Examiners' Report
Principal Examiner Feedback

January 2020

Pearson Edexcel International GCSE
in Mathematics A (4MA1) Paper 1H

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Students who were well prepared for this paper were able to make a good attempt at most questions.

Students were less successful in understanding when to apply the formula for area of a triangle within a problem and finding the length of a side by using the cosine rule.

On the whole, working was shown and easy to follow through. There were some instances where students failed to read the question properly. For example, in question 11 some students ignored ‘compound interest’, using simple interest and did not do well with the change of rate during the term.

Completing the square, probability, manipulating surds, compound functions involving inverses and coordinate geometry involving gradients and (perpendicular lines) seemed to be a weakness for many students. Operations involving negative numbers was also a weakness

Overall problem solving questions and questions assessing mathematical reasoning were tackled well.

Question 1

(a) Some students were able to find the coordinates of the midpoint of *AB*, but there were several spurious attempts, showing little understanding of what was required. Some students simply subtracted the x values or the y values and then divided by 2 while others simply added the coordinates, showing no intention of dividing by 2. Sketches often failed to show a method to find the midpoint. If students picked up only one mark, it was generally for the x coordinate being correctly given as 9; (the y coordinate of -1.5 seemed harder to find) or the coordinates were written in reverse. A number of students were calculated the gradient and wrote the change in y as the y coordinate of the midpoint and the change in x as the x-coordinate of the midpoint.
(b) Many students wrote down the correct answer, only a minority wrote down 2 or 3
(c) Many students answered this part quite well by substituting x into $y = 2 - 3x$ and obtaining -298 and writing down no or equivalent. A minority of students substituted y into the equation and obtained 103.3 or compared the y-intercept values. Some students lost the mark by not evaluating their expression such as $-302 \neq 2 - 3(100)$ and stating no. A few candidates made errors in their calculations and therefore lost the mark.

Question 2

For the first mark candidates only had to show both numbers written as prime factors, which could be at the end of factor trees or on 'ladder' diagrams, or 4 multiples for each number or use of the table method. Most managed to do this for one mark, and a significant number achieved full marks. A small number of candidates were successful by applying the method of multiplying the two numbers to reach 2940 and then dividing by the common factor of 7. Many gave the final answer as 7. Some students used factor trees or ‘ladder’ diagrams and then drew a Venn diagram which they tried to use and lost the final mark. A common mistake was to include 7 twice in their expression for example $2^2 \times 3 \times 5 \times 7^2$

Some candidates confused HCF and LCM and simply listed all the factors of 28 and 105. Others lost the final mark by not evaluating their correct product and leaving their answer as $2^2 \times 3 \times 5 \times 7$

Question 3

This question proved straightforward for the majority of candidates. A few found only the area of the one rectangle such as 12 × 9 or 12 × 6. Many students did not approach the question using an algebraic method. A common approach was 129 – 108 and then divide by 3. Some students left their answers as 3 × 7 = 21 thus losing the final A mark. Some students found the perimeter and equated this 129.

Question 4

(a) This part was answered well. Only a minority of students wrote down 16. It was encouraging to see the majority write down $3 < w \leq 4$. Correct notation was not required to identify the modal group

(b) Many students answered this question well. The majority of the students showed clear working However, a common error by some students was to use the lower limits or the upper limits to work out $\sum fx$ so gained 2 out of the 4 marks available. This method is incorrect and the students need to understand that they must use the mid points. Other common errors were to write $\frac{144}{\text{their freq}}$ (students should note that the value of the sum of the frequencies was given in the question) or writing $\frac{144}{5}$. A common error was to multiply the frequencies by the class width (1).

(c) The correct answer was very common but a significant number of students included the class interval $4 < w \leq 5$ so obtaining $\frac{9+2+1}{40}$ which resulted in an incorrect answer.

Question 5

Whilst many correct answers were seen, some students were unable to successfully navigate their way through this problem.

It was not uncommon, for example, to see students who correctly shared 120 in the given ratio but then found $\frac{16}{25}$ of 45 rather than $\frac{16}{25}$ of 75. Those who did get as far as calculating $\frac{16}{25}$ of 75 then did not know how to divide the 45 in the ratio 2:1. Some students did not understand the statement ‘Twice as many girls go sailing as go climbing’ as they divided 45 by 2. Others thought it was twice as many girls go sailing as boys go climbing. Some students found 30 or 15 but went on to add 30 with 48 or 15 with 48 or 15 with 27 due to not clearly labelling what each value meant in their working and not realising they had to add 30 with 27 to obtain the correct answer.

Question 6

(a) This part was answered well as majority of the students gave the correct answer. Only a minority wrote down 78 000.
(b) This part was frequently correct and those who did not gain full marks often gained 1 mark for 22 500 000 or for an equivalent such as 22.5×10^6, or for writing 2.25×10^n where n could be any value but not 7. Some students may benefit from being reminded how to use the standard form button on their calculators.

Question 7

(a) Generally, this part was answered well, however, a common error was − 3 rather than − 40; some students also had difficulty in simplifying $-8m + 5m$ correctly. Overall the errors made were usually down to poor arithmetic skills when dealing with negative numbers. Many students expanded the brackets correctly and then proceeded to factorise their answer putting $(m - 8)(m + 5)$ on the answer line or even $m = 8$ or $m = -5$
(b) This was generally well answered although the expression was occasionally only partially factorised rather than fully factorised. Others gave the answer $5y(4y)$.
(c) This was answered well with the majority of students giving an answer of 1
(d) Many students gained all 4 marks for this question, demonstrating an excellent understanding of, and ability to manipulate the algebra in this linear equation. Students often cleared the fraction or expanded the bracket on the left hand side. A failure to use brackets when multiplying both sides by 2 often led to mistakes in the algebra. Some students tried to do these two operations in one step; this was to the detriment of some students who made mistakes in their expansion and were not clear in their intent to multiply both sides by 2. Mistakes also crept in when some students attempted to isolate their x terms, adding instead of subtracting or vice versa.

Students who used the alternative method given in the mark scheme and separated the right side of the equation into two fractions, were generally unable to do so correctly. It was common for students to divide only one term by 2, resulting in $4.5 – x$. However, if they isolated their x terms correctly then they could gain the third M mark.

Too many students did not appreciate the importance of dividing both terms by 2 on the right or multiplying both terms by 2 on the left, resulting in one term inside a bracket being added or subtracted to the other side, or the constant term in the numerator of the fraction being added to the other side, with no understanding that a factor of 2 or 1/2 was missing.

Question 8

This question was generally answered well. If incorrect, most students enlarged the shape successfully but did not draw it in the correct position, this was awarded 1 mark for having the shape in the correct orientation.

Question 9

The majority of students worked with cos 63. Others used sin 27 either using the trigonometric ratio or the Sine Rule. successfully. A few students gave a two stage solution generally using tan to find the other shorter side and then Pythagoras's Theorem. Provided that accuracy was maintained throughout, this lead to the correct answer and full marks. The most common mistake seen was to start correctly with cos 63 = $\frac{24.3}{PQ}$ but then make an error in rearranging this to get 24.3 × cos 63. It was also interesting to see students using 24 instead of 24.3. Students should not round the numbers given in the question. Some students went ahead with the Sine rule and many who did this found the correct answer. However, a number of students then got confused with this method and didn't rearrange correctly, or used Sin 63 instead of Sin 27. Students should be encouraged to seek the simplest method, and know that sine rule and cosine rules are never necessary on right angled triangles.

Question 10

Most students scored some marks on this question. The award of two marks was relatively frequent and shows that these students could correctly identify two of the lines bordering the region. Sometimes $y \geq -1$ instead of $x \geq -1$. Another common error was to write $x \leq y - 4$ or $y \leq x + 4$ instead of $x + y \leq 4$ or $y \leq - x+4$. Some students could not give the inequality signs correctly. For those that failed to score at all, the most common incorrect answer seen was just a list of coordinates with a complete failure to engage with the concept of boundary lines.

Question 11

This question differentiated well. Most students were able to access the first mark for writing down the multiplier for years 1 and 2 $(1.015)^2$. The weaker students found 15% of $6000 and then multiplied by 2 thus losing all the marks in the question. Many students showed a very good understanding to gain the second M mark by showing different correct methods for a complete method. Some students lost the final mark as they left their answer as 1.021 or 102.1. Some candidates, having correctly calculated the interest paid in the third year, expressed this as a percentage of the total amount after three years rather than the amount after two years or as a percentage of the original $6000. When finding the rate of interest for the 3rd year, some students used the final value £6311.16 as the divisor, rather than £6181.35. This led to a value of 2.056….which appeared to round to the 'correct' answer of 2.1%. Students must always remember, when dealing with percentage increases, to use the *starting* value as their 'baseline', rather than the *finishing* value.

Question 12

The majority of candidates fell into one of three categories. Firstly, there were many who scored full marks. Secondly, a significant number appeared to be unfamiliar with cumulative frequency and were unable to make a meaningful attempt by not being able to find the lower quartile or upper quartile in part (a) or simply worked out 60 - 20. Thirdly, a large number of candidates fell at the last hurdle; having read the appropriate value from their graph in part (b), they failed to divide by 0.6 or use an alternative method to find the number of men who took part in the race. A significant number of candidates read ‘42’ correctly from the graph but then found 60% of 42.

Question 13

This question differentiated well. Most students were able to access the first mark for writing down 56 ÷ 0.14 and then obtaining 400 or wrote down $0.14 = \frac{56}{w^2}$. Students who wrote down $0.14 = \frac{56}{area}$ lost the first mark unless they recovered by writing down 56 ÷ 0.14 or equivalent. It was disappointing to see that some students could not rearrange $0.14 = \frac{56}{w^2}$. A common error was to write 0.14 × 56 at this stage of the problem. Many students who found 400 went on to gain full marks. A minority of students who worked out 400 then equated this to the surface area of the cube ie. $400 = 6w^2$ lost the final two marks. Others simply divided 400 by 2 to give 200 as the length of the side and then cubed 200, again losing the final two marks.

Question 14

(a) The majority of students correctly identified this part of the question as one in which the area of a triangle ($\frac{1}{2}ab\text{Sin}\,C$) was needed. Some students worked out the area of the triangle and then forgot to multiply their answer by 2 thus losing the A mark. Some students worked out the perpendicular length from FG or EH and then multiplying by 14.7 which gave the correct answer. Less able students simply multiplied 9.3 by 14.7
(b) The majority of students correctly identified this part of the question as one in which the cosine rule was needed. A few used the cosine rule incorrectly, and some, after a correct initial equation showed that they used the incorrect order of operations. A few forgot to square root their EG^2 giving the answer of 377.9...., for which they gained 2 method marks. Some students rounded in the middle of the calculation and lost the accuracy mark despite using a correct method.

Question 15

(a) The more able students scored well on this part of the question requiring the expansion of a product of three linear expressions to give a fully simplified cubic expression. Errors were usually restricted to incorrect terms rather than a flawed strategy although some students omitted terms from their expansion. It was usual for students to earn two or three of the available marks. Less able students lacked a clear strategy and sometimes tried to multiply all three brackets together at once. Several students failed to use brackets in the first stage of their multiplication which sometimes led to errors in the algebra. Students should be encouraged to use brackets to clearly indicate all of the terms being multiplied.
(b) This question was only accessible to the more able students. These students understood that they had to equate dy/dx to zero and find the values for x. The differentiation was usually correct for those who knew what they were meant to do. This was sometimes the only 2 marks scored for this part of the question. Working then deteriorated for the next stage. Only the more able students showed a clear and correct equation and the less able students just did not attempt this part. A few students failed to

reject the negative solution to the quadratic equation and therefore lost the final accuracy mark whilst a few equated their second derivative to 0.

Question 16

The correct reasoning process needed to answer this question was $\frac{2 \times a_{UB} - c_{LB}}{d_{LB}}$

.Responses tended to fall into three groups (i) students who followed the processes shown above (generally gained full marks), (ii) students who knew something about lower bounds and upper bounds but could not apply the reasoning correctly (1 mark) and (iii) students who had little or no idea of bounds (those who worked out an answer using exact values and then took the upper bound of this exact value). A few students were careless and omitted the '2' in the formula in their evaluation.

Question 17

(a) Students answering 'show that' questions involving surds should always show detailed steps. Assuming known facts or skipping steps often leads to marks being withheld. Students with some understanding of surds usually scored at least one mark unless they made an error expanding the brackets. Frequently, students were able to simplify the expression as far as $84 + 48\sqrt{3}$ but struggled to factorise the expression to show the final answer. Only students targeting the top grade tended to be equipped with the skills to manipulate the expression fully.

Some answers clearly came straight from the use of a calculator as no understanding of how to expand and simplify brackets with surds.

(b) Students found this question very challenging and while we saw a number of students giving a correct answer, there were several who really struggled with the power of minus two-third and found it hard to make any progress. The mark scheme broke the award of marks down into 'cube rooting' 'inverting', and 'squaring' and many were able to gain one mark, usually for cube rooting or squaring. A good number gained 2 out of 3 marks for 2 applying two index rules from the three stated. Often the letters had the correct powers but dealing with 27 caused problems. 0.1 was sometimes seen instead of 1/9 and lost marks unless the recurring sign was added.

Question 18

This question was a good discriminator and those who understood the topic normally found a correct answer efficiently and concisely. Many others gained only one mark because they failed to recognise all of the possibilities. Many students worked out the probability of *BBB* or *OOO* or *LLL* and then went on to work out the probabilities of *BOO* or *BBO* thus gaining 2 marks. They did not realise that *BOO* or *BBO* could be arranged in three ways so losing the third M mark as they did not have a complete method. Some students worked out the probability of *LLL* and subtracted this value from 1 just gaining 1 mark. The least able students found it difficult to make any progress at all. Tree diagrams were rarely seen and not often successful; a small number of students failed to realise the probabilities were conditional and so used denominators of 16 throughout their working. A promising number of students approached the question in a very efficient and successful way of calculating successive probabilities of ‘not lemon’. This approach invariably gained them 4 marks.

Question 19

Students often find 3-D trigonometry and Pythagoras challenging and this question was no different. There were a number of correct answers, but there were a wide range of incorrect responses, where, in many cases, the student found the incorrect side and then found the incorrect angle. This question was essentially marked as a 2 stage problem. The first stage was to use Pythagoras to find *AH* or *FH (or GE).* The second stage was to involve the latter in trigonometry to find the required angle. A minority of candidates incorrectly calculated *BH or DH* and then used an incorrect trigonometric ratio. Sometimes at the end some students wrote down the trigonometric ratio the wrong way round e.g. tan x = Adjacent/Opposite. Some students worked out the size of angle *FAH* and did not subtract this value from 90°. This gained a mark if identified, however in general, angles were rarely identified. Some candidates lost the accuracy mark by premature rounding of *AH* and/or *FH*. A number of students, having identified the correct angle to calculate and the side lengths required, needlessly and usually unsuccessfully tried to use the Sine Rule and/or the Cosine Rule to find their answer.

Question 20

This question was not answered well most candidates seemed unfamiliar with how the quadratic in this form related to the minimum point. However, most students did gain at least one mark. The first mark was often obtained for sketching any parabola with a minimum value. Many students sketched a correct quadratic with a minimum in any quadrant. Some students found the correct turning point and/or the correct intercept on the y axis. Most students struggled to find the roots of the equation ie where the curve crossed the x axis. Only a minority of students gained full marks. Some students took from the question the prescription that '$a > 4$', to mean that they were at liberty to substitute a numerical value for a, often the value 5.

Question 21

This question was poorly attempted by the majority of students. Only the most able mathematicians were able to secure a correct answer. Some students gained one or two marks for substituting g(x) into f(x). It was disappointing to see students expand $(x + 3)^2 - 2(x + 3)$ incorrectly often expanding the second bracket to give $-2x + 6$. It was also common to see $(x + 3)2 - 2x$, ie omitting to substitute into the last past of the expression. Students are making simple arithmetic or algebraic errors and then losing marks for carelessness. Once the students substituted g(x) into f(x) then a majority of the students did not know how to start the next stage of the question and thus could not gain further marks. Those who knew how to find the inverse of a function sometimes found the algebraic techniques required too challenging particularly by using the method of completing the square. Some students gave an answer of $-2 \pm \sqrt{x+1}$ not realising that only the positive answer was required as it was given in the question that $x \geq -2$. Some misinterpreted $x \geq -2$ as a cue to solve a quadratic inequality.

Question 22

This was a very challenging question and only the most able mathematicians were able to gain some or full marks. There were two ways of starting this question. The first way was to find the gradient of *JK* (−0.5) and then equate this to an expression for the gradient of *JK* in terms of *j* and *k*. A second equation was required, this could be the length of *JK* in terms of *j* and *k* or for equating length *HJ* with length *HK*. Once two equations were set up in terms of *j* and *k* then they could be solved simultaneously to obtain the correct answer. A second way was to find the midpoint of *M* and then to set up an equation for the gradient of *HM* in terms of *j* and *k*. A second equation was needed to be set up for finding the length of *JK* in terms of *j* and *k* **or** for equating length *HJ* with length *HK*. Once two equations were set up in terms of *j* and *k* then they could be solved simultaneously to obtain the correct answer. Students found it very challenging to set up the two equations and then solve them simultaneously. Some students were careless with their algebra. Many students did not recognise that algebra had to be used to make progress with this question and thus gained no marks.

Summary

Based on their performance in this paper, students should:

- be able to recall and manipulate the formula $\frac{1}{2}ab\sin C$ for the area of a triangle
- be able to recall and manipulate the formula $a^2 = b^2 + c^2 - 2bc\,\mathrm{Cos}\,A$ for the length of a side
- Be able to manipulate surds and indices
- 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.
- Students must, when asked, show their working or risk gaining no marks for correct answers

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