Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

November 2023

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 provided the majority of students with a good opportunity to demonstrate their knowledge, skills and understanding. All questions were accessible to some students. The early questions were generally answered well and there were some good responses to the later questions from the more able students.

Students appeared well prepared for topics such as long multiplication, prime factors, indices and box plots. There were some pleasing responses to Q7, a problem solving question that started with forming and solving an equation. Calculating exactly with π in Q10, finding the equation of a perpendicular line in Q12 and using lengths and volumes in similar figures in Q13 challenged a significant number of students at the ability levels these questions were aimed at. Many students were not able to give correct explanations in Q9 and in Q16.

In the summer series there were too many cases of students miscopying their own figures or misreading the numbers in questions but in working through this paper students appeared to have shown greater care in reading figures. Working was generally presented clearly and logically. When answers were not fully correct examiners could often award some credit for correct methods and processes shown in the working.

REPORT ON INDIVIDUAL QUESTIONS

Question 1

The majority of students used a suitable method to multiply 6.3 by 2.4 and most commonly this was the traditional long multiplication method. Many students gained the first mark for a complete method with relative place value correct and most then went on to get two or three marks. Some students correctly came up with the digits 1512 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 $6 \times 2 + 0.3 \times 0.4$ and gaining no marks.

Question 2

Part (a)(i) was generally answered well. Common incorrect answers were 5 and 0.

Fewer students were able to write down the value of 5^{-2} in part (a)(ii). The most common incorrect answer was –25.

In part (b) many students made a good start by working out $2^5 \times 2^4$ as 2^9 and gained the method mark. Many of these students went on to give 2^6 as the final answer but some wrote $2^9 \div 2^3 = 2^3$ and did not gain the accuracy mark. A common incorrect approach was

$2^5 \times 2^4 = 4^9$ followed by $4^9 \div 2^3 = 2^6$. Although this approach resulted in 2^6 it was awarded 0 marks because the "correct" answer had been obtained from incorrect working.

Question 3

In part (a) a good proportion of students gained two marks for writing 156 as a product of its prime factors, usually by using a factor tree, and relatively few students failed to gain at least one mark. Some students gained the method mark for drawing a correct factor tree with branches ending at 2, 2, 3 and 13 but then failed to write a correct product. Students who showed a complete method but made only one arithmetic error also gained the method mark. When no marks were awarded this was usually because the method was incomplete (often due to thinking that 39 is a prime number) or because there was more than one arithmetic error.

Most students were able to gain the method mark in part (b) but only about half then went on to gain both marks for finding the highest common factor of 156 and 130. A very common incorrect answer was 13 and this gained one mark. Many students chose to draw a factor tree for 130, having already drawn a factor tree for 156 in part (a), and good use was made of Venn diagrams although some students were confused as to which section of the diagram represented the highest common factor. Those students who listed factors or factor pairs of 156 and 130 were less likely to score full marks because they often failed to find all the factors or factor pairs.

Question 4

Some of the students who achieved the first mark in part (a) for a process to find the length of the 5 sticks, 4.2×5, made no further progress. Many, though, did go on to show a complete process, subtracting 7 from 21 and then dividing the result by 4. 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. Sometimes 4.2×5 was evaluated incorrectly but most arithmetic errors occurred with $14 \div 4$. Answers of 3.2 were quite common.

In part (b) a good number of students were able to explain how the answer to part (a) would be affected. Some explanations gained no mark because they said that the mean would be higher but there were many explanations which made no mention of the answer to part (a) or the mean but simply referred to the lengths of the sticks, stating that the remaining sticks would be shorter.

Question 5

In order to gain both marks students needed to construct a 90° angle at P with correct construction arcs shown. Most students were able to gain one mark for drawing a 90° angle at P within the guidelines but relatively few students showed correct construction arcs. It was evident that some students first drew the 90° angle and then attempted to draw construction arcs. Often these arcs were centred at each end of the line, not at points equidistant from P.

Question 6

Many students gained one mark for using angle facts to write an equation such as $y + w = 180$ or $x + x + y = 180$. Further progress then depended on being able to use the ratio $x : y = 2 : 1$

correctly. Those that could deal with the ratio usually went on to give fully correct solutions. A significant number of students, though, could not use the ratio correctly and incorrect statements such as $x = 120$, $y = 60$ or $x = 90$, $y = 45$ were very common. It was disappointing that a large proportion of the students failed to make any meaningful progress with this question.

Question 7

There were a good number of well presented and fully correct solutions. After scoring the first mark for forming a correct equation some students made no further progress but many went on to gain full marks. Some students got as far as finding that the mass of one book is 300 grams but gave this as the final answer and scored 3 of the 5 marks. Many attempts failed at the first hurdle when students could not use the information given to form a correct equation. A common incorrect equation was $3x + 1 = 7500$.

Question 8

Those students who knew how to work out the normal price of the mattress were usually able to complete the arithmetic correctly and gain both marks. Many went from 60% = 660 to either 10% = 110 or 1% = 11 before finding that 100% = 1100. Many students did not recognise this as a reverse percentage question. The most common misunderstanding was to use £660 as 100% instead of 60%, with students working out 40% of £660 and adding it to £660 to get an answer of £924. Some students took £660 to be 40% of the original price and gave an answer of £1650.

Question 9

It was pleasing that more than half of the students were able to draw a correct graph in part (a) to show the relationship between the number of cups of water and the number of cups of rice. Some students gained one mark only, usually for plotting at least two points on the line. In some of these responses the graph passed through (0, 0) and (4, 5) but was not a single straight line and in some cases the points were not joined. Common incorrect answers that gained no marks were straight lines from (0, 1) to (9, 10) and straight lines from (0, 0) that passed through (5, 4) instead of (4, 5).

In (b)(i) a reasonable number of students were able to find the gradient of the line drawn in part (a). Some students made finding the gradient more complicated than it needed to be. Those who drew a triangle below their line and showed a correct method to find the gradient did not gain the one mark available if their answer was not equivalent to 1.25. A few students divided the change in x by the change in y.

Relatively few students managed to explain what the gradient represents in (b)(ii). Some of the incorrect explanations did refer to cups of water and cups of rice but failed to explain what the gradient represents. There were many explanations though that did not mention the context at all and used words such as steepness, ratio, correlation and proportionality.

Question 10

This question was answered quite poorly. Given that a statement such as $\pi d = 10$ or $2\pi r = 10$ was sufficient for the first mark to be awarded it was disappointing that more than half of the students scored no marks. Many of those who did score the first mark were unable to make any further correct progress. It was not uncommon to see $2\pi r = 10$ followed by $r = 5\pi$. Students were awarded the second mark for substituting a correct expression for the radius in πr^2 to give an expression such as $\pi \times \left(\frac{5}{\pi}\right)^2$ for the area. Often this expression was not simplified correctly to show a single value of π and the final mark could not be awarded. Marks were also lost because necessary brackets were omitted.

Question 11

Part (a) was answered quite well with many students scoring at least one mark and a good proportion of students completed both the box plot and the table correctly. A common error was failing to use the given range of 1000 to find the greatest number and this resulted in some box plots with only one whisker. Often vertical lines were drawn inside the box at both 900 and 1000. Some students misread the scale of the box plot, particularly when finding the lower quartile of 780.

Part (b) was not well understood and fewer students than might have been expected realised that Alice saw fewer than 1200 cars on 3/4 of the days. Those who did were almost always able to work out 3/4 of 80 and score 2 marks. Dividing 1200 by 80 was a very common incorrect method. Students should be reminded that box plots effectively divide the distribution of the data into four parts.

Question 12

Some students made a successful start by finding the gradient of the straight line **L** and were then able to find that the gradient of a line perpendicular to **L** is $-\frac{2}{3}$. Having found the gradient of the perpendicular line some made no further correct progress, but many went on to substitute $x = 6$ and $y = -5$ in $y = -\frac{2}{3}x + c$ to work out the value of c. Arithmetic slips were quite common. Substituting $-\frac{2}{3}$, 6 and –5 into $y - y_1 = m(x - x_1)$ gave some students a quick route to an answer. Some students did not take sufficient care over finding the gradient of the straight line **L** and assumed it was 3. These students could gain one mark for showing an otherwise correct method to get to an answer of $y = -\frac{1}{3}x - 3$.

Question 13

This question was very poorly answered. Relatively few students showed that they understood the relationships between lengths, areas and volumes in similar figures. Those who did recognise that they should use the ratio of the heights, 2 : 5, to find the ratio of the volumes or the volume scale factor were usually able to give a complete method to find the volume of solid **B**. Many students worked out the scale factor as 2.5 but the majority then proceeded to use this as their volume scale factor, giving an answer of 30.

Question 14

Students who gained the first mark for interpreting $27^{\frac{2}{3}}$ as $\left(\sqrt[3]{27}\right)^2$ or $\left(\frac{1}{2}\right)^{-3}$ as 2^3 often went on to gain at least two of the three marks for evaluating either 3^2 as 9 or 2^3 as 8.
A good proportion of students evaluated both correctly and gave a final answer of 17. When only one term was evaluated correctly it was more often $27^{\frac{2}{3}}$ as 9. Students encountered more problems evaluating $\left(\frac{1}{2}\right)^{-3}$ and common incorrect values were $\frac{1}{8}$, $-\frac{1}{8}$ and –8. Mistakes in the evaluation of $27^{\frac{2}{3}}$ included $\sqrt[3]{27} = 9$ and $\sqrt[3]{27} = 3$ followed by $3 \times 2 = 6$.

Question 15

When tangents were drawn they were generally accurate and students often went on to gain all three marks for working out an estimate of the gradient that was within the acceptable range. Some answers were given in the form *a*/*b* and the final mark was lost when *a* and *b* were not integers. Many of the students who gained the first method mark for drawing a tangent could not complete the method to find the gradient. Some students were unable to use the scales on the axes correctly and a few students divided the increase in *x* by the increase in *y*. Students who did not draw a tangent at the correct point were still able to access the second mark for a correct method to find the gradient from their tangent. Many students tried to find the gradient without first drawing a tangent, often using the coordinates of the point on the curve at $t = 3$. These students got no marks.

Question 16

In part (a) it was clear that many students did not have a clear understanding of the notation used in the recurrence relation. However, those that did understand the notation and scored the first mark for $6 = 8 \times k$ usually went on to give a complete and fully correct solution. The students who worked with 6 000 000 and 8 000 000 rather than with 6 and 8 tended to make more arithmetic errors. Many students simply assumed that the population decreased by 2 million each year which resulted in the very common incorrect answer of 4 million.

A reasonable proportion of the students scoring marks in part (a) were able to make a correct decision in part (b) and give an acceptable reason. Students needed to justify their decision by linking the increase in the value of *k* to the value of *k* found in part (a). Some of those who made the correct decision could not give an acceptable reason for their answer and consequently did not gain the mark. Many students claimed that as the value of *k* increased, so did the population. This is only true in this specific case as the value of *k* would now exceed 1.

Question 17

Those students who knew how to factorise a quadratic expression often gained both available marks in part (a). Some made an error with the signs, giving an answer of $(2x - 1)(3x + 4)$, and were awarded one mark. Some were awarded one mark for giving two pairs of brackets which when expanded gave two out of three terms correct. Students could be encouraged to multiply out their brackets as a final check – there was little evidence of this taking place. A popular error was to factorise the first two terms and give $x(6x – 5) – 4$ as the answer.

In part (b) many of the students who gained one mark for giving two critical values with at least one correct then gave the critical values as their final answer. Disappointingly few students gave a fully correct answer. Students who drew a sketch of the curve and identified the part which was < 0 were able to give the correct inequality symbols in their final answer. Many students did not realise that they could use their answer from part (a) and started again – often with no success.

Question 18

A pleasing number students made a good start to this probability question, using the two given probabilities to work out the probability that spinner **B** lands on red, and scored the first mark. Almost half of these students then went on to show a complete process and the majority of those that did show a complete process were able to complete the arithmetic and give a correct final answer. Some students gained the second mark for writing at least one correct product but were unable to show a complete process. Probability tree diagrams were very common and helped some students to formulate their solutions. A common error was to use $\frac{1}{24}$ as the probability that spinner **B** lands on red. Students doing this gained no marks.

Question 19

In part (a) a good proportion of students knew how to find an estimate for at least one solution of the equation and gained the method mark for drawing a line from (0, 0.3) to the sine curve. Many, though, were not able to go on and achieve both marks for two correct answers. Usually this was because they did not realise that there are two solutions and only gave the solution in the range 15 to 18. Sometimes it was because they made errors reading from the scale on the *x*-axis.

A reasonable number of students were able to write down a correct value of *x* in part (b). Answers of –20 were slightly more common than answers of 160.

Question 20

This proved to be a challenging question and finding the size of angle *ABC* was beyond most students. The first mark was awarded for using the cosine rule for any angle but many students could not even get that far despite the cosine rule formula being given on the formula sheet. Many lost marks for not using brackets when squaring $5\sqrt{7}$ and this often resulted in 35 as only the $\sqrt{7}$ was squared. Many of those that did correctly substitute into the cosine rule for angle *ABC* could not then rearrange the equation to make $\cos B$ the subject. Mistakes in the order of operations and sign errors were very common. Relatively few students got as far as $\cos B = –0.5$ and many of those that did then failed to give the answer as 120°. Many students showed a lack of understanding of the requirements of the question and attempted to use the sine rule or right-angled trigonometry.

Question 21

In part (a) a number of students recognised $x^2 + y^2 = 169$ as being the equation of a circle and many of these students drew an accurately constructed circle and gained two marks. Quite a few circles were drawn freehand, suggesting that some students did not have a pair of compasses, but these circles were only awarded two marks if they closely approximated to the correct circle. Some students scored a single mark for drawing a circle with centre (0, 0) with an incorrect radius or for attempting to draw a circle with radius 13 and centre (0, 0).

Students were less successful in part (b). Nevertheless, some students scored one mark for drawing the line $2y = 3x$ and they were often able to use the line to find estimates for the solutions of the simultaneous equations. The final mark was sometimes lost because students did not match the values in pairs or because they found the values of x but did not find the corresponding values of y. Students who only scored one mark in part (a) were able to score follow through marks for correct work in part (b). A number of students chose to ignore the instruction to "use your graph" and attempted an algebraic approach. They gained no credit.

Question 22

This proved to be a challenging question with very few students knowing how to work out the value of the common ratio of the sequence. Some of the students who were able to use the 2nd term and 3rd term to write down the common ratio $\frac{13+9\sqrt{2}}{3+2\sqrt{2}}$ made no further progress but it was pleasing that there were others who showed a complete process and went on to gain full marks. When attempting to rationalise the denominator errors were sometimes made in expanding terms, most commonly in the numerator. One error was condoned for the third mark. Many students did not know how to use the 2nd term and 3rd term to find the common ratio.

Summary

Based on their performance on this paper, students should:

- practise their arithmetic skills, particularly division and operations with decimals
- consider whether or not an answer to a calculation is of a sensible size
- take care when interpreting the scales on the axes of graphs
- practise using the standard ruler and compass constructions
- understand the difference between standard and reverse percentage
- practise using the relationships between lengths, areas and volumes in similar figures

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