# Examiners' Report
# Principal Examiner Feedback

## November 2021

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

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**GCSE Mathematics 1MA1**
**Principal Examiner Feedback – Higher Paper 1**

## Introduction

This paper gave students of all abilities the opportunity to demonstrate their knowledge, skills and understanding. The early questions were generally well answered. Many of the later questions were often not attempted because the majority of students were targeting the lower grades.

On this non-calculator paper poor arithmetic often let students down when they knew the correct process. Students should be encouraged to check their calculations as a significant number of simple arithmetic errors were made, especially in the easier and more straightforward questions, and these resulted in a loss of marks.

Students should be encouraged to check the reasonableness of their answers. In question 1(b), for example, students should have realised that the answer cannot be 0.374 because 59.84 is being divided by a smaller number and in question 4 neither £48 000 or £640 000 is a sensible value for a £160 000 house after a 30% increase.

Many students seemed unable to apply their mathematical knowledge to a situation they may not have previously met and did not recognise what was required. Some of the questions that assessed problem solving skills, even ones early in the paper such as question 5 (application of ratios) and question 6 (volume of a prism), were not answered as well as might have been expected.

### Report on individual questions

### Question 1

In part (a) many students used a suitable method to multiply the two decimals, with relative place value correct. This meant that all of these students were able to gain the method mark and many went on to get two or three marks. Some students correctly came up with the digits 15414 but placed the decimal point incorrectly and gained two of the three marks. Students making arithmetical errors were also able to score two of the three marks by giving an answer with the decimal place correctly positioned, if this followed a correct method. Students who tried to answer this question by a less formal method were not as successful, often showing an incomplete method such as $3 \times 4 + 0.67 \times 0.2$ and gaining no marks.

Students were not quite as successful in part (b). Those who used a formal method to divide a number with the digits 5984 by a number with the digits 16 usually gained the first mark for making a correct start to the method and getting 3 as the first digit. Many went on to gain all three marks. Some of those who divided correctly to get the digits 374 positioned the decimal point incorrectly and gained two of the three marks. Arithmetic errors were common but, as in part (a), students could still gain two of the three marks if the decimal place was correctly positioned in their final answer. Some students rounded both 59.84 and 1.6, divided 60 by 2, and wrote 30 as the final answer. This gained no marks but it would have been a useful strategy for students to use when deciding where to position the decimal point in their final answer.

### Question 2

Those students who started by writing 6 and 18 in the intersection generally went on to answer this question quite well and often placed all five numbers correctly inside the circles to gain the first two marks. Some students, however, wrote 6 and 18 in more than one region or wrote just 18 in the intersection with 6 written in two different regions. The outside region, $(A \cup B)'$, proved to be more problematic. It was common to see either no numbers at all in this region or many of the numbers that had been placed inside the circles. Those who did attempt to put the rest of the even numbers in this region sometimes failed to include all four numbers.

**Question 3**

This question was generally answered quite well. The most common method seen was to convert both mixed numbers into improper fractions and then write both fractions over a common denominator. Many students gained at least two of the three marks for getting this far. The accuracy mark was often lost because students failed to write their answer as a mixed number or made an arithmetic error. Having written both mixed numbers as improper fractions some students made no further correct progress and gained one mark only. Far fewer students chose to subtract the whole numbers and deal with the fractional parts separately. The difficulty with this method was subtracting a larger fraction from a smaller fraction which meant that $4\frac{3}{15} - 2\frac{10}{15}$ was often followed by an answer of $2\frac{7}{10}$ or $2\frac{-7}{10}$.

**Question 4**

It was pleasing that a great many students were able to gain at least three of the four marks by working out the value of either Tamara's house or Rahim's house at the end of 2019. Many students worked out both values correctly and stated that Rahim's house had the greater value and they were awarded full marks. Too many responses, though, were spoilt by careless errors. Some students used the multipliers 0.8 and 1.3 to work out the new values but it was more common to see students start by working out 20% of 220 000 and 30% of 160 000. Build up methods for finding percentages were quite popular but incorrect statements such as 10% of 220 000 = 2200 and 10% of 160 000 = 1600 with no method shown gained no credit. Students should be advised that the method needs to be clear. When finding 10%, for example, they should show that they intend to divide by 10. Errors were frequently made in the final part of the process. Subtracting 44 000 from 220 000 was a problem for some students; sometimes the result of this calculation was greater than 220 000. Some students correctly found 30% of 160 000 but then subtracted this from 160 000 instead of adding. A few students only worked out 20% of 220 000 as 44 000 and 30% of 160 000 as 48 000 and stated that Rahim's house had the greater value. They were awarded the first mark only.

**Question 5**

Although some students gained only the first mark, usually for 15 – 7 = 8 or for 24 ÷ 3 = 8, the majority of students gained either full marks or no marks. Those that made a correct start frequently went on to gain all three marks but many students were not able to find a suitable strategy to solve this ratio problem. Incorrect processes were often the result of adding the three numbers in the ratio, 4 + 7 + 15 = 26, as a first step.

**Question 6**

Many of the attempts to work out the height of the triangular prism failed because students treated the shape as a cuboid and worked with length × width × height. This meant that 6 was a very common incorrect answer. Some of the students who gained the first mark for dividing 750 by 25 to find the area of the cross section made no further progress but most went on to make an attempt at finding the height of the triangle. These attempts were often not successful because students failed to take into account the fact that the cross section was a triangle. Some students wrote an equation such as $\frac{1}{2} \times 5 \times h \times 25 = 750$ and were awarded the first two marks but they were not always able to solve their equation correctly. For those students who had gained no process marks yet had only omitted division by 2 there was a special case mark for a final answer of 6.

**Question 7**

This question was not answered particularly well. Many students gained one mark for using the given formula to write a correct expression for the surface area of the sphere, $4 \times \pi \times 3^2$ for example, but not many of these students attempted to find the surface area of the cube. It was very common to see $4 \times \pi \times 3^2$ followed by $x = \sqrt{36\pi}$ . Those students who did find an expression for the surface area of the cube generally went on to form a suitable equation and complete the method to gain full marks. Some students found an expression for the area of one face of the cube rather than for the surface area, often writing $x^2 = 36\pi$ , and gained the first two marks only.

**Question 8**

Students who rearranged the given equation to get $x^2 - 5x - 24 = 0$ often went on to give a fully correct answer. Some, however, lost marks because they were unable to factorise correctly or they factorised correctly but then wrote $(x - 8)(x + 3)$ as the final answer. A surprising number of students did not realise that a sensible first step would be to rearrange the equation and attempted to factorise straight away. Those who gave a factorisation of the form $(x \pm 8)(x \pm 3)$ gained the second method mark.

**Question 9**

Part (a) was answered quite well with many students knowing that the value of $7^0$ is 1. The common incorrect answers were 0 and 7.

Slightly fewer students were able to find the value of $3 \times 3^6 \times 3^{-6}$ in part (b) with the most common incorrect answer being 27.

In part (c), some of the students who knew that a negative power involved a reciprocal made arithmetic mistakes and gave incorrect answers such as $\frac{1}{8}$ or $\frac{1}{32}$.

In part (d), students not familiar with fractional indices often divided 27 by 3 instead of finding the cube root of 27 which resulted in 9 being a common incorrect answer.

**Question 10**

Since students were asked to find an estimate for the length of one side of each square in part (a) it should have been evident to them that they would need to use a rounded value. Some students did this at the start of the process, rounding the total area to 5400 before dividing by 6. Others started by dividing 5406 by 6 and then rounded 901 to 900 before attempting to find the square root. Many students gained the first mark for dividing by 6 but the next stage in the process proved to be beyond a considerable number of these students. Those who recognised that they needed to find the square root often went on to get full marks for an answer of 30 but the incorrect processes seen were many and varied. Often these involved division by 4 or by 2. Some students gained the first mark and gave 900 or 901 as the final answer.

The mark in part (b) was not dependent on a complete process in part (a). To be in a position to say whether their answer was an underestimate or an overestimate, students must have used a rounded value in a calculation. Many students did state that their answer was an underestimate and gave a suitable reason; for example they had rounded the total area down or they had rounded 901 to 900.

Some students chose underestimate or overestimate but gave no reason for their choice. Overall, part (b) was not answered particularly well.

**Question 11**

This question was not well answer with relatively few students managing to gain more than the first two marks. Writing an expression for the area of each rectangle and forming an equation ought to have been a straightforward process for the first mark, particularly as missing brackets were condoned. Some students wrote two expressions and failed to form an equation but many students were unable to write two correct expressions. A significant number of students worked with perimeter rather than with area. Having gained the first mark, many students were not able to make any further correct progress. Those without brackets in their equation usually failed to expand correctly. Some with brackets made errors expanding and some expanded correctly but then simplified incorrectly. Many students did not know how to deal with the fact that $y$ appeared on both sides of the equation. Those who isolated the terms in $y$ often went on to factorise correctly and were able to find a correct expression for $y$ in terms of $w$.

**Question 12**

This very familiar type of question was not answered as well as might have been expected. Many students did plot the points correctly and joined them with a curve or with line segments and gained both marks. A few students did not join the points and some attempts at a line of best fit were seen. Some graphs were drawn with the points plotted at the midpoints of the intervals and these were awarded one mark if the points were plotted at the correct heights and joined. Some students plotted at the midpoints of the intervals in the cumulative frequency table and this resulted in graphs that were ‘squashed’ into the region from $h = 2.5$ to 15. These graphs gained no marks. Histograms were often drawn and these gained no marks unless at least 5 or 6 of the points were identified and plotted correctly. In part (b) many students gained one mark for finding the median. Some errors were made when reading from the graph, most often with the scale on the horizontal axis. A surprising number of students used the graph incorrectly or made no attempt to use the graph.

**Question 13**

Some good evaluations of Ted’s method were seen. Successful students often explained that Ted should have used $100x$ and $x$ or that he should have used $1000x$ and $10x$. Some students gave acceptable explanations that focused on the recurring numbers after the decimal points.
Any numerical examples given as part of an explanation needed to be correct for the mark to be awarded. This was often not the case. Some answers consisted only of a correct numerical method showing that the recurring decimal could be written as the fraction $\frac{43}{99}$ and these were accepted. Some answers, such as “he should have used $100x$” or “he needs to find $1000x$”, did not go quite far enough. Many answers were simply incorrect. A common misconception was that Ted had made a multiplication error because the value he found for $10x$ was wrong. A significant number of answers consisted of a commentary of what Ted was doing but no evaluation of his method.

**Question 14**

It was pleasing to see many fully correct answers with clear accurate algebra but there were also very many responses where algebraic weaknesses were apparent. Most of the students who indicated that they were going to find the area of the L-shape by splitting it up into two rectangles were able to score at least one mark for a correct expression for the area of one rectangle. A complete expression for the total area was needed for the second mark; most commonly this was given as $4(x + 1) + (x + 7)(2x + 6)$, with $(x + 1)(x + 11) + (x + 7)(x + 5)$ and $(x + 11)(2x + 6) – 4(x + 5)$ used less often. Incorrect expressions for the total area were often the result of working out missing lengths in the shape incorrectly. Many students could not handle the algebra accurately enough to show a complete chain of reasoning leading to $A = 2x^2 + 24x + 46$. Omitting necessary brackets and expanding brackets incorrectly were common errors.

**Question 15**

Most of the students who used $10x$ as a common denominator went on to score full marks. Exceptions to this were those who made errors in expanding brackets, for example $5(4x + 3) = 20x + 3$, and those who wrote $\frac{3}{5}$ as $\frac{6}{10x}$. Some students wrote only one of the fractions with a suitable denominator, often this was $(\frac{20x+15}{10x})$ and gained the first mark only. Many students did not know how to tackle this question.

**Question 16**

Probability tree diagrams were very common and those students that attempted to draw a tree diagram often achieved the first mark for use of $\frac{3}{7}$, $\frac{4}{7}$ or $\frac{5}{7}$, showing understanding that the first counter was not replaced. Those who wrote at least one correct product gained the second mark but often these students were not able to go on and show a complete process. Sometimes this was because they did not consider all three ways that Jude could take exactly one red counter and sometimes it was because they used incorrect probabilities in their products. The majority of those that did show a complete process were able to complete the arithmetic and give a correct final answer. For some students the tree diagram was often all they managed; they did not know what to do with the probabilities. Some added rather than multiplied the probabilities.

**Question 17**

Many students gained no marks because they were not able to draw two of the three lines correctly. When only two of the three lines were drawn correctly it was most commonly the lines $x = 3$ and $y = 6 – 3x$. The graph of $2y + 4 = x$ caused the most problems. A common error was to draw this line with the correct gradient but the wrong $y$-axis intercept. Some students confused the line $x = 3$ with the line $y = 3$. Even after gaining the first two marks for drawing all three lines correctly many students failed to give a fully correct solution because they identified the wrong region – often this was the region enclosed by the three lines. Students should check whether points in the region they choose satisfy all three inequalities.

**Question 18**

This proved to be a challenging question and finding the length of *AB* proved to be beyond most students. Some of those who attempted the question identified that they need to find the perpendicular height of the trapezium and gained the first mark for writing a correct trigonometric statement such as $\sin 30 = h/6$. Some students could not recall the value of sin30 and did not complete the process to find the height. After finding the height many students struggled to make any further progress, failing to realise that they should use the formula for the area of a trapezium. It was common to see the trapezium split into two triangles and a rectangle and attempts at using Pythagoras. A good proportion of those that did substitute correctly into the formula went on to show a complete process to find the length of *AB*. A small number of students gave $\frac{88}{5}$ as the final answer and lost the accuracy mark.

**Question 19**

Writing $\sqrt{12}$ as $2\sqrt{3}$ was sometimes seen as the first step and sometimes it was seen later in the process. Some of the students who started by writing $\sqrt{12}$ as $2\sqrt{3}$ and simplified the numerator of the fraction to $8+2\sqrt{3}$ made no further progress. Those students who realised that they needed to rationalise the denominator were not always able to show a correct method to do so. Attempts at multiplying both the numerator and the denominator by $5+\sqrt{3}$ or by $\sqrt{3}$ were often seen and gained no credit. Those who did appreciate the need to multiply numerator and denominator by $5-\sqrt{3}$ often went on to expand the terms correctly although some students made sign errors. Having got as far as $\frac{(34+2\sqrt{3})}{22}$ some students gave this as the final answer and did not score the final mark because the question asked for an answer in the form $\frac{(a+\sqrt{3})}{b}$.

**Question 20**

This question was poorly answered with relatively few students achieving any marks. For those who drew the graph of $y - 2x = 1$ it was common to see at least two marks awarded if not all three. When one of the accuracy marks was lost this was usually due to the values not being given as pairs or an error being made when reading from the graph. Not all attempts at drawing the graph of $y - 2x = 1$ were successful. Some students attempted an algebraic approach despite the question directing them to use the graph but these attempts were doomed to failure on this non-calculator paper and gained no marks.

**Question 21**

In part (a), the most popular approach to a correct answer was to first find f(1) = 4 and then work out g(4) although some students first found gf($x$) and then substituted $x = 1$. A surprising number of students could not evaluate $3\times1^2 + 1$ correctly and lost the accuracy mark. Misunderstanding of composite functions was evident in many answers and a common incorrect method was to find both f(1) and g(1) and then multiply the two results or add one to the other.

Part (b) was not well answered. Students with some knowledge of functions often gained the first mark for finding fg($x$) but most then made little or no progress in finding the inverse function. Errors in algebraic manipulation frequently spoilt the attempts of those who did carry on and only a small number of students gave a fully correct answer.

**Question 22**

Very few students showed a full understanding of what was required to find the coordinates of the turning point on the curve. Some of those who realised that they needed to use completing the square tried to do this as the first step and invariably failed. Some students divided $9 + 18x - 3x^2$ by –3 and worked with $x^2 - 6x - 3$, often gaining one mark for starting the process to complete the square. Those who started by factorising often went on to give fully correct answers but sign errors and missing brackets prevented some students from achieving full marks.

**In Summary**

Based on their performance on this paper, students should:

- practise their arithmetic skills, particularly division and operations with mixed numbers
- consider whether or not an answer to a calculation is of a sensible size
- practise working out estimates by rounding numbers and develop an understanding of the purpose of rounding so that they can choose appropriate rounded values
- show their method when working out a percentage of an amount
- know and be able to use area formulae for triangles and trapezia
- practise answering questions involving algebraic fractions

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