# Examiners' Report
# Principal Examiner Feedback

January 2023

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

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**4MA1 2HR**
**January 2023**
**Principal Examiner's report**

It was pleasing to see this cohort attempt the majority of questions for what is the final 2HR paper seen in the January session, since 4MA1 will move to a June/November cycle from this year onwards. Working was present for almost all questions that required a method and this certainly helped students to gain more marks. It was also pleasing to see students adhere to the instructions in the question, in particular when working was asked for, to ensure they were credited for correct methods and answers. Up until the final few questions, most responses saw an attempt and further question-by-question detail can be seen below.

1 This familiar start to the paper saw many students gain full marks. Almost all were able to score the first M1 for two correct improper fractions and then also gain the second M1, usually by inverting the second fraction and multiplying. The final A mark was seen less frequently with some students not showing the intermediary step such as multiplying the fractions to reach 84/33 or cancelling and instead going to straight to 28/11 and losing the third mark.

2 Part (a) of this transformations question was answered well with most able to produce a correct shape with correct orientation and position. Of those that didn't, many picked up one mark for a correct shape with correct orientation but incorrect position. In (b) many managed to place the shape C in the correct position, however it was not uncommon to see the shape incorrectly placed showing that some students do not understand how to interpret vectors.

3 Part (a) of this inequalities question was answered well with the majority of students producing the 5 correct values and no incorrect values. Common incorrect answers included listing the integers from −7 to 2 or including an extra value such as −4. In (b) many picked up one mark for a correct inequality, with most using the letter $x$, although some used $y$ which was condoned as long as the inequality was correct. The most common incorrect answer was a closed inequality from −1 to 5.

4 This angle bisector question saw varying degrees of success. Around half of students were able to produce a correct bisector with relevant arcs for 2 marks. Of those that didn't, it was not uncommon to see a correct bisector without any arcs or with insufficient arcs. Some students clearly lacked understanding of this topic and simply drew lines on the diagram such as a straight line from $B$ to $C$.

5 This question was answered well with the majority of students scoring full marks. Of those that didn't, some picked up B2 for a line through at least 3 of the points or B1 for a line with a gradient of −2.5.

6 This question involved both probability and linear equations and was answered well. The majority were able to set up and solve an equation in $x$ and go on to get an answer of 19/80. Of those that didn't, common errors were to reach $x = 13$ but then consider the red counters as 13 instead of 20 and also to attempt to set up an equation with a new variable for yellow such as $y$ which occasionally led to success but often to 0 marks. An answer of 19 was commonly seen. Many assigned $x$ as the number of yellow counters and set up the incorrect equation $6x - 4 = 80$.

7 Part (a) was answered well with the majority of students gaining 2 marks for a correct answer; both 20 and $2^2 \times 5$ were seen regularly. Of those that did not gain 2 marks, many picked up one mark for correctly identifying the prime factors or either or both numbers. Some were able to list at least 2 factors of 200 and 420. It was clear that some students had confused the highest common factor with the lowest common multiple by giving an answer of 4200. Part (b) was also answered well with a good number able to pick up 2 marks for an answer either as a product of prime factors or as an ordinary number 970 200. A score of one mark was seen less often as those students who didn't get the correct answer generally didn't know how to start the question. Occasionally a fully correct Venn diagram was seen without the correct answer.

8 This combined mean question was answered very well with most students gaining full marks. Of those that didn't, the most common incorrect method was to find the sum of the two means given in the question and divide by 2.

9 Part (a) of this familiar looking percentages question was generally answered well. A variety of methods were seen and it was pleasing to see the majority of students use the 'efficient' method of $2000 \times 1.04^3$. Some students used the percentage button on their calculators e.g. $2000 \times (1 + 4\%)^3$; it should be noted that without the correct answer this method gains 0 marks. Part (b) saw more mixed results, around half of the cohort were able to interpret the information correctly and produce a correct answer of 1500. Common incorrect methods included finding 109% of 1365 and treating the initial percentage change as an increase and doing e.g. $1365 \div 1.09$.

10 The two M1 marks were independent of each other on this volume and density problem meaning a good number of students who did not gain full marks still picked up 1 or 2. Many were able to find the volume of the cylinder with help from the formula on page 2. Some students then came unstuck for the second step as they did not sum the two masses and two volumes and divide, with many instead finding the density of Solid A and the density of Solid B and then finding the sum of the two densities; this approach still gained the second M1 but not the A mark.

11 This question saw varying degrees of success but did provide students with multiple routes to gaining marks. The first two marks were for working with angles and getting as far as finding the size of the interior or exterior angle; this was often seen on the diagram. The 3rd method mark was for using their 160 or 20 in the interior or exterior angles formula correctly and a good number who managed to do this went on to score full marks. It is important for students to clearly identify their angles, either on the diagram or

by using three letter notation. It was not apparent to all students which the correct exterior angle was; 148 from 180 − 32 or 200 from 180 + 20 were occasionally seen, often followed by an attempt to divide into 360. Some stated the correct answer of 18 but did not justify this in their working. 180 – (128 + 32) without assigning angles was insufficient.

12 Part (a) of this question was answered well with most students recognising that $y^0 = 1$ and therefore the fraction simplified to 2. Part (b) was also answered well with the majority of students gaining 2 marks; of those that didn't most gained B1 for $ka^3$, with a coefficient of 12 commonly seen. Finally, part (c) saw many students gain full marks for a fully correct expansion and simplification. A small number of students gained no marks as they multiplied two factors and then a different two factors and then tried to simplify from there. Of those that did gain the correct answer, some then attempted to factorise. If done correctly, 3 marks were still awarded as per the mark scheme. If done incorrectly e.g. dividing by 5, M2A0 was awarded.

13 There were a variety of approaches seen to this question. The most common was to work with multipliers e.g. 1.2 × 0.65 or $1.2L \times 0.65W$ and go on from there, many reached 0.78 or 78 and then stopped, hence gaining only 1 mark. Those that did realise this was not the percentage change did go on to get the full marks for an answer of 22. Some students approached the question by assigning values for *L* and *W* with varying degrees of success with the second method mark proving challenging to achieve.

14 This question combined circle theorems and arc length and students could pick up one mark for understanding of each topic. The first mark was for using angle at the centre is twice the angle at the circumference correctly and this was seen with varying success. Many thought *OABC* was a cyclic quadrilateral and worked out obtuse *AOC* to be 48. If an incorrect angle had been found students could still gain the second M mark for using it correctly to find the major arc or the perimeter of the major sector and this was seen frequently. Some students had correct circle theorems work and the length of the major arc but failed to add the lengths of *OA* and *OC* onto the arc gaining M2A0. A common error was to work out the perimeter of the minor sector.

15 Part (a) of this statistics question was answered well with many able to identify 11 and 2 as the quartiles and subtract to gain a correct answer and two marks. Part (b) saw mixed results; (i) saw more success with a good number able to interpret the information correctly and select Kim supported with a correct reason. Some students did not understand Interquartile Range and concluded that Rutger was more consistent in (ii) as he had a higher IQR.

16 This question was answered well with a good number able to give a correct answer for two marks. Of those who didn't gain two marks, many were able to gain M1 for one correct value or two correct values with the incorrect signs. The most common incorrect method seen was to add together the two vectors.

17 Part (a) proved to be a good differentiator for this cohort with the full range of marks being seen. Some students found 4 correct frequency densities and went on to convert these into 4 correct bars. Failing that some were able to gain 1 or 2 marks for 2 or 3 correct frequency densities and this was seen often. The special case available for the students that used their own scale despite one being given was also seen regularly. There were also a good number who did not know how to approach a histogram and left the grid blank or attempted a bar chart. Part (b) saw some success with a good number able to interpret either their histogram or the information in the table a give a correct answer of $\frac{42}{50}$. Of those that didn't, some gained 1 mark for working out an estimate for a sub group of the students with the 30-45 minutes being most commonly seen. Also commonly seen was the fraction $\frac{57}{69}$ corresponding to the students in the whole group who took less than 50 minutes.

18 The most common seen scores on this question were 0 or 3. Of those who gained full marks, most found the linear scale factor and then did $750 \times 2.4^2$. Of those who gained 0, the most common error was to work with 3600 and 625 as if they were lengths and divide them to find the scale factor.

19 It was pleasing to see many students be successful with this algebraic proof question. Many were able to make a correct start with 3 consecutive even expressions and the second mark could be gained by starting to square the expressions. The final A mark proved more challenging to achieve as students needed correct algebra and a conclusion. It was common to see students not work with even numbers e.g. using $n$, $n + 2$ and $n + 4$, although this could still gain full marks if $n$ was defined as being even. There were still a good number who did not use any algebra and tried to substitute in values but this appeared to be fewer students than in previous sessions.

20 This question saw the full range of marks awarded. A mark of 2 was commonly seen for completing 4 sections correctly, generally $A \cap B, A' \cap B \cap C', (A \cap B \cap C)'$. It was common to see Venn diagrams completed with no correct sections. Around a third of students were able to interpret the information correctly and gain full marks.

21 This question required students to draw a tangent to gain any marks. Half of students did this and if they then went on to achieve a gradient in the range 0.2 to 0.8 the full 3 marks were gained. Some students missed out on more than one mark as their method for gradient was incorrect and some muddled the order of the $x$ and $y$-coordinates in their calculation; they could still gain two marks for an answer in the range −0.8 to −0.2. It was not uncommon to see no tangent drawn or the question left blank. Students should be encouraged to draw a tangent of sufficient length. A tangent that covers at least 2 large squares is easier to calculate an accurate gradient from.

22 This was a challenging simultaneous equations question and as a result the full range of marks were seen. Some students were able to substitute the linear equation into the quadratic, expand, simplify and solve for the full 5 marks. Of those that didn't get the

correct answer but did make a correct start by substituting, some came unstuck with the expanding and simplifying but even though they didn't get the correct quadratic equation could still go on to gain method marks for solving their quadratic. Those who rearranged the linear equation to $y = -3 - 2x$ were more likely to gain full marks than those who made $x$ the subject. It should be noted that students should always show their methods as if a incorrect quadratic was solved using an algebraic method, marks could be gained, but using calculator equation solver was M0. Another common error was to convert $\frac{2}{3}$ or $-\frac{13}{3}$ into a decimal and round to one decimal place which cost students marks.

23 For any progress to be made on this high grade question students needed to set up a correct equation using the Intersecting Chords Theorem. A decent proportion of this cohort were able to do this and a good number of those went on to gain full marks - it was pleasing to see students choose the positive value for $x$ following solving the quadratic. It should be noted that students should always show their method for solving quadratic equations, it was seen several times where students had the incorrect quadratic equation and solved it, presumably using their calculator, without a method and gained no further marks as the values for $x$ were inaccurate and therefore the method needed to be seen to award credit.

24 Some students were able to make a start on this question by setting up an equation and some simplification. Those that did it correctly and reached $h = \frac{4r}{k}$ gained the second mark and often went on to gain the 3rd for use of Pythagoras' Theorem. However, many did not have a strategy for deriving the given expression; they did not realise they had to eliminate $h$ so left the relationship between $k$, $h$ and $r$ in the form $k = \frac{4r}{h}$. Gaining marks beyond this point proved difficult for most as it required some complicated algebra including rearranging and removing a factor of $r$ from the square root.

25 There were several routes to marks for students for this 6 mark straight line geometry question. The most common method seen was to work with gradients and find the equations of *AB* and the line of symmetry. For those that did not gain full marks, it was common to see method marks picked up for the midpoint of *AB* and the gradients of *AB* and the line of symmetry. The 4th method mark proved to be a challenge as students struggled to find a correct equation for *AB* or the line of symmetry. The alternative method on the mark scheme was seen less regularly and if it was used, it was rare to see students gain more than the first 2 or 3 method marks. If students did get as far the correct coordinates for *C*, many struggled to decide between the two options for the final answer (one creates a trapezium, one creates a parallelogram).

26 The first 2 marks in this question were for factorising quadratics and it was pleasing to see many students pick up 1 or 2 marks for correct factorisation although many could not factorise accurately, if at all. The next mark was much more difficult to gain as students needed to write the correct fractions over a common denominator so any errors meant no further marks could be gained. Just over a quarter of students did manage a full correct method and answer for 4 marks.

**Summary**

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Based on their performance in this paper, students should:

- Ensure that on questions involving angles, that they clearly identify / assign the angles they are calculating.
- Be more familiar with completing a Venn Diagram.
- Always show the method when solving a quadratic equation using the formula or factorising.
- Practise translating shapes using vectors.
- Work on compass and ruler constructions.

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