Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2024

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

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

Introduction

This paper was accessible to the majority of students. Overall, the paper was well answered and allowed a good differentiation between the students achieving higher grades and the students achieving lower grades. The majority of students appeared well prepared and familiar with the types of questions they were presented with and understood how to approach many questions.

Students were well-prepared for topics such as the *n*th term of a linear sequence (Q1), subtraction of fractions (Q2), simultaneous equations (Q10), expanding triple brackets (Q14), rationalising the denominator (Q17a) and recurring decimals (Q18). The two early problem solving questions involving area of compound shapes (Q3) and ratio and percentage (Q7) were both well answered. Many students did not recognise the need to find and use frequency densities in order to draw a histogram in Q13 and a large number of students failed to make any progress with the similar triangles problem in Q19 or with using the equation of a circle in Q23.

Arithmetic errors led to many students losing marks, particularly on questions involving division or negative numbers. On many occasions a simple check would have alerted students to an error which could have been corrected. On a non-calculator paper, students should look to use efficient methods to perform arithmetic operations, including where possible simplifying calculations by using fractions in their simplest form, for example cancelling $\frac{150}{360}$ to $\frac{5}{12}$ in Q15.

The general standard of presentation of solutions was quite varied but it was pleasing that many students presented their answers in a clear and logical way. Attempts at the more challenging questions were sometimes quite messy with working spread all over the page which made them difficult for examiners to follow. It is in a student’s own interest to ensure that working is clearly laid out and flows logically down the page. Centres should advise students to cross out unnecessary working to avoid leaving a choice of methods. There were many cases across many different questions of students miscopying their own figures or misreading the numbers in questions.

Report on individual questions

Question 1

This familiar type of question was answered well. Many of the students who recognised that $4n$ was needed in their expression were able to write the correct expression, $4n – 3$, for the *n*th term of the sequence. Answers such as $4n$, $4n + 1$ and $4n +3$ were common and these gained one of the two marks for an expression of the form $4n + k$, with $k \neq – 3$. The most common incorrect answers that gained no marks were $n + 4$ and $–3n + 4$.

Question 2

Part (a) was answered very well. The most common approach was to convert both mixed numbers into improper fractions and then add these fractions using a common denominator of 15. Errors were made when converting to improper fractions and when writing to a common denominator but one mark was awarded for a method to subtract using a common denominator with at least one correct numerator. Simple arithmetic errors when subtracting numerators were common. Many students did convert back to a mixed number even though it wasn't required but any mistakes made converting $\frac{32}{15}$ into a mixed number were not penalised. Students who chose to deal with the whole numbers and the fraction parts separately had a quicker method that resulted in fewer arithmetic errors. A small number of students did not know that a common denominator was needed.

In part (b) many students were able to identify that Kevin had made a mistake when changing $\frac{35}{24}$ into a mixed number. The most common approach was to work through the problem and compare the result with the given solution. Students who could do the multiplication then spotted that Kevin's answer should be $1\frac{11}{24}$. Some students started from 35 – 24 which should be 11 and not 9 and some considered 24 + 9 which should be 33 and not the 35 that is needed. A common incorrect explanation was that Kevin should have simplified his final answer and some students stated that he should have used a common denominator or that he should have used 'keep, flip, change'. Very often the incorrect statements were from those students who had not tried to work through the problem themselves.

Question 3

It was pleasing to see many fully correct solutions to the problem in part (a) and the majority of students gained at least one mark. Most students divided the floor plan into two rectangles and were usually able to work out that the area is 68 m^2. A few students made simple arithmetic errors but still gained the mark for a complete process to find the total area. After finding a floor area, students needed to find out whether Petra has enough paint to cover the floor. The most common approach was to work out that the 3 tins will cover an area of 75 m^2. Alternatively, some students divided their area by 10 to find the number of litres needed and multiplied 3 by 2.5 to find that Petra has 7.5 litres of paint. Some students used approximation successfully, stating the area and stating that 7 litres would be sufficient and this was less than the 7.5 litres Petra had available. Whichever approach they chose, students usually went on to give the correct decision that Petra has enough paint. The majority of students did specify a "yes/no" answer and very few lost the final mark if the rest of the work was correct. Incorrect approaches included working with the perimeter or finding the product of all the given lengths.

Part (b) was also well answered with many students stating that it would not affect the answer to part (a) and giving a correct reason such as she will need less paint or she will have more paint left over. Some students made a comment about Petra needing less paint but could not be awarded the mark because they did not make a decision. If figures were included in the answer to part (b) they had to be correct for the area that had been calculated in part (a). Many students correctly found that Petra would now be able to cover 82.5 m^2.

Question 4

In part (a) almost half of the students correctly identified the numbers that are in set P'. The most common errors were to list the three numbers in set *P* or the two numbers, 12 and 15, that are only in set *P*. Some students wrote down the correct six numbers but also included 18 and gained no mark.

In part (b) many students scored one mark for writing a probability with the correct denominator of 9. A correct numerator was seen less frequently. Some students identified the members of the set $P \cup Q$ and scored one mark but then added the five numbers. It was evident that many students were unable to identify the region $P \cup Q$ and the most common mistake was to give the probability that the number is in set $P \cap Q$. Another incorrect method was finding P(*P*) × P(*Q*).

Question 5

Marks were often lost in part (a) because students did not understand the implications of the word "estimate". Most students were able to demonstrate a full process to find the total amount that Sophie pays which earned them one mark but there was a significant number of students who used very little rounding or no rounding at all and gained no further marks. As this question was testing estimation skills students were expected to round at least one value to 1 significant figure in order to get a calculation that they could work out in their heads. Rounding 513 to 500 and 0.81 to 0.8 was quite a common route to a correct estimate. Some students divided 513 by 10 to get 51.3 and then rounded this to 50 before multiplying by 0.8 or 0.81. Many students chose to round 0.81 to 1 rather than to 0.8 and although this made the calculation much easier it did not result in a very good estimate of the total amount. This approach scored at most two of the three marks. The working for this problem was very variable. The good responses generally clearly stated the estimates that they were working with. In some of the poorer attempts, students seemed to have taken multiple approaches in a bid to find an easier calculation but often their lack of estimation prevented them from finding an easier calculation.

To be in a position to say whether their answer was an underestimate or an overestimate in part (b), students must have used a rounded value in a calculation in part (a). Many students did state that their answer was an underestimate and gave a suitable reason; for example, they had rounded both 513 and 0.81 down. Some students rounded one value up and the other value down but gave a reason that only mentioned rounding one value and they could not be awarded the mark. A small number of students were able to successfully explain that rounding 0.81 to 1 was more significant than rounding 513 down to 500 and could gain the credit here.

Question 6

Part (a) was generally answered quite well. Many students were able to get one mark for being able to use $y = mx + c$. Some students drew an appropriate triangle on the diagram but did not know how to use it, others did use it and showed correct working or stated that the gradient is $\frac{3}{2}$. Incorrect gradients included $-\frac{3}{2}$ and $\frac{2}{3}$. Students should be encouraged to write down the formula for a gradient before applying it as this may minimise the use of incorrect values. Many went on to use the gradient correctly in an equation but some students did not know what to do with it. When the gradient was used correctly a common wrong answer was $y = \frac{3}{2}x - 2$ where the *x* intercept was used rather than the *y* intercept and some gave the answer as $y = \frac{3}{2}x$. Answers such as these were awarded the two method marks. A few students, who knew what they were doing, spoiled their final answers by using L instead of *y* in their equation, but were awarded two of the three marks. Students who did not know how to find the gradient could gain the first method mark for demonstrating understanding of the *y*-intercept.

A similar number of students were successful in part (b) when writing down the equation of a straight line parallel to $y = 5x$. It was clear that some students did not know that parallel lines have the same gradient. Common incorrect answers often included the digit 5, for example $y = -\frac{1}{5}x$, $y = \frac{1}{5}x$, $y = -5x$ and even $y = 5x$. Some students simply changed the 5 for a different digit and gave answers such as $y = 4x$ or $y = 2x$.

Question 7

Most students made very good attempts at this multi-step question with many achieving at least three of the five marks. It was pleasing to see many well presented solutions with working out that was easy to follow. Most students worked with the number of jars with only a few choosing to take the more direct approach of working only with proportions. The majority of students gained the first mark by showing a process to find the number of empty jars. In order to make further progress students needed to associate corresponding parts from the two ratios. Many students realised that they needed to multiply both parts of the ratio 1 : 2 by 4 and they were able to write down the ratio 3 : 4 : 8 and gain the second mark. Using the ratio 3 : 4 : 8 to find the number of empty small jars gained the third mark. Some did this by finding $\frac{3}{15}$ of 150, others by writing the ratio as 30 : 40 : 80. Having found that Kasim has 30 empty small jars, many students did not read the question with sufficient care. The question asks for the percentage of Kasim's jars that are empty small jars so the required proportion is $\frac{30}{400}$. Many students, though, used $\frac{30}{150}$ and it was very common to see $\frac{30}{150} \times 100$ and an answer of 20%. Most of those students who did use $\frac{30}{400}$ were able to find the correct percentage but arithmetic errors cost some students the final mark. A common error was to divide 400 by 30 rather than 30 by 400.

Question 8

This question was generally answered well and there were many fully correct responses. If students knew how to get started they often went on to gain full marks. Some of the students who achieved the first mark for a method to find the total weight of the 8 parcels or the total weight of the 3 parcels made no further progress. Some did subtract 6 from 20 but gave 14 as the final answer. Many, though, did go on to show a complete process, subtracting 6 from 20 and then dividing the result by 5. If the calculations were carried out correctly, they scored full marks but some students made an arithmetic error and this meant that they did not gain the accuracy mark. Most arithmetic errors occurred when working out 14 ÷ 5. Some gave the answer $\frac{14}{5}$ but this was not awarded the accuracy mark. A common misconception was that the weight of the three parcels should be added to the weight of the eight parcels. Some students merely subtracted 2 from 2.5 and either gave 0.5 as the answer or multiplied it by 5 and gave 2.5 as the answer. Some found the mean of 2.5 and 2. These methods could not, of course, be awarded any marks.

Question 9

A good portion of the students found the correct value of *R*. Those who wrote 30% rather than 30 on the answer line were awarded the mark. Common incorrect answers were 70, 0.7 and 0.3

Question 10

Many of the students appeared familiar with simultaneous equations and started by multiplying both equations to make the coefficients of x or y the same. Most then subtracted one equation from the other to eliminate one of the variables and gained the first method mark. Accuracy was sometimes lost through arithmetic errors in the multiplying or subtracting. The most successful students were those who eliminated y first as this made the arithmetic easier. Eliminating x using $10x – 4y = 46$ and $10x – 15y = 90$ tended to lead to more subtraction errors than using $15x – 6y = 69$ and $4x – 6y = 36$ to eliminate y. Having carried out the necessary multiplications some students added the two equations and gained no marks. Students who used a correct method to find one value usually went on to substitute this value into an equation in order to find the other value and so gained the second method mark. A number of students who substituted $x = 3$ into the second equation to get $15 – 2y = 23$ could not solve the equation correctly, often arriving at $y = 4$. Eliminating one variable by rearranging one equation and substituting into the other equation was attempted by a few students but this method rarely led to a fully correct answer. There were many responses in which students had made multiple attempts to find a solution and the working was often difficult for examiners to follow.

Question 11

Most students attempted to draw triangle **B** and triangle **C** on the grid and many gained the first mark for showing at least one of the triangles in the correct position or for rotating their incorrectly positioned triangle **B** by 90° clockwise about the point (1, 2). Often both triangles were correctly positioned. Students who drew triangle **B** and triangle **C** in the correct positions were often able to recognise that the single transformation that will map shape **A** to shape **C** is a rotation. Descriptions of the transformation were generally good although sometimes when the angle of rotation was given as 90° the direction of ‘clockwise’ was missing or given as ‘anticlockwise’. The centre of rotation was sometimes missing or incorrect. It was apparent that some students had used tracing paper when answering this question and this was generally a successful strategy for determining the centre of rotation. Many students gave more than one transformation, often using a rotation and a translation, and therefore got neither of the two marks available for the description as the question asked for a single transformation. Quite a few students simply restated the transformations given in the question.

Question 12

Most of the students correctly identified graph **H** as the graph of $y = x^2 - 4$. Less of the students identified graph **F** as the graph of $y = -x^2$. Not surprisingly, the other two cubic graphs, graph **C** and graph **E**, were common incorrect responses. Even fewer students were able to identify graph **J** as the graph of $y = -\frac{5}{x}$. Common incorrect answers were **A**, **C**, **F** and **G**.

Question 13

In part (a) the students who worked out the frequency densities and used these to draw a histogram often drew five correct bars. This alone was not sufficient for full marks because the two axes needed to be correctly scaled and labelled. Some arithmetic errors such as $22 \div 5 = 4.5$ were made when working out the frequency densities. Students should be encouraged to show the method they use to work out each frequency density so that examiners can see if incorrect values come from a correct method of dividing frequency by class width. Some students made an error drawing one of the bars but still gained two of the three marks. A few students with the correct frequency densities did not draw the bars in the correct intervals and gained one mark only. Weaker students often did not recognise the need to find frequency densities and drew a bar chart or a frequency polygon or a cumulative frequency graph.

A similar proportion of students gained full marks in part (b) for working out an estimate for the fraction of the 150 people who were in the shop for between 20 minutes and 40 minutes. As this can be done by using the table or by using the histogram some students who had gained no marks in part (a) were able to give a correct fraction in part (b) by using the table. The marks were also awarded in part (b) for answers which followed through correctly from incorrect histograms. A common mistake was to give the answer as 67, not as a fraction, and this gained one mark only.

Question 14

This question, which required the expansion and then simplification of a product of three linear expressions, was generally answered well. Usually, students showed their working in an organised way or used a grid to show the terms in their products. Errors were usually restricted to incorrect terms or difficulties in dealing with the signs when collecting terms together, rather than a flawed strategy. Some students omitted terms from their expansion when at the stage of multiplying a quadratic expression by a linear expression and they could not be awarded the second mark because their method was not complete. For students who did not give a fully correct answer, it was commonplace to see 2 marks, or 1 mark awarded. Some lower attaining students sometimes either stopped after multiplying two linear expressions together or lacked a clear strategy and tried to multiply all three brackets together at once. Misreads of one or more of the expressions were common and there were a surprising number of transcription errors made when transferring a correct answer from the final line of working to the answer line.

Question 15

This question was not answered as well as might have been expected and a surprising number of students failed to gain any marks at all. Many of those with some knowledge of sectors of circles went wrong at the first step, using πr^2 or πr instead of $2\pi r$ and gained no marks. A good proportion of those who did make a correct start went on to get full marks. Marks were often lost because of arithmetic errors or poor algebraic manipulation. Students who cancelled down fractions before multiplying worked more accurately than those who left cancelling until the end. Those who started by forming the equation $\frac{x}{360}\times 2\times \pi \times 6=5\pi$ gained the first mark but rearranging the equation correctly to find the value of *x* was a problem for some. Students who worked with proportion and found that the arc length is $\frac{5}{12}$ of the circumference of the circle gained the first two marks. They could then complete the process to find the area of the sector by working out $\frac{5}{12}\times \pi \times 6^2$ although many chose to first work out the size of angle *AOB*. After gaining the first three marks for a complete process to find the area of the sector a significant number of students failed to get an answer of 15π because they could not evaluate $\frac{150}{360}\times \pi \times 6^2$ correctly. Those who used $\frac{5}{12}\times \pi \times 6^2$ made fewer arithmetic errors. Some students assumed that the sector was one third of a circle and worked with an angle of 120^o and some measured the angle and used 130^o in their calculations. These students gained no marks.

Question 16

A good number of students gained the first mark for giving the probability that the first sweet is orange as $\frac{n}{n+1}$. Often this probability was seen on a tree diagram. About half of these students were able to give the probability that the second sweet is orange as $\frac{n-1}{n}$ and then multiply the two probabilities together. Just $\frac{n}{n+1}\times \frac{n-1}{n}=\frac{n-1}{n+1}$ was sufficient for both marks to be awarded but it was pleasing to see some students include the intermediate step $\frac{n(n-1)}{n(n+1)}$. Many students gave clear concise responses which often involved cancelling the *n*. However, there were many who overcomplicated the problem by multiplying the fractions, then factorising the numerator and denominator before finally cancelling the common factor. In some cases, $\frac{n(n-1)}{n(n+1)}$ was incorrectly expanding to give $\frac{n^2-1}{n^2+1}$ before writing the correct final answer. If any incorrect algebra was shown after a correct product then the accuracy mark could not be awarded. A common error was to give the second probability as $\frac{n-1}{n+1}$. Some students did not know what to do with the probabilities, often adding them rather than multiplying. Others hoped that a random mixture of algebraic fractions similar to that given in the question could somehow be manipulated to miraculously come up with the correct final answer. This approach did not earn any credit.

Question 17

Part (a) was generally answered quite well. Most students who knew about rationalising a denominator chose to multiply numerator and denominator by $\sqrt{7}$ although a few used $-\sqrt{7}$ instead. The multiplying was usually carried out correctly. However, $\frac{\sqrt{7}}{7}$ was sometimes incorrectly simplified, often to 1, and the mark could not be awarded. It was common to see $\frac{1\sqrt{7}}{7}$ as the final answer and this was awarded one mark. A common error was to find the reciprocal rather than rationalise. Incorrect manipulation of the surd was seen when students wrote $\sqrt{7} = \sqrt{4+3} = 2\sqrt{3}$ or $2+\sqrt{3}$.

In part (b) many students were able to gain at least one of the two marks for writing $\sqrt{80}$ as $\sqrt{16\times5}$ or $\sqrt{16}\times\sqrt{5}$ or $4\sqrt{5}$. Although many went on to get the correct answer of $3\sqrt{5}$ it was not unusual to see $4\sqrt{5}-\sqrt{5}$ followed by an answer of 4 or to see $4\sqrt{5}-\sqrt{5}$ given as the final answer. Writing $\sqrt{80}$ as $\sqrt{10\times8}$ or $\sqrt{4\times20}$ was a first step that often led to no marks being awarded although some students did get to $4\sqrt{5}$. A common mistake was to write $\sqrt{80}-\sqrt{5}$ as $\sqrt{75}$ and this often resulted in an answer of $5\sqrt{3}$.

Question 18

This was one of the better answered questions in the latter stages of the paper with most students gaining at least one mark. It was pleasing that many students were able to show a complete method leading to 25/66. Converting a recurring decimal to a fraction is a familiar type of question but here students had two recurring decimals to deal with. Adding the two decimals as a first step gives students only one recurring decimal to convert to a fraction but relatively few students chose this route. Those who did could often not add the recurring decimals correctly. The majority of students chose to convert both $0.\dot{1}\dot{5}$ and $0.2\dot{2}\dot{7}$ into fractions and most were able to gain the first mark for the start of a method to convert either decimal to a fraction. A common error at this stage was to follow x = 0.2272727 with $10x$ = 2.727272. After finding two appropriate decimals to subtract some students spoilt their solution by making careless arithmetic errors such as $1000x - 10x = 900x$. Some students could recall the need to multiply the recurring decimal by powers of ten but were either unable to find the multiples needed to eliminate the recurring nature of the decimal or could not carry out the multiplications correctly. Many students, however, showed correct methods to convert both fractions to decimals and gained the second mark. Students still had to show that adding the two fractions gives an answer that can be written in the form $\frac{m}{66}$. Some achieved this by adding the two fractions to get $\frac{375}{990}$ and then simplifying, others simplified the two fractions before adding. Arithmetic errors in this final stage sometimes resulted in a fraction that was not $\frac{25}{66}$ and the final mark could not be awarded. The presentation of working was often quite poor in this question.

Question 19

Overall, this question was answered poorly with the majority of students unable to find an appropriate strategy to work out the ratio *AB* : *AD*. Some students made a good start by using similar triangles to form an equation involving *AB*, e.g. $\frac{AB}{4} = \frac{25}{AB}$, or an equation involving the scale factor, e.g. 4 × scale factor = 25 ÷ scale factor. Many of those who formed a correct equation were able to complete the process to find the required ratio.
Most students, however, were unable to identify the need to compare the sides of the two similar triangles, *ABC* and *DAB*. Many used the ratio 4 : 21 incorrectly and answers of 4 : 25 were common. Students are advised that drawing two separate triangles and marking in lengths on the sides may help them to use the similarity of the triangles. A small number of students used Pythagoras to find the perpendicular height of the triangles and then *AB*. Some students assumed that Pythagoras could be applied to triangle *ACD* to find *AC* but it is not a right-angled triangle.

Question 20

This question was not answered as well as might have been expected. The expressions for 2^x and 2^y contained a combination of surds and indices and many students worked with surds but not with indices and made no meaningful progress. It was common, for example, to see $\left(\sqrt{2}\right)^5$ written as $4\sqrt{2}$ rather than as $2^{\frac{5}{2}}$. Many of the students who did get the first mark for $2^{\frac{5}{2}}$ or for $y = 2.5$ were unable to write $\frac{2^n}{\sqrt[3]{2}}$ as $2^{n-\frac{1}{3}}$. Those who got the second mark for an equation such as $8 = n - \frac{1}{3} + \frac{5}{2}$ usually went on to give a correct answer although arithmetic errors cost some students the final mark. Any errors made when converting $\frac{35}{6}$ into a mixed number were ignored as the improper fraction is acceptable as the final answer.

Question 21

Many students gained the first mark for dividing 300 by 20 to find the area of one face of the cuboid or for forming an equation using the volume such as $20wh = 300$. Many students then gave an answer of 3 because 3 × 5 = 15 and the width is greater than the height. Those who did make further correct progress gained the second mark for forming an equation using the surface area. A common mistake at this stage was assuming that four of the faces of the cuboid have the same area. Fewer than half of the students who formed two correct equations went on to gain any more marks. Some students completed the solution by eliminating one variable and solving the resulting quadratic equation. The majority of those who found both 2.5 and 6 then chose the correct value for the height. Others simplified the two equations to $wh = 15$ and $w + h = 8.5$ and hence deduced that $h = 2.5$. An apparent lack of confidence with simultaneous equations meant that a significant number of students resorted to trial and improvement methods once they had equations for volume and surface area. Some tried several pairs of numbers multiplying to 15 until they found the pair that resulted in the correct total surface area. Others were not successful because they only used integer values. A common misconception was to divide the surface area by 6, assuming that the shape was a cube.

Question 22

In part (a) a good number of students gained the method mark for sketching a graph with the correct shape between $x = 0$ and $x = 360$. About half of these students went on to gain both marks for a fully correct sketch with labels at 1 and –1. Incorrect sketches that gained no marks were often attempts at a sine curve with an incorrect period or attempts at a cosine curve but sketches of horizontal lines were also quite common.

Part (b) was not as well answered as part (a). Some students gained the method mark for stating that $\sin 30 = \frac{1}{2}$, which was often seen in a table of exact trig values, or for giving one correct solution. About one third of those who gained the method mark went on to give the two correct solutions.

Question 23

It was pleasing to see some fully correct and well presented solutions to this grade 9 problem. Many students attempted to draw diagrams to help them structure their response. Some of those who did then started to solve the problem by using the equation of a circle and gained the first mark. Some made no further progress but a good number were able to show a correct process to find the y coordinate of Q which gained the second mark. Selecting the negative square root (because **L** has a positive gradient) gained the third mark. Students who used 11 rather than –11 were still able to gain the fourth mark for a process to find the y intercept. This process usually involved finding the gradient of **L** and if the gradient was incorrect then the mark could only be awarded if it could be seen that the gradient had come from a correct process. A significant number of students attempted to solve the problem by using only gradients and scored no marks.

Summary

Based on their performance on this paper, students should:

- communicate clearly when a decision and a reason are required
- develop an understanding of the purpose of rounding so that they can choose appropriate. rounded values when working out an estimate
- become more familiar with the set notation for the complement of a set
- practise applying the rules of indices in problems, including the use of negative and fractional indices
- practise solving problems involving similar triangles
- ensure that axes are correctly labelled on graphs and charts
- practise drawing and interpreting histograms

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