Examiners' Report
Principal Examiner Feedback

November 2021

Pearson Edexcel GCSE (9 – 1)
In Mathematics (1MA1)
Higher (Calculator) Paper 2H

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GCSE Mathematics 1MA1
Principal Examiner Feedback – Higher Paper 2

Introduction

The first half of the paper proved to be accessible with most students able to gain some marks on each question, but often the performance seen, even on the earlier questions was of a lower standard than we would normally expect to see on a higher tier paper. This does raise the question as to whether students were entered for the correct tier.
It seemed clear that students were suitably equipped with all but a few lacking a calculator. Again, students continue to improve their performance on the problem-based questions, with clear strategies seen to access these questions.

Report on individual questions

Question 1

Part (a) was answered very well. Almost every candidate was able to extract the correct critical value, and most provided the correct inequality symbol too. It was not uncommon to see $-1 < x$ as an acceptable alternative answer. Those who did drop marks were fairly equally spread between choosing < over > or for including an inclusive inequality.
Part (b) was again very well answered. Almost all students scored at least one mark, either for a line of correct length, or for a closed circle at −3, with a large proportion gaining the second mark also. Those who failed to score typically had their circles the wrong way round, **or** the line stopping at 3 rather than 4.

Question 2

Both parts (a) and (b) were similarly well answered. In both cases the vast majority of students gained the first mark for prime factors or a factor tree, many then continuing to gain the correct answers. When students didn't score full marks it was very often because they mixed up HCF and LCM. There was a significant number who found correct prime factors, and entered these into a Venn diagram, but were then unsure how to use this to complete the question. Those who scored zero normally did so because they had chosen a listing method, but unfortunately listed multiples in place of factors or vice versa.

Question 3

In both parts of this question it was evident that many students did not have a secure understanding of time and calculations involving time. In part (a) students typically scored either two marks as they understood the question, or no marks as they incorrectly worked in minutes rather than hours. Part (b) allowed students who struggled with time to score at least one mark for the horizontal line segment to represent the stationary part of the journey. Those who calculated the time correctly and gained a method mark then normally gained the communication mark for the correct sloping section to the graph. A note to students is that $\frac{1}{3}$ is not equal to 0.3

Question 4

This question was one where the performance was below that of a typical higher tier cohort. Quite a number of students were unable to complete the table, and therefore scored no marks at all. Of those who were able to gain a single mark in (a), most were unable to identify their error (usually the point with x co-ordinate -1) when plotting, and hence showed a real lack of understanding of the shape and symmetry of a parabola. It is important that students learn how to use their calculators when calculating with negative numbers. Part (c) was answered poorly. Most students had no method at all for using a quadratic graph to solve a quadratic equation, and hence didn't attempt the question.

Question 5

The first real problem question on the paper and it was good to see the majority of students were able to spot the need to use Pythagoras' Theorem to find the length of the hypotenuse. It was also really pleasing to see that once that had been identified**,** most were then able to score 2 marks for completing the process to find the missing length of the triangle. At this stage many understood the need to add the sides to find the perimeter**,** but a significant number were unable to complete this process successfully. A common misconception was to find the perimeter of one triangle and then double it, thus not dealing with the overlapping sides.

Question 6

It was evident that students had spent some time studying trigonometry, but again the learning did not seem to be secure. Many students were not able to identify the correct ratio for either part. Of those who did, many either substituted incorrectly, or they gained the first mark but were unable to gain the second as they struggled with the rearrangement. This was most evident in part (b) but was still seen in part (a).
Of those who attempted an alternative method, a good number were again able to evidence understanding of Pythagoras' Theorem, but were again unable to choose the correct ratio to gain the first mark.

Question 7

A fully correct response was not seen in the majority of cases, and in fact it was evident that students did not properly know the formula linking density, mass and volume. Of those who were able to score a mark the most common score was one mark for finding either an individual mass, or the total mass (192). At this point most didn't know to use total volume to calculate the density of **C**, and often divided by 3.

Question 8

The first question requiring a written response and it was pleasing to see a good proportion of students were able to identify the error in the lower bounds. This was expressed in various ways, but the most common type of response related to the starting value should be zero for all intervals.

Question 9

Part (a) was not well answered with students showing they either didn't understand a very standard higher tier topic or that they couldn't accurately read the scale on an axis. It was the former that was most common, but many didn't know the difference between range and interquartile range, or simply had no idea. Of those who did know, many were unable to read the upper quartile from the diagram. Part (b) proved a challenge for many. The mark was for understanding the proportional representation of a box plot and that 50% of waiting times will be up to the median. Part (c) was answered better with the most common response relating the median wait time being higher on Monday than Tuesday. Reference to measures of spread were not able to gain credit in part (c), and this was costly for some.

Question 10

The problem nature of this question proved a challenge for a good number of students, with many being unable to work backwards to find the initial investment. It was very common to see a multiplier of 0.975 rather than 1.025 being used. However, of those who struggled with the first part, and therefore to access the first two marks, many were then able to gain the third mark as they knew the required processes to calculate compound interest.

Question 11

Part (a) was not well answered, with most students not understanding the ratio and how to apply it to the coordinates. It was rare to award both marks, with some students able to find one coordinate (typically the *x* value) or for getting as far as 4.5 when working with the *y*-coordinate.
Part (b) was a more common type of question and it showed that students have completed work on gradients and**,** compared to previous questions, a good number showed knowledge of gradients of perpendicular lines. The first mark was awarded in equal numbers for a correct process to find the gradient of **L** or for an equation in the form $y = mx + 3$. Those who correctly (or incorrectly) found a gradient for **L**, were still able to gain the second mark for a correct process to find the gradient of the perpendicular line, and this mark was awarded nearly as frequently as the first. Few gained full marks, either due to an error in finding the first gradient or for an incorrect *y* intercept, despite this being given in the question.

Question 12

This question was answered well, with the majority of students scoring at least one mark for expanding two brackets, and many gaining two marks for the expansion of all three brackets. It was possible for both of these marks to be awarded with mistakes in the working, and this was usually the reason why full marks were not awarded for the final answer given. However, it was clear students understood the processes required to complete this question. It is interesting to see that the use of grid method to expand two brackets, once a common method, was very rarely seen. This may go some way to explaining why it was quite common to see 3 instead of 4 terms for the first expansion, or 7 instead of 8 terms, for the full expansion.

Question 13

Many students on this paper appear to have not been taught the product rule for counting, and as a result, had no real strategy to approach the question. Those who did correctly multiply the values, often then carried out another calculation, such as dividing by 3, and hence ended with an incorrect answer.

Question 14

To access any marks on this question students had to understand the ratio and be able to use this with a circle theorem to find *BCD* or *BAD*. Unfortunately, many were not able to do this and thus scored no marks. Those who did, typically scored at least two marks as they normally stated the correct circle theorem. As is often the case, many students struggled to apply (or name) the ‘alternate segment theorem’ and therefore struggled to find the correct value for *SBA*. Some gained the second method mark for using angles in a triangle to find *BDA* or a small number recognised the relationship between *BCD* and *SBD* but this was rare. Very few were able to correctly find the required angle and provide both correct circle theorems.

Question 15

The use of more complex trigonometry proved very challenging for the bulk of the students. Many attempted to use the standard ratios, not realising they only apply to right-angles triangles. Another significant proportion had obviously studied these formulae but were unable to accurately quote them and/or substitute into them. This applied to both parts (a) and (b). In part (b) it was seen on a number of occasions, that students used the value found in part (a) in their substitution (normally 11.4 in place of 11) and therefore gained no marks. Although various alternative methods were seen in both parts, they were very rarely successful.

Question 16

The majority of students did not know how to work with general iterative processes such as this. It was common to see students substituting in a succession of integers starting with 0 or 1. This typically brought up one correct value (1.817…) but didn't gain credit as it was not a correct process to find x_1. Of those who did correctly find the first value, most were able to go on to gain all three values. Some however went too far, and then put the wrong values as their answers (such as x_2, x_3 and x_4) and therefore lost the accuracy mark. Very few students had any idea how to complete part (b) with many either leaving it blank or just guessing random values.

Question 17

This histogram question was pleasing to mark, with a surprising number of students gaining some credit. Many were able to gain the first mark for one (or more) correct frequencies~~,~~ and of these, a significant number going on to gain three marks for the correct process to find the total and then find 20%. The last mark proved extremely challenging but gaining 3 marks at this level showed good performance for a number of students. It was interesting to see that almost all worked with frequencies rather than areas, which shows a good understanding of histograms and frequency density.

Question 18

At this stage of the paper many students had no knowledge to help in accessing the marks. If marks were awarded in part (a) it was usually 1 mark, for 2 correct values, rather than both marks. This is because even those who did know to read values off from the graph, then either didn't read the range for solutions, or more commonly, didn't understand how to find the values beyond 360°.
In part (b) it was again quite rare to award the mark for a correct equation as many didn't understand the effect on the function caused by a reflection. Of those who did gain credit, $y = -\sin x$ was the most common response.
More students realised what was needed in part (c), that a translation was required, but to the left or down were more common than the correct direction of right.

Question 19

This ratio problem required students to work with scale factors and ratios between 3 spheres. The most common error was to work with the 27 and the ratio 1 : 2 and arrive at 54. The first mark was for the ability to cube root to find 5 and 3, and at this stage the values did not need to be given in a ratio. Many students who succeeded this far then got confused and failed to work with the value of 3 and the ratio 1 : 2. Of those who got to the values of 3 and 6, many then failed to link the 6 from sphere **C** and the 5 from sphere **A**. Even fewer then knew to square to find the ratio of surface areas. Quite a few saw the question as having to find the radius for the sphere and had difficulty rearranging the correct formula or even trying to use an incorrect formula.

Question 20

This question proved a real challenge due to the fact it involved 3 days, rather than the 2 that students are more familiar with. Also, the lack of scaffolding, which is to be expected at this grade, challenged students. Many attempted to draw a probability tree, and that alone was too difficult. A first mark could be gained for a correct product for consecutive days, typically seen for Monday and Tuesday, such as 0.7 × 0.8, but could equally be for Tuesday and Wednesday such as 0.2 × 0.6. Two marks were awarded for a correct triple probability and, when seen, it was normally for RM, RT, RW or

NRM, RT, RW. In fact it was the probabilities when it didn’t rain on Tuesday that students found the most challenging. Awarding 3 or 4 marks was very rare.

Question 21

This grade 9 problem was a struggle for most, however there was scope for a good number to gain a single mark for one correct bound. This was normally a bound for *T* rather than *l*. The bounds for *l* most commonly seen were 51.5 and 52.5. These were outside the range that was acceptable for the substitution mark, so those who made this error were unable to gain the third mark even if they chose the correct pair. The second mark was for rearrangement, either before or after substitution, and proved to be unattainable for the majority of students due to the complex nature of the stated formula. To gain the third mark students had to select the correct pairs, eg LB of *l* and UB of *T*, or vice versa, and substitute these into a formula.

In Summary

Based on their performance on this paper, students should:

- ensure they are familiar with sufficient higher tier content to be able to access the paper
- work on understanding standard topics such as trigonometry, graphs, and box plots
- spend more time working with ratio and proportional reasoning to allow them to work confidently with problems relating to these areas.
- be confident in the different applications of trigonometry, depending on the type of triangle presented
- practise solving problems which require conversion between units, in particular here for time in minutes and hours
- make use of the units given in questions to determine formulae eg density units of g/cm^3 lead to density = mass/volume
- use brackets around negative numbers when entering these into a calculator

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