Examiners' Report
Principal Examiner Feedback

November 2017

Pearson Edexcel GCSE (9 – 1)
In Mathematics (1MA1)
Higher (Calculator) Paper 3H

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GCSE (9 – 1) Mathematics – 1MA1
Principal Examiner Feedback – Higher Paper 3

Introduction

There were some able students who made good attempts at most of the questions on the paper but many of the later questions were often not attempted because the majority of students were targeting the lower grades.

It was pleasing that many of the students showed clear steps of working on this calculator paper. Centres should continue to emphasise the need to show full working. It is often apparent that a calculation has been performed but unless values are correct, part marks cannot be awarded for processes not shown.

Some students lost marks through not reading questions with sufficient care. Errors were made because students made 'assumptions' rather than reading and using the information that was given to them.

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. Questions that assessed problem solving techniques, even ones early in the paper such as Q4 (application of ratios) and Q6 (deriving and solving an equation), were poorly attempted.

Unnecessary early rounding or truncating, on this calculator paper, gave rise to inaccuracies.

Report on individual questions

Question 1

Part (a) was not answered particularly well. A common error was to choose the class interval $150 < h \leq 160$ which is in the middle of the five class intervals in the table. Some students chose the class interval $170 < h \leq 180$, often because 19 is the median of the five frequencies.

Part (b) was not answered as well as might have been expected considering that frequency polygons have featured regularly on examination papers for a number of years. Points were frequently plotted at the ends of the intervals or at the beginnings of the intervals rather than at the midpoints. Many students did join their points with line segments; some joined them with a curve and some did not join them at all. Some otherwise correct frequency polygons were spoilt by students joining the first point to the last point. A number of students drew histograms.

Question 2

Many students did make some headway on this question and it was attempted in a variety of ways. Some students used one of the given costs to find a comparative value, eg changing 108.9p per litre into \$6.01 per gallon which could then be compared with the cost in New York. Other students used both given costs to find comparative values, eg changing 108.9p per litre into £4.12 per gallon and changing \$2.83 per gallon into £1.94 per gallon. Mistakes were often made with the conversions, eg dividing by 1.46 instead of multiplying by 1.46, and some students wrote 108.9p as £1.89. Students attempting to work out the cost (in \$) per litre in New York often did the division the wrong way round. It might help students to clarify their thinking if they included units with their values, eg \$2.83 per gallon, not just 2.83. Those students that did find comparative values usually made the correct decision but it was common for students to make a decision without having found values that could be compared. A few students made the wrong decision despite having correct values. Students had to deal with two conversion factors and they did not always present a clear picture of what they were trying to do.

Question 3

Many students were unable to use volume = mass ÷ density. A very common error was to multiply the mass by the density in an attempt to find the volume and some students divided the density by the mass. Those that did use volume = mass ÷ density frequently gained only one mark because they gave no consideration to the units or because they dealt with the units incorrectly. Many students forgot to multiply by 1000.

Question 4

Students found this question challenging. In order to make progress they needed to associate corresponding parts from the two ratios in a way that would help them. Some students did write down a ratio equivalent to 2 : 5 and a ratio equivalent to 4 : 1 but often the components for green pens were not the same. Those that did write down the ratios 8 : 20 and 20 : 5 or the ratio 8 : 20 : 5 were often able to go on and work out the greatest possible number of red pens. Some students went from 8 : 20 : 5 to 16 : 40 : 10 and finally to 24 : 60 : 15, the last figure being the number required, and a few went from 8 : 20 : 5 to calculate $\frac{5}{33} \times 100$. Some partially correct ratios such as 8 : 20 : 4 were seen but these gained no credit. A very common error was for students to start the problem by adding the numbers in the ratios, working out 2 + 5 = 7 and 4 + 1 = 5.

Question 5

In part (a) many students were unable to find the value of the reciprocal of 1.6 and a wide variety of incorrect responses were seen.

In part (b) one mark was often scored for showing 9.75 or 9.85 or both of these values but relatively few students went on to give a fully correct error interval. Those that attempted to write an error interval frequently made mistakes with the inequality signs. Some students used 9.84 rather than 9.85. Those that wrote the upper bound as 9.849 failed to indicate the recurring nature of the final digit.

Question 6

It was pleasing that some good attempts that used an algebraic approach were seen though these were relatively few in number. Some students wrote x and $x + 7$ on the diagram of the rectangle but made no further progress. Successful attempts generally started with students writing expressions for the lengths of the sides on the diagram of the 8-sided shape. The most common mistake at this stage was for the two lengths of 7 to be incorrect or missing. Students often went on to write down an expression for the perimeter of the shape and equate this to 70. Those that formed an equation were usually able to solve it correctly. The final mark was awarded if students used their value of x correctly to find the area of the 8-sided shape. A common mistake was to multiply the area of one rectangle by 8 (number of sides). A few students mistakenly used $7x$ instead of $x + 7$. Trial and improvement approaches were seen; they were usually unsuccessful and so gained no marks.

Question 7

This question was well attempted. The main obstacle to a correct answer for many students was the inability to write 7.452×10^{-4} as an ordinary number. In many responses 7.452×10^{-4} was either converted incorrectly to an ordinary number or given as the final answer. Many students scored one mark for showing the digits 7452. Although the calculation is one that can be entered directly into a calculator there were a number of students who attempted, often unsuccessfully, to first write the numbers in the question as ordinary numbers.

Question 8

Students who identified Mel in part (a) did not always give a correct reason. Some referred to her having the greatest number of points up, not to her having done the most trials. Tom was identified by some students because his results give the greatest probability of getting point up or because his results have the smallest difference between the number of points down and the number of points up.

In part (b) students were expected to use all the results to find the fractions $\frac{100}{150}$ and $\frac{50}{150}$ and to then multiply these two fractions. Many students did find these two fractions. Those who simplified them to $\frac{2}{3}$ and $\frac{1}{3}$ often went on to multiply but most students did not multiply the two fractions. Many students added rather than multiplied. A few students used the results from just one of the three people but they could be awarded the method mark if they multiplied their two fractions to find the probability of point up followed by point down. Some students lost the accuracy mark because they gave the answer as 0.2. A decimal equivalent to a probability should be written to at least 2 decimal places (unless tenths).

Question 9

Part (a) was answered quite well. Students were often able to substitute at least one value of n into $12\,500 \times (0.85)^n$ and gain the first mark. For some students this was just substituting $n = 1$ to get 10625. Some of those that showed enough correct further substitutions to answer the question chose the wrong number of years. Some used parts of a year, giving an answer such as 4.27, and could be awarded only one mark. A number of students just found 50% of 12500 (= 6250) and scored no marks.

Students were much less successful in part (b). Those who recognised that 79.20 = 60% of the interest before tax were sometimes able to work out the interest before tax. A common mistake was to work out 40% of 79.20 and then add the result to 79.20. Some students worked out the interest before tax as £132 but then stopped. Those that did attempt to work out 132 as a percentage of 5500 did not always complete the final step, giving an answer of 1.024 or 0.024 rather than 2.4. Some students started the question by working out 40% of 5500 as 3300. Although a small number of these students went on to give complete solutions most failed to make any further progress. Many students did not know how to start the question.

Question 10

In part (a) many students worked out the probability of getting a red counter as 0.05. A common incorrect answer was 0.5, often with 0.95 or 1 – 0.95 shown in the working.

Part (b) asks for the least possible number of counters in the bag. Students are advised to read the question carefully as a surprisingly large number gave a colour, not a number, as the answer. Sometimes they gave the lowest probability. Some students worked out the least possible number of counters as 20 but gave no reason for their answer; they scored one of the two marks. The most common correct reasons given referred to the numbers of counters having to be whole numbers. Some students gave a number greater than 20 as the least possible number of counters but scored one mark for a correct reason.

Question 11

In part (a) many students correctly read the value of the median from the cumulative frequency graph. Common incorrect answers were 60, 38 and 55.

Correct answers were rarely seen in part (b). Most students either stated that Jamil is correct because the range is the largest value minus the smallest value or stated that he is incorrect because his calculation should have been 80 – 30 = 50. Very few students appreciated that the greatest value could be less than 80 or that the smallest value could be less than 40.

Many students gained one mark in part (c) for reading from the graph. This was usually done from a weight of 65g and resulted in a cumulative frequency value of 48 or 49. The successful students subtracted this value from 60 to find the number of potatoes with a weight greater than 65g and then either worked out this number of potatoes as a percentage of 60 or worked out 25% of 60 (15). A common error was failing to subtract the reading from 60. Some students got no further than reading from the graph.

Question 12

Working out 0.75×0.4 to get the probability of both spinners landing on white and working out 0.25×0.6 to get the probability of both spinners landing on red gained the two method marks. Some students found only one of these probabilities, usually the former, and scored one mark only. A number of those students who did work out both probabilities failed to spot that 0.3 is double 0.15 and therefore the answer will be double 24. Some students used 0.15 and 24 to work out that the total number of spins is 160 and were then often able to get the correct answer. A common error was to add the probabilities instead of multiplying them.

Question 13

Those students with some idea about completing the square were often able to score one mark for $(x + 3)^2$ but errors were frequently made with the '– 16'.

Question 14

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 volumes, 27 : 8, to find the ratio of the lengths or the length scale factor were usually able to give a complete method to show that the surface area of cone B is 132 cm^2. Many students assumed the result they were given instead of proving it.

Question 15

In part (a) those students that gained the first mark by substituting two appropriate values into $x^3 + 7x - 5$ often failed to make a deduction about the roots. Students seemed to think that getting one positive answer and one negative answer was sufficient. Many students had no idea how to show that the equation has a solution between $x = 0$ and $x = 1$. Attempts at using the quadratic equation formula were very common.

Many students were able to gain one mark in part (b) by showing a correct first step in the rearrangement, most commonly this was $x^3 + 7x = 5$. Many, though, were then unable to continue with the rearrangement by using factorisation and show a complete method.

When answers were seen in part (c) it was evident that some students had a good appreciation of the process of iteration and they were able to gain the first method mark for substituting the starting value of 1 into the formula. When the results of the next two iterations were not accurate the second method mark could only be awarded if the substitutions were shown. Rounding or truncating the value of x_2 resulted in some final answers that were not sufficiently accurate. Some students carried out more than three iterations. In these responses the accuracy mark was awarded for the value 0.6704 and any further iterations were ignored.

Part (d) was poorly answered. Those students who did gain one mark for substituting their answer to part (c) into $x^3 + 7x - 5$ rarely compared the result of the substitution with zero to determine the accuracy of their estimate. Even when the correct value was substituted the result of the substitution was often incorrect.

Question 16

Most students failed to identify from the question that they needed to work with bounds and it was very common to see 11.8 and 148 substituted into the formula for petrol consumption. There were no marks for this approach which completely ignored the topic that the question was actually assessing. Identifying at least one upper bound or one lower bound was sufficient for the first mark. A few students used 148.49 instead of 148.5 but made no attempt to show that the 9 is recurring. Some students with the correct bounds did not appreciate that they needed to use the upper bound for litres of petrol and the lower bound for distance. Some substituted the two upper bounds or the two lower bounds into the formula. Those that did substitute the two correct bounds usually went on to make the correct decision.

Question 17

In order to start this question and work out the length of *CD*, students needed to recall that the area of a triangle is given by $\frac{1}{2}ab\sin C$. Those that did recall this correctly often gained the first mark for writing a correct statement such as $0.5 \times 11 \times CD \times \sin 105 = 56$. Mistakes, though, were often made when rearranging to find *CD*. Those students that did not show a correct process to work out *CD* were still able to gain subsequent process marks - one mark for using the cosine rule to work out *AC* and one mark for using the sine rule to work out *AB*. A number of students assumed that the triangles were right-angled and tried to find *CD* by using base (*AD*) × height (*CD*) ÷ 2 = 56. It was not uncommon to see students attempting to use Pythagoras and SOHCAHTOA when trying to work out the length of *AC*.

Question 18

In part (a) relatively few students appreciated that working out an estimate for the distance the train travelled required them to find the area under the curve. Those that did usually showed 4 strips of equal width on the graph and made an attempt at working out the area. Some very good answers were seen but attempts were often spoilt by values being read incorrectly from the graph or by the formula for finding the area of a trapezium being used incorrectly. Some students worked with rectangles and triangles, often successfully. Many students, though, simply used distance, speed, time formulas and finished with wrong answers of 320 or 360.

Part (b) was only accessible to those students who had attempted to work out an area in part (a). Some students did state that their estimate was an overestimate and gave a reason linked to their method. However, many of the reasons given had nothing to do with the method used to work out the area.

Question 19

Some students rearranged the equation of the straight line to make either x or y the subject and those who realised that they needed to solve the equations simultaneously then substituted into the equation of the circle. Mistakes were often made when expanding the brackets and when simplifying the resulting quadratic equation. Students usually solved the quadratic equation to show that the line and the circle only intersect at one point although in a few responses the discriminant was used to show that there is only one solution. Some students solved the equation but made no concluding statement about how this proved that the straight line is a tangent to the circle and they were not awarded the final mark.

Question 20

Some of the students that started by drawing in the radius *OC* to give two isosceles triangles were able to go on and show that angle *ACB* = 90°. Some did so by introducing algebraic notation whereas others used angle notation. It was pleasing to see some very good attempts but these were few in number. Students should note that this type of geometric proof does require full and correctly worded reasons to be given. It is not enough to state, for example, that angle *OAC* = angle *OCA*, it is also necessary to give a reason why. Those students that showed that angle *ACB* = 90° but gave no reasons or incomplete reasons were awarded 3 of the 4 marks. Some students ignored the statement "You must **not** use any circle theorems in your proof" and focused on angles in a semicircle.

Question 21

Some students scored one mark for *AB* = **b** – **a** or *BA* = **a** – **b** but few were able to make any further meaningful progress. Those that did were most likely to find a correct expression for *MN*. Few students wrote that *AP* = *k*(**b** – **a**) which meant that correct expressions for *MP* and *PN* were rare. Mistakes were sometimes made with the direction signs of the vectors.

Summary

Based on their performance in this paper, students should:

- Read the information given in each question very carefully.
- Practise solving problems that require an algebraic approach.
- Use a calculator to work out accurate values without rounding or truncating early.
- Practice using their knowledge in different ways and in a wide variety of contexts.
- Recognise which rules and theorems are associated with triangles without a 90^o angle and use them appropriately.
- Give correctly worded reasons when presenting a geometric proof.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
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