Examiners' Report
Principal Examiner Feedback

November 2020

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

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November 2020
Publications Code 1MA1_1H_2020_ER

GCSE (9 – 1) Mathematics – 1MA1
Principal Examiner Feedback – Higher 1

Introduction

The early questions were generally well answered. Questions towards the end of the paper were designed for the most able students so it was inevitable that these would be out of reach for many of the students entered for this paper.

A significant number of simple arithmetic errors were made and marks lost when students knew the correct process. Students should be encouraged to check their calculations. Multiplication and division calculations were often carried out poorly and Q14 highlighted weaknesses when working with decimals. In some cases students could have chosen a strategy that would have reduced the complexity of the arithmetic required.

It was pleasing that many students set out their solutions clearly and logically. However, the poor presentation of working was an issue in some of the longer questions, particularly in questions 20 and 22. Students should be encouraged to set their working out clearly as unstructured responses continued in different sections of the page make the processes being applied difficult for examiners to follow.

Report on individual questions

Question 1

This very familiar type of question was not answered as well as might have been expected. Many of the students who recognised that $3n$ was needed in their expression were able to write the correct expression, $3n - 2$, for the nth term of the sequence. However, a significant number wrote an expression of the form $3n + k$, with $k \neq -2$, and gained one mark only. Answers such as $3n + 1$, $3n - 1$ and $3n$ were common. Predictably, many students gave an answer of $n + 3$ and gained no marks.

Question 2

This question was generally answered well. The question required students to show that the answer is $8\frac{3}{4}$ so it was necessary for each stage of working to be shown. Many students gained at least two of the three marks for converting both mixed numbers into improper fractions (with at least one correct) and then multiplying correctly. It was pleasing to see some students making the arithmetic more straightforward by simplifying $\frac{7}{3}\times\frac{15}{4}$ to $\frac{7}{1}\times\frac{5}{4}$. Those students that wrote $\frac{7}{3} \times \frac{15}{4} = \frac{105}{12}$ had to simplify $\frac{105}{12}$ to $\frac{35}{4}$ or write it as $8\frac{9}{12}$ in order to complete the working and gain the final mark. Having converted both mixed numbers into improper fractions some students made the arithmetic unnecessarily complicated by choosing to use a common denominator of 12. Sometimes these students multiplied the numerators but left the denominator as 12. Some students wrote both mixed numbers as improper fractions and made no further progress. When no marks were scored this was often because students had attempted to multiply the whole numbers and the fractions separately.

Question 3

It was pleasing that many students were able to complete the table correctly. A common error was to mix up graph B and graph C.

Question 4

This question was answered quite well with many students able to identify A and D as the congruent triangles. The most common error was to choose triangles B and C, the two triangles with sides marked as 8 cm and 10 cm.

Question 5

The vast majority of students gained the first mark for multiplying 24 by 50p and many went on to find that Sean made £2 profit. Some students were able to go directly from the profit of £2 and give an answer of 20% without showing any working whereas many used methods such as $\frac{(12-10)}{10\times 100}$. Some students did not find the actual profit but chose to use $\frac{12}{10}$ and this was sufficient for the second mark. Sometimes the process was not completed correctly and the accuracy mark was lost. Some students, for example found $\frac{12}{10} = 1.2$ but did not give an answer of 20% and some $\frac{12}{10} \times 100$ and gave an answer of 120%.

Question 6

In this question the use of 3 letter angle notation was generally very good and many students also wrote the sizes of angles on the diagram. For the first method mark it was necessary to use parallel lines to find an angle, e.g. angle *AEB* = 63º or angle *BCD* = 32º. Students that did use angles on parallel lines correctly were often able to show a complete method to find the size of angle *EAB*. Some solutions, though, were spoilt by arithmetic errors. Students who made a start by using angles on a straight line to find that angle *ABE* = 32º and then failed to make any further correct progress got no marks. Many students made incorrect assumptions about other angles, e.g. angle *AEB* = 32º or angle *BCD* = 63º. This question required students to give reasons for each stage of their working. It was encouraging to see responses with all the appropriate reasons but unfortunately many students were not able to give all the necessary correctly worded reasons. Reasons given must include the key words underlined in the mark scheme so a statement such as “There’s 180º in a triangle” is not acceptable because it does not include a reference to angles. Many students were not able to give a correct reason relating to parallel lines. Corresponding angles or co-interior angles were often incorrectly named and statements such as “Parallel so angles are the same” were often seen. Some students gave no reasons at all.

Question 7

The first mark was awarded most often for finding the median of the boys’ heights as 168. A common mistake was to work out the median as 167 or 167.5. The ranges were seen far less often. Relatively few students were able to give both a correct comparison of medians and a correct comparison of ranges supported by correct figures. Students should be aware that the standard method to compare two data sets is to compare a measure of central tendency, the mean or the median, and to compare the spread of data using the range or the IQR. The typical response involved comparisons of the lowest heights, of the medians and of the greatest heights because these were the values given in the table. Statements that just referred to least heights or greatest heights were ignored. Many students scored two of the three marks for this question because they made no comparison of ranges or because one of the figures used in their comparisons was incorrect. Some students quoted values for the median and/or the ranges but made no comparison and could be awarded at most the first mark for a correct value. Figures did not need to appear in the comparisons if they were clearly shown with the diagrams but when no figures at all were seen the comparisons could be awarded no marks.

Question 8

Many attempts failed at the first hurdle when students either used an incorrect method to find the area of the base of the prism, e.g. $18 \times 3 = 54$, or did not realise that they needed to find the area of the base. These students gained no marks. Some of the students who divided 18 by 3 to find the area of the base made no further progress but most went on to use the pressure formula. Many gained all three marks for an answer of 450 but some students evaluated 75×6 incorrectly and lost the accuracy mark. A few students used the formula incorrectly and worked out $75 \div 6$ rather than 75×6.

Question 9

This question was well answered with many students writing the four numbers in order of size. Common mistakes were to place 67.2×10^{-4} before 0.000672 and 672×10^{4} before 6.72×10^{5}. Many students scored one mark for writing three of the numbers in the correct order (ignoring one). The most common approach seen was to convert each number into ordinary form but conversion into standard form was used by some students. The number 67.2×10^{-4} was often written incorrectly as 0.0000672 or as 6.72×10^{-5}. Some students showed no working at all.

Question 10

Many students gained the first mark for writing $\frac{3}{4}$ as $\frac{15}{20}$ or for writing the ratios 2 : 5 and 3 : 4.
To make further progress students had to realise that they needed to make the value of *b* the same in each fraction or in each ratio. Unfortunately, those writing $\frac{3}{4}$ as $\frac{15}{20}$ often wrote $\frac{2}{5} = \frac{8}{20}$ instead of writing $\frac{2}{5} = \frac{6}{15}$ and those who started with the ratios 2 : 5 and 3 : 4 often failed to link the two ratios correctly. The students that did show a correct process for the second mark usually went on to give the correct answer.

Question 11

In part (a), many students were able to gain at least one of the two marks. Most commonly one mark was awarded for working out $\sqrt[4]{81}$ as 3 with fewer students able to work out $\sqrt[4]{10^8}$ as 10^2. 3×10^8 and 3×10^4 were common incorrect answers. Those students who started by writing 81×10^8 as 8100000000 rarely went on to get the correct answer but they often gained one mark when their attempt at finding the 4th root resulted in an answer of 3 followed by an incorrect number of zeros.

In part (b), many students were able to gain at least one of the two marks. Most commonly one mark was awarded for evaluating $64^{\frac{1}{2}}$ as 8 with fewer students able to interpret a negative index as a reciprocal. Negative values given as answers were very common. A number of students merely found $\frac{1}{2}$ of 64 instead of using indices properly.

Part (c) was poorly answered. Many of the students who gained the first mark for writing 9^{n-1} as $(3^2)^{n-1}$ or as 3^{2n-2} were not able to complete the method. Attempts at subtracting $2n - 2$ from n often resulted in sign errors. Some of the students with some idea wrote 9^{n-1} as 3^{2n-1}. Many students had no idea how to start.

Question 12

The cumulative frequency table was often completed correctly although some addition errors were made. However, a significant number of students clearly had no idea how to work out cumulative frequencies. Those who completed the table correctly generally plotted the points and joined them with a curve or with line segments. A few students did not join the points and some drew a line of best fit. There were some graphs drawn with the points plotted at the midpoints of the intervals and these were awarded one mark if the points were joined. Some graphs were 'squashed' into the region from $w = 225$ to 350 because students plotted at the midpoints of the intervals in the cumulative frequency table and these graphs gained no marks. Histograms were often drawn and very few of them had the cumulative frequency points identified. In part (c) many students gained one mark for working out 60% of 80 as 48 or for reading a value from the graph at wage = 360 but fully correct solutions were not as common as might have been expected. Errors were often made when reading from the graph, most often with the scale on the horizontal axis. A significant number of students made no attempt to use the graph.

Question 13

Many students achieved the first mark for showing a process to find either the volume of liquid **A** or the mass of liquid **B**. Completing the process to find the density of liquid **C** proved problematic for some. Instead of using 20 and 8400 to find the mass and the volume of liquid C a common error was to divide 8400 by 20 and give an answer of 420. Those students who showed a complete process to find the density of liquid **C** usually gave a correct answer although arithmetic slips were frequently seen, most notably in working out 280 × 30 and 9800 ÷ 50. Mistakes in this question were often the result of using the formula for density incorrectly. A very common misconception, even amongst some students who showed some correct working, was that the density of **C** could be found by adding the density of **A** and the density of **B**. An answer of 350 from 70 + 280 was awarded no marks.

Question 14

Tree diagrams were often used. When a complete process was seen this was often adding four products, 0.3 × 0.1 + 0.3 × 0.6 + 0.6 × 0.3 + 0.1 × 0.3, but some students used the probability of Sally not winning and added two products, 0.3 × 0.7 + 0.7 × 0.3. The final accuracy mark was often lost because of arithmetic errors in the multiplication of decimals. Some students scored one mark for having at least one correct product but were unable to show a complete process. For some students the tree diagram was often all they managed; they did not know what to do with the probabilities and many added rather than multiplied the probabilities.

Question 15

There was quite a good understanding that the gradient of the line L_2 is obtained by finding the negative reciprocal of 3. A common error was use 3 or −3 as the gradient of L_2. Having found the gradient

of $-\frac{1}{3}$ students often went on to substitute x = 9 and y = 5 in y = $-\frac{1}{3}$x + c to work out the value of c. Arithmetic slips were surprisingly common. Some of those who used y = mx + c did not substitute x = 9 and y = 5; instead they just wrote an answer such as y = $-\frac{1}{3}$x + 5. Substituting $-\frac{1}{3}$, 9 and 5 into $y - y_1 = m(x - x_1)$ gave some students a quick route to an answer. Some students found the gradient
of $-\frac{1}{3}$ and made no further progress. Many, though, did not even get that far.

Question 16

In part (a) those students that understood the concepts involved usually gave the correct answer. Some students gained the first mark for writing a correct fraction such as $\frac{\mathbf{20}}{\mathbf{120}}$ but could not complete the solution. The incorrect answer 120 – 20 + 90 = 190 was very common.

In part (b) it was sufficient for students to explain that the answer would be smaller, e.g. there will be fewer bees. Some students made the wrong decision and wrote that the number of bees would be greater and some said that the number would change but did not specify how it would change. Students did not score this mark if they gave two contradictory statements.

Question 17

This question was poorly answered. Relatively few students managed to gain more than the first mark for multiplying both sides by (f – 4) to clear the fraction. Those students that wrote $d \times f - 4$ on the left hand side were only awarded the first mark if they recovered to $d(f - 4)$ or $df - 4d$. Students did appear to realise that they needed to find 'f = something' but did not know how to deal with the fact that f appeared on both sides of the equation. Attempts to isolate the terms in f were not always successful and only some of those who did isolate the terms in f went on to factorise correctly.

Question 18

After gaining the first mark for the statement $x = k\sqrt{y}$ many students could not make any further progress. Many attempts using 44 did not lead anywhere. Those that used $\sqrt{1.44}$ as a multiplier gained the second mark but some students could not then make the step from 1.2 or 1.2y to find the percentage increase as 20%. Some students approached this question by using values of x and y. If, for example, y = 100 (and k =1) then x = 10 and after the increase y = 144 and x = 12. This approach often proved successful.

Question 19

Part (a) was answered quite well with many students knowing how to find g(5).

In part (b), the most popular approach to a correct answer was to find f(9) = 4 and then find g(4) although some students first found gf(x) and substituted x = 9. It was surprising to see 3(2×4 + 1) = 24 + 1 = 25 in a number of responses. Misunderstanding of composite functions was evident in many answers. In order to find gf(9) many students found both f(9) and g(9) and then multiplied them or added one to the other.

In part (c), students who knew about inverse functions usually found $g^{-1}(6)$ by first finding $g^{-1}(x)$. Incorrect expressions for $g^{-1}(x)$ were often the result of applying ÷3, −1 and ÷2 in the wrong order. Some students found $g^{-1}(6)$ by solving the equation $3(2x + 1) = 6$. A common incorrect answer was $\frac{1}{39}$ because $g^{-1}(6)$ was often interpreted as 1/g(6), the notation for inverse functions being confused with the notation for a negative power. Some students simply worked out g(6) and gave 39 as the answer.

Question 20

Those students who started by writing $\sqrt{180}$ as $6\sqrt{5}$ to simplify the numerator tended to be the more successful because doing so made the subsequent arithmetic easier. Rather surprisingly some students simplified the numerator only as far as $6\sqrt{5} - 2\sqrt{5}$ before rationalising the denominator. Sometimes the numerator was simplified but then no attempt was made to rationalise the denominator. Students who started by attempting to rationalise the denominator often made errors when expanding $(\sqrt{180} - 2\sqrt{5})(5\sqrt{5} + 5)$. Some students used an incorrect method when attempting to rationalise the denominator, e.g. multiplying the numerator and denominator by $5\sqrt{5} - 5$, failing to link the process to the difference of two squares. Having got as far as $(100 + 20\sqrt{5})/100$ some students did not score the final mark because their attempt at simplifying did not lead to $1 + \sqrt{5}/5$.

Question 21

Relatively few students achieved any marks. Those that found a correct expression for *DQ* or *EQ* were usually able to write down a correct expression for *PQ* and simplify it to ½**b.** Mistakes were often made with the direction signs of the vectors and some students used ½**a** for the vector *EQ*. Those students obtaining all 4 marks generally made a very clear final statement. Some statements were insufficient with students mentioning "gradient" or "both have **b**" rather than stating that one vector was a multiple of the other.

Question 22

This proved to be a challenging question and finding the value of *x* proved to be beyond most students. Although there were relatively few fully correct solutions a number of students did gain at least one mark. This was usually for expanding and simplifying an expression for the area of shape **B**. A common error was not applying π to all 3 terms of an expanded quadratic expression, omitting brackets and writing π only before the first term or after the last term. Students struggled to find an expression for the area of shape **A**. Even when students realised that they needed to subtract the area of the white sector from the area of the whole sector they often failed to find a correct expression. Some students used areas of whole circles, not areas of sectors, and some forgot to square the radii.

Question 23

Many students made a successful start by showing the fractions $\frac{3}{8}$ and $\frac{7}{9}$ and gained the first mark. However, a very common incorrect next step was to multiply the two fractions and give an answer of $\frac{21}{72}$. Some students did divide $\frac{3}{8}$ by $\frac{7}{9}$ to get $\frac{27}{56}$ and scored full marks. A more common route to the correct answer was for students to recognise the significance of 72 and write $\frac{3}{8} = \frac{27}{72}$ and $\frac{7}{9} = \frac{56}{72}$ or use the ratios 3 : 5 and 2 : 7 to get 27 : 45 and 16 : 56. Some students could not then make the final step to $\frac{27}{56}$. The final mark was lost if the answer was given as a ratio and not as a fraction.

Summary

Based on their performance on this paper, students should:

- practise finding missing angles using angles on parallel lines and giving correctly worded reasons
- practise their arithmetic skills, particularly division and operations with decimals
- take care when interpreting the scales on the axes of graphs
- present their working clearly and in an organised way on the page so that the order of the process of solution is clear and unambiguous.

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