Question 25

Most students were able to score well on the first part of this question, although some ignored the instruction to give answers in simplest form, typically leaving their vectors as $3\mathbf{b} + \frac{4}{5}.2\mathbf{a}$ and $\frac{3}{4}.3\mathbf{b} - 2\mathbf{a}$. These vectors were intended to give a starting point for part (b) and many students accepted the hint and made reasonable progress. There were also plenty of alternative approaches. In both cases, many errors were seen, especially with signs and missing brackets, such as $\overrightarrow{OY} = k.3\mathbf{b} + \frac{8}{5}\mathbf{a}$.

The question asked for a vector method to be used. Those who based an answer on similar triangles with no significant use of vectors did not score marks for their answer. It was not unusual to see a complete mixture of inaccurate notation, with vectors put equal to scalars and vectors divided by vectors.

Question 26

This question was generally well answered, with most students recognising the need for factorisation, followed by inverting and cancelling. Careless use of brackets prevented a significant number of students gaining the final mark, with ' $\frac{7}{x+2}$ ' being a common incorrect answer. Failure to factorise the quadratic led to unnecessary working and limited reward.

Summary

Based on their performance in this paper, students should:

- learn to write a number as a product of its primes in index form
- learn how to apply trigonometry to problems
- learn the formula for the circumference of a circle
- use brackets when formulating expressions or equations
- read the question carefully and review their answer to ensure that the question set is the one that has been answered
- make sure that their working is to a sufficient degree of accuracy that does not affect the required accuracy of the answer.

