Examiners' Report
Principal Examiner Feedback

Summer 2023

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

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Introduction

Overall, the students taking this paper seemed well prepared for the standard questions and those destined for the higher grades made a good attempt at the higher level problem solving questions near the end of the paper.

Most students seemed to have time to complete the paper.

Sometimes students forgot that the formula sheet on page 2 existed or copied the formulae incorrectly, which was a shame.

Generally, students seemed to use their calculators correctly and showed their working; but there are always some students who lose marks unnecessarily because they miss out some steps or make careless errors without showing their working.

It was pleasing to see many students attempting the higher graded questions near the end of the paper and in several cases, good working enabled them to gain method marks even if they could not get to the final answer.

Question 1

Most students used the standard approach to divide the two fractions, although the method of finding a common denominator was also used. Whichever the chosen method, it was unusual to see an error changing from mixed numbers to improper fractions. Some students changed the right-hand side of the equation to an improper fraction and then demonstrated this is equal to the left-hand side of the equation. The final mark was often lost for failing to show comprehensively that the result is true. An example of this was to proceed directly from $\frac{70}{18}$ to $3\frac{8}{9}$ rather than stating that $\frac{70}{18} = \frac{35}{9}$ before finishing with $3\frac{8}{9}$.

Question 2

Overall this was a strong topic for the students and most students were able to answer this question successfully and get the correct answer of 54. Of those who didn't score full marks the majority found the probability of pink as 0.27 and stopped there. Some students showed a correct method but made mistakes in working out $1 - 0.32 - 0.13 - 0.28$. The only other mistake seen fairly commonly was to give the answer as a probability of 54/200. Credit was given if the value of 0.27 appeared in the table or in the working.

Question 3

Many students had difficulty with this question. Common errors included equating the opposite pair of angles, *B* and *D*, or summing base angles *A* and *D* to give 180°. Those who knew that the sum of the interior angles was 360° sometimes added just the three given angles to give this total. A common start was to sum the three given angles and some expression for *C* to give 360°, usually resulting in an incorrect value for x because the expression for *C* was wrong. However, this then allowed a further mark to be awarded for using their value of x to calculate angle *B* or *C*.

A less common approach was to draw a line dividing the trapezium which is perpendicular to the parallel sides. This leads to the equation $(3x + 46) + (4x - 27) + 90 + 90 = 360$, which was usually solved correctly. Students who successfully found the correct value of x usually scored full marks.

Question 4

a) This was answered very well, with most students scoring both marks for a completely correct table. There were some who had problems squaring the -3, but they still managed to score one mark for 3 or 4 correct values in the table. A small number of students gained no credit for attempting to find a linear sequence believing the graph was going to be a straight line.

b) Again, this was answered very well with most students who scored full marks in part a going on to draw a completely correct curve, thus gaining 2 marks in part (b). It was not possible for students who scored 1 mark in b to gain 2 marks here because the A mark was for a completely correct curve. However, most did gain a follow through mark for accurately plotting 5 points from their table. Students who scored no marks in part (a) could gain no credit in part (b). There were a significant number of students who dropped one mark for their curve either by joining their points with straight lines or more commonly by joining (0,-4) and (1,-4) with a straight line instead of a smooth curve.

Question 5

Many students appeared not to have a full understanding of the information provided in the question, which was evident with many unstructured approaches being used. Those who had a grasp of the problem often divided 85 by 17 and then multiplied the answer by 2 and by 15. Some students then continued to obtain the correct answer while others found the difference between 10 and 75. Others adopted a listing approach, by grouping the coins as 2555, 2555 until the total of 85 was reached. As with most methods, some students found the value of the coins rather than the number of coins. A small number attempted a more sophisticated algebraic method which usually resulted in full marks. A common error was to split 85 into the ratio 1:3 by dividing it by 4. Those who chose this path scored one mark.

Question 6

Many students were completely successful on the question, both being able to write a number in standard form and being able to convert a number given in standard form into a normal number. Mistakes commonly seen involved trying to write 76 000 000 as 76×10^6 or using a negative power rather than the correct positive one. In (b) some students also got mixed up with the negative power, giving the answer as 54 000 rather than 0.000 54

Question 7

This question was generally answered well, but there was a lot of confusion between the reflex angle and the obtuse angle at *O*. The reflex angle was labelled with angle notation to make it clear that this was the angle to find, but there were still a lot of answers between 90 and 180 degrees. Most students got the correct answer of 228. Of those who didn't there was a lot of confusion involving circle theorems. *OACD* is a cyclic quadrilateral and the first method mark was for showing this by stating the angles at *A* and *C* are right angles. Many students missed this implication of the fact that *OA* and *OC* are tangents. The second Method mark was then getting the obtuse angle at *O* as 132 degrees. 132 on it's own without justification scored B1. The other common mistake was to say that the obtuse angle at O was 96 degrees as the angle at the centre is double the other angle which gained no credit.

Question 8

This question, a familiar type testing compound interest, in the slightly different context of a painting accumulating in value was well answered with most students using the efficient method of multiplying by 1.04^3 . Some were successful using a build-up approach building up the value year by year. Less valid approaches included treating the 4% as simple interest or depreciating the painting's value often using 0.96 Students were awarded full marks for an answer between $764 and $765.

Question 9

Many students scored full marks on this question by multiplying by 1000 and then dividing by 3600 to get 7.5 Of those that didn't score full marks most had some combination of either incorrectly multiplying by 3600 or dividing by 1000. A few thought there were only 100 metres in a kilometre or 60 seconds in an hour. but could still get one out of two for either multiplying correctly by 1000, dividing by 3600 or dividing twice by 60. A significant number multiplied by 1000 and then also multiplied by 3600. Many students appear to have little or no 'feel' for what their figures might mean in practice in the real world - for example the speed of 27 km per hour should be recognisable as a fairly normal speed for a moving vehicle on the road, and yet some seemed content to convert this into moving at many millions of metres per second.

Question 10

Most students were able to gain at least one mark for calculating the total of *A* or *B* before or after the final round and many went on to gain a second mark either for the number of points gained by *A* or *B* in the final round or for the difference between *A* and *B* either before or after the final round. It was pleasing to see that many students held it together to gain full marks for an answer of 12. Many of these students had annotated their answers explaining what they were calculating, which I′m sure helped them with what was quite a challenging question.

Question 11

Most students were able to calculate the interior or exterior angles of a nonagon. They usually deduced that angle *OFE* = 70°. Further progress often depended on finding angle *FOD* = 80° but it was not unusual to see it given wrongly as 90° or 40°. Some students chose to work with the angles in triangle *DEK*, with some success.

Question 12

Most students who gained marks for this question started by finding *BD* using Pythagoras' Theorem. In many cases, no more marks were scored as a result of triangle *ABC* being treated as a right-angled triangle. Those who continued to the correct answer used a variety of methods, including the Cosine and Sine rules. Those who used the more efficient approach by finding angle *BAD* using Cos(*BAD*) = $\frac{8}{14}$ usually continued to score full marks. There was an issue with premature rounding in this multi-step question, particularly with those who chose the less efficient approaches.

Question 13

a) Most students gained both marks for a completely correct tree diagram. The most common error was to anticipate the question and repeat the probabilities of Dice *A* in the second part of the tree diagram instead of using the probabilities for Dice *A*. Some students were guilty of overthinking by manufacturing a non-replacement scenario in the 2nd part. However, even these students scored one mark for a correct probability for dice *A*.

b) This was also answered very well with most students gaining full marks for a correct answer of 5/9. Even those with an incorrect tree diagram usually scored one follow through mark in (b) for a correct product from their tree diagram. It was pleasing to see that very few students added the probabilities instead of multiplying.

It was pleasing to see that most students understood that their answer needed to start with T as the subject, meaning a response T = ... usually enabled the award of at least one mark. However, some students ignored the T= hence scoring 2 for $8h + 20j$

Question 14

Most students obtained correct values for the angles. Marks for the reasons were dependent on correct values for the angles.. Ideally, part (a) would state "angle in a semicircle is 90°" but a variety of responses that referred to triangles in a semicircle or with the diameter as one side, as long as clear, were accepted. However, students do need to learn the correct explanations as it saved on words and there was never any doubt on the marks being awarded. The standard response for part (b) is "angles in the same segment are equal" but variations of "angles at the circumference subtended by the same arc or chord are equal" also scored the mark.

Question 15a

Many fully correct responses were seen leading to $8a^9$ both the numerical term and the algebraic term correctly processed. The most common errors were not to treat correctly the power of $32^{3/5}$ and answers of 19.2 were often seen coming from 32 × 3/5. Fewer errors were made with the term in a with most using indices correctly processed to obtain 9.

Question 15b

Fewer correct responses were seen in this second part of question 15 than in the first part. Far fewer students correctly dealt with the 3 stages needed. Many dealt with cubing x, fewer with $(x^3)^{-1}$, and even fewer with $(1/10)^{-3}$. The partially correct answer of $10x^3$ was seen far more often than the correct $1000x^3$. A product with one part correct scored 1 mark.

Question 15c

Most students gained at least one mark in this question by expressing two or more of the fractions with common denominators of 6, 10 or 30. They often gained a 2nd mark by eliminating the fractions, helped by the fact that they were allowed one error in expanding brackets for this mark. A significant number of students attempted to eliminate the fractions at the first step by multiplying by 30, but the ones who attempted to remove the denominators one at a time tended to forget to multiply every term or multiplied numerator and denominator by mistake. This was seen as an error in their method and so this gained no credit. A significant number of students did go on to gain the correct answer of 2.9

Question 16

In part (a) those students who performed well generally followed the route of expressing the given proportionality arrangement as an equation with an unknown, conventionally k. They then used points on the graph with integer coordinates eg (4, 6) to calculate k. Those students who were unable to express the relationship as an equation rarely scored any marks. There were a few solutions that used non-integer points on the graph but many correctly found k as 3 and then wrote the equation needed. Part (b) was less well answered with far fewer students recognising the need to square the factor of 1.2 which led to the answer of 44%. Some used a valid approach using the graph by taking a value of Q multiplying it by 1.2 and using the change in t values. Some allowance was made that these rarely led to an answer of 44% with answers in the range 43-45 credited. Many students did not use the squaring relationship or left the answer space blank.

Question 17a

This was a standard expansion to form a trinomial, where two of the factors are the same. Most students first expanded 2 brackets and then multiplied the result by the third bracket. In the first stage one arithmetic error was condoned for M1 and then in the second stage a further arithmetic error was condoned. there was also credit given for an all in one approach where students were awarded M2 for at least 4 correct terms out of a total of 8 terms. The vast majority of students were able to answer the question successfully with good algebra on show. Some made it slightly more difficult by not simplifying the first expansion before multiplying again. Any mistakes tended to be arithmetic errors rather than method errors. A good number of students had learned to display their working for this kind of algebraic expansion in grid form, and this was usually clearly and successfully set out.

Question 17b

Most students scored the first mark for squaring both sides of the equation correctly. The second mark was for multiplying by the denominator and expanding the brackets. Those who failed to gain this mark sometimes expanded the brackets incorrectly or chose not to use brackets at all. Gathering the terms in e on one side of the equation and the terms not in e on the other side of the equation proved one step too far for many. Some were not aware of the need to do this while others made errors when attempting to rearrange the equation. Those who managed to perform this step correctly usually progressed to score all four marks.

Question 18

There were no obvious patterns, though C and A were more often answered correctly; those who didn't get full marks often got the first and third graphs 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 19

Many attempts moved quickly towards expressions involving $(x – 3)^2$, usually scoring no marks. Most of the students who made any progress started by factorising 3 out of the expression, scoring M1 if $x^2 – 2x$ appeared in the bracket. Some were not able to proceed to $(x – 1)^2$ from here. Those who did often failed to calculate the constant term successfully. Very few tried to expand $a(x – b)^2 + c$ and equate coefficients to find the values of a, b and c, though some attempted to work out these values from memorised formulae, which were frequently incorrect.

Question 20

It was pleasing to see students succeeding regularly on this question. The simplest way to solve the question was to take the probability of all red away from 1 and such students usually had no need to draw a tree diagram. Others answered it successfully by finding the seven required combinations of green and red and adding them all together; however those who took this 'long way round' approach very often gave incomplete working and/or made arithmetic mistakes so that a clearly long time spent on the question resulted in only 1 mark. Those that worked in decimals also achieved success by both methods mentioned. Common mistakes included missing some of the 7 required combinations or occasionally treating it as a with replacement question. No credit was given for treating it as a with replacement question as it made it nonsensical. Of those who didn't score full marks most students scored 1 mark for finding any combination of red and/or green. The second method mark was for a complete method which was occasionally scored without a correct answer.

Students should be reminded that when asked to draw a graph this includes joining the points. A surprising number of otherwise correct answers lost a mark by failing to do this. Students should be reminded that a quadratic curve must be curved around the minimum point.

Question 21

Although this is a familiar type of question it is one demanding accurate algebra and an understanding of the stages needed to solve non-linear simultaneous equations. The correct start is one to eliminate one variable, in this case using the linear equation as written. Some tried to treat the equations as if they were both linear and solve by elimination with no success. Errors dealing with $2(3y - 1)^2$ were common although most recognised this should lead to a quadratic equation. Those who got this far used factorisation or the quadratic formula to generate the 2 values; normally the y values. A significant number of students treated the 2 values coming out of a quadratic in y as x values – an error which should have been spotted. Those who got the 2 y values (assuming they worked initially by eliminating x) then used the linear equation to find the corresponding values of x. The final mark is for indicating that the solution amounted to 2 pairs of (x, y) values. Some students failed to gain this mark as they listed eg $y = 1, -3/7 \quad x = 2, -16/7$.

Question 22

Many students did not attempt this question. Of those who did attempt it a significant number gained no credit, either by assuming triangle ABC was right-angled or isosceles with $AD = DC = 8$cm, or by working with triangle BFC because it was right-angled, but unfortunately did not make progress towards the solution.

Many students did know to use the cosine rule, but often chose to use a rearranged form to give the angle directly. Misremembering the rearranged form meant many of these students gained no credit for this question. Apart from 0 the most common score was 2 marks for a correct angle in triangle ABC. Most students who gained a correct length for BD went on to gain full marks for a correct answer of 59.2 degrees.

Question 23

Whilst many students were able to form a correct equation for the volume, they did not always score the first mark by reaching a correct expression for x^2. Those who expanded $x^2(2\sqrt{5} - 3)$ rarely recovered to gain any marks. Some found the correct expression for x^2 but labelled it incorrectly as $2x$. Many who did score this mark often showed the correct method to rationalise the denominator and usually continued by expanding the product to score three marks. Incorrect attempts to rationalise the denominator included multiplying by $\frac{2\sqrt{5}-3}{2\sqrt{5}-3}$ and $\frac{2\sqrt{5}}{2\sqrt{5}}$.

Question 24

This was a challenging question, set at the top grade for the paper. Some students made little or no attempt; others spent considerable time on it without making any progress. The most common, successful route through this problem started with finding the gradient of AC, and using it with the coordinates of A or C to find an equation for AC. The next step was usually to use perpendicular gradients to find the gradient of BD and hence an equation for this line. This was often the limit of success. Few managed to equate these equations and find the midpoint of BD, which leads on to the coordinates of D.

It was also quite common to see students using $AD^2 = AB^2$ or $CD^2 = CB^2$, or both. A few tried to use these equations to find the equation of *BD* but the difficult coefficients involved tended to prevent a correct outcome, usually after much long working.

It was not unusual to see attempts to find the gradients and equations for any of the four sides of the kite, but such attempts did not make any useful progress. A common mistake was to assume that the midpoint of *AC* was on the line *BD*.

Question 25

Many students found the density of a sphere using the given radius 2.8 cm and mass 260π grams. Of these, some attempted to find an upper bound of their answer while others did not appreciate the need to work with bounds at all; either way, no marks were gained. Those who appreciated the need for bounds to be found usually scored at least one mark for 2.75, 2.85, 255 or 265. Unfortunately, a significant number used an incorrect formula for the volume of a sphere (the formula is given on the formula sheet on page 2 so it was surprising), preventing them from gaining further marks. Those who used the correct formula often went on to write a valid expression for the density of the sphere, although it was quite common for the mass to be given as 265, rather than 265π.

Summary

Based on their performance in this paper, students should:

- Show all stages in any question asking for working to be shown, especially for fractions and surds.
- Know the difference between eg ‘number of times that pink occurs’ and ‘probability of getting pink.’
- Read questions carefully and ensure the answers they are giving are the ones that are asked for.
- Use the formula sheet on page 2 of the examination paper and take extra special care in copying the correct powers where appropriate eg the power of 3 for *r* when finding the volume of a sphere.
- Practice expanding brackets and collecting like terms, especially when minus numbers are involved.
- Know the difference between replacement and non-replacement events in probability.

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