Pearson

Examiners' Report
Principal Examiner Feedback

Summer 2017

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

A significant minority of candidates found this paper difficult, and were clearly unprepared for some of the questions. In this reformed GCSE examination they would probably have been better entered at Foundation level, where accessing a greater number of marks would have given them a more rewarding, and probably productive, experience.

But there were many able candidates who were able to make a good attempt at most of the questions on the paper. Performance was not always consistently good across the paper, but with a good range of questions the paper was able to discriminate well. Questions towards the end of the paper were designed for the most able aiming towards grades 8 and 9, so it was inevitable that these would be out of reach of the majority of those entered for this paper, even at Higher level.

Weakest areas included algebraic manipulation and derivation, percentage calculation and application of ratios and proportion.

Questions which assessed the use of mathematics across a range of aspects of the specification were sometimes done poorly, such as Q14 and Q18, but in other cases done well, such as in question 5. There was also inconsistency of approach to questions that might be considered more traditional where the process of solution might be considered predictable, such as poor attempts in Q7, Q20 and Q13, yet good attempts at Q2, Q3 and Q17. There were far fewer attempts using trial and improvement approaches, but inevitably poor arithmetic skills, even at the level of a lack of knowledge of multiplication tables, cost candidates marks on this non-calculator paper, even for the brightest candidates.

The inclusion of working out to support answers remains an issue for many; but not only does working out need to be shown, it needs to be shown legibly, demonstrating the processes of calculation that are used. This is most important in longer questions, and in “show that” questions. Examiners reported frequent difficulty in interpreting complex and poorly laid out responses in Q14, Q15, Q19 and Q20

Report on Individual Questions

Question 1

This was a well answered question. In part (a) nearly all candidates correctly identified the outlier; there were only a few who reversed the coordinates.

In part (b) it was again very common for the mark to be awarded; candidates who exemplified their statement of "positive" with additional statements (eg strong, hard) were not penalised as long as there was no contradiction.

In part (c) the majority of candidates successfully found a correct prediction within the required range. Mistakes were usually due to incorrect reading of the scales. The candidates that drew an appropriate line of best fit usually went on to score full marks. A few candidates drew a horizontal line from the vertical axis but often misread the scale and plotted at 16.2

In part (d) many stated positive correlation or gave two relevant sets of points to show it was true. Occasionally an explanation of the relationship was lacking, with a few candidates stating that it did not prove the statement due to the outlier.

Question 2

The most common approach was to create a factor tree. Many candidates opted to start with 8 and 7 and then correctly completed this approach. Poor arithmetic stopped some candidates from gaining full credit but they were able to pick up a method mark for completing their tree to prime number ends provided there was only one error. Many candidates were able to express the prime numbers as a product, but some lost the final mark by writing the prime factors as a list. Some candidates chose to use index notation to tidy up their final answer; this was not required to score full marks and any errors in doing this were not penalised.

Question 3

Most candidates attempted this question using partitioning, Napier's bones or vertical methods. Usually when candidates made arithmetical errors they were still able to score two out of the three marks by giving an answer with the decimal place correctly positioned, if this followed a correct method. Candidates who tried to answer this question by a less formal method were not as successful often doing only a partial calculation such as 54×4 and 0.6×0.3 gaining no marks. Some candidates correctly came up with the correct digits 23478 but placed the decimal point incorrectly usually to give 23.478

Question 4

Many candidates started by attempting to multiply the 2 side lengths algebraically. Most candidates were successful after starting with this approach, setting the sum of their expansion equal to 10 and re-arranging. A significant number started by finding the areas of each of the 4 sections on the diagram, then forming an equation equal to 10 or concluding that the 3 algebraic areas would sum to 1, but some candidates failed to show sufficient working when using this latter approach. Of those unable to gain full marks, many secured the first mark for showing at least two correct area expressions or forming an initial algebraic expression for the area i.e. $(x + 3)(x + 3)$. The most common incorrect approach was finding the side length as $3x$. Candidates should be encouraged to write down what they can see in a 'show that' question, making clear where expressions have come from and annotating in a clear manner.

Question 5

A significant minority of candidates found the area of the rectangle and then multiplied this by the 1.5, gaining no marks. However the majority who used Pythagoras's theorem were successful in at least gaining the marks for a Pythagorean approach; some were unable to state the square root of 169. Many were able to go on and complete the question, though there were arithmetic errors, whether candidates found individual masses and added, or added the lengths first and multiplied by 1.5. When applying the latter method those finding it as 47+ 23.5 were more successful than those attempting to multiply 47 by 1.5. Some divided by 1.5 instead of multiplying while others included the diagonal twice, but overall this question was very well answered. Candidates need to read the question carefully; for example, an error for some was not appreciating that this was a rectangular frame as attempts to find the area were seen.

Question 6

Most candidates understood the need to manipulate to get the two equations into the same form. The majority preferred to rearrange to make y the subject. Many began with L_2 and gave $3y = 9x - 5$ thus gaining the first method mark for starting to manipulate an expression. They then divided by 3 which successfully gave them two equations in the same form and gained the second mark. It is interesting that many candidates wrote $\frac{5}{3}$ as a decimal - seemingly more comfortable to work with decimals than fractions even for this non-calculator question. Even more usual was for the division by 3 not to be applied to the constant. Often the constant term was incorrect but this was condoned as it was irrelevant to proving the lines parallel. Another successful route was to multiply L_1 by 3 and subtract $9x$. This often resulted in the constant term having an incorrect sign, again condoned.

Question 7

Generally a well answered question, with many fully correct responses. If candidates knew how to get started with this question they usually progressed to gain full marks. Many candidates could calculate 30 × 60 but fell down on the multiplication of 54 × 20. Very few used an alternate method. The number 66 was seen as the answer in a number of cases where candidates did not appreciate the difference in the number of boys to girls. A very small handful of responses showed an excellent level of ratio knowledge.

Question 8

In part (a) there were many correct responses, but sometimes spoilt by insufficient care taken to count zeros. Only a few took the unnecessary step of rounding the 7.97, thereby rendering their answer incorrect.

In part (b) a large number of candidates had problems dividing 2.52 by 4 or they left it as a fraction without any calculation attempted. It was also common to see the 2.52 and 4 multiplied to 10.08. There was more success dealing with the indices, though $10^5 \div 10^{-3}$ was sometimes given as 10^2. It was not always clear whether this was a failure to deal with subtracting a negative number, or if addition was being applied rather than subtraction. Some candidates left their answer as 0.63×10^8.

Question 9

The most common misunderstanding was to use £600 as 100% instead of 120%, with many candidates working out 20% of 600 and subtracting to get £480. Some thought that as £600 was 120% they had to find 80% of £600 to get back to the original value. These candidates also got £480 as their answer. Quite a few candidates found 1% (from 600 ÷ 120), then 10% as £50, then subtracted it from 600 to get £550. Other candidates lacked the skills to work out 600 ÷ 1.2 (600 ÷ 1.2 = 600 ÷ 12 = 50 was seen). Good candidates checked their work. If they first of all got £480, they found 20% as £96 and realised that it didn't work (480 + 96 ≠ 600 or 600 − 96 ≠ 480). They then corrected themselves and checked again, just to make sure. It was the good practice of checking the working by taking their answer and adding 20% that saved them two marks.

Question 10

As this question only involved positive terms most candidates were able to successfully expand a pair of brackets usually the first two brackets $(x + 1)(x + 2)$ although a few still made arithmetical errors with multiplying simple values like 1 × 2 and writing 3 as their answer. Once one set of brackets had been expanded candidates generally seemed to be able to then expand this over a third bracket and were more successful when systematically multiplying each term across the bracket. They usually also then went onto get the second method mark for at least half the terms written correctly. There were some candidates who tried to do all three brackets in one step, usually leading to few marks being awarded.

Candidates needed to be careful in copying their own work, often losing a mark when re-writing their answer out incorrectly in the next stage of their working. For example, having given x^3 in their second stage of working, ending up writing $x^2 + 6x^2 + 11x + 6$ as their final answer.

Question 11

In part (a) the turning point was well understood, with nearly all candidates gaining this mark.

In part (b) most candidates knew they had to read off the values at the intersection of the curve with the x axis, but in part (c) the use of function notation confused a significant minority, who failed to give an answer; those who understood usually went on to read off from 1.5 as intended.

In both parts (b) and (c) it was the most basic of errors that lost candidates marks. This included those who mis-read the scale, those who failed to include negative sings when needed, and those who gave coordinates as the roots rather than the values of x.

Question 12

In part (a) many candidates knew to use the reciprocal or to find the square root of 81 and were rewarded with a method mark. The correct value was seen less often.

Part (b) was less successful with candidates required to show the need to both cube root and square to score the method mark. Of the candidates that did find the cube root of the fraction some then chose to double their numerator and denominator rather than square the values. Perhaps encouraged by part (a) some candidates incorrectly used the reciprocal at some point.

Question 13

The major errors made on part (a) were to get the wrong proportional formula. $y=kx^2$, $y=\frac{k}{\sqrt{x}}$, $y=\frac{k}{x}$ were all seen. Occasionally the proportional symbol, was not replaced by =, and occasionally $y=\frac{1}{x^2}$ was seen with no reference made to a constant. Several candidates gave their final answer as $y=\frac{k}{x^2}$ but, if they gave their value for *k* elsewhere, they were still able to get full marks in part (a) for this question. A small number of times candidates gave an equation for x (or x^2) in terms of y on the answer line, forfeiting a mark.

Having got full marks in part (a), the most common problem in part (b) was not being able to solve $16 = \frac{9}{x^2}$. $x = 12$ was a popular answer from $x = \sqrt{16\times9}$

A few left their answer in square root form, typically $x = \sqrt{16 \times 9}$. Others tried to work out 9 ÷ 16 (or even 16 ÷ 9) before finding the square root which inevitably led to problems.

Question 14

This proportional reasoning problem proved a step too far for many candidates. Most were unable to access the question and chose to add the ratio parts for circles to incorrectly express as a fraction of the total ratio parts. Candidates that had some idea of what they needed to do often incorrectly multiplied the fraction of white circles by the fraction of black circles. Of the few candidates that were successful, most took a fractional approach and realised that they needed to multiply the fraction of white shapes by the fraction of white circles and add that to the fraction of black shapes multiplied by the fraction of black circles. Other candidates chose to use a nominal total to calculate the relevant fractions, however some could not overcome the difficultly this posed when 30% of their chosen total was not a multiple of 9 or when 70% of their chosen total was not a multiple of 7

Question 15

Candidates had varying degrees of success with this question. Many did much of the work using the original values and introduced estimated values only after they had completed nearly all their manipulation. When substituting the values into the formula, many omitted to square the radius. A significant number of candidates failed to write out a full equation, many calculating individual parts as opposed to using the given formula. There was poor rearrangement of the equation sometimes ending with subtraction rather than division. π = 3.14 was common, but without estimating this as 3 they then had difficulty cancelling π with $\frac{1}{3}$; many kept 98 rather than rounding to 100. Those who gained full marks usually gave an answer of "4" from a calculation of 100 ÷ 25, because the actual working here was very simple for those who recognised what the question was asking. In many cases working was often poorly set out and difficult to follow. Candidates need to consider how they present their solutions. Using a systematic and logical sequence of steps leading to a final answer is highly recommended.

In part (b) only the most able candidates were able to explain concisely the result of their division, which required a real understanding of the effects on calculation of rounding in both the numerator and denominator. Reference to the numerator and denominator was rarely seen. The majority stated that if they rounded more values down than up then their answer would be less, or that John would be more accurate as he had used a calculator.

Question 16

Numerical solutions were attempted, despite the instruction being given to prove algebraically, which could not be awarded any credit. Almost all algebraic attempts correctly expanded the brackets for one mark but then failed to arrive at the correct expression for the second mark as they incorrectly dealt with the negative in front of the bracket. The final mark was available and largely awarded to those candidates who concluded by justifying their final expression as even; it was definitely easier to justify that the expression was even if the student factorised by putting 2 outside of the bracket and concluding it was therefore always even. Those that did not factorise needed to conclude by explaining that since both are even numbers (or multiples of 2) the expression is always even.

Question 17

A correct answer of $\frac{28}{72}$ or $\frac{7}{18}$ was obtained by a large proportion of candidates gaining full marks; incorrect simplification of an otherwise correct answer was not penalised. Candidates were usually able to pick one mark up for writing a fraction over 8, showing understanding that the counter was not replaced. Where marks were lost this tended to be for common errors such as using a method that involved replacement, or incorrect processing of the fraction such as addition of the fractions done incorrectly, or writing only one of the fractions rather than adding them. Some candidates used fractions with a denominator of 9 on their first branches and then a denominator of 7 on their second set of branches which then failed to score them any marks.

Question 18

Many candidates picked up a first mark by realising that the diagonals on a rhombus intersect at right angles. This was either shown on the diagram by inserting right-angles, by a statement, or by a correct start at using $-\frac{1}{m}$.

Common errors with the gradient of AC involved giving the gradient as $-\frac{1}{2}$ (negative of $\frac{1}{2}$) or 2 (the reciprocal of $\frac{1}{2}$). Many candidates missed an easy mark by not stating the gradient of DB as $\frac{1}{2}$; they went on to give the gradient of AC as $-\frac{1}{2}$ or 2 so they must have used the $\frac{1}{2}$ to get their gradient, but it was not stated. Some candidates thought that the intercept should be +6 as in the equation of DB, whilst other candidates thought it should be −6. Those candidates who got as far as $y = -2x + c$ then made often mistakes with their substitution or subsequent manipulation. For example, having got to $11 = -10 + c$, they then stated $c = 1$ (or sometimes $c = 22$).

Question 19

Those candidates who were able to understand the problem scored the first mark for correctly adding *X* and *D* to the diagram or by making a relevant correct first step; expressing vector *AD* in terms of **a** and **c.** Many candidates that got this far were able to start to use a vector equation using vector *CD*, however some candidates expressed this incorrectly by using incorrect signs that stopped any further progress. Of those candidates who were able to show that vector *CD* was 2.5**c**, some were perplexed as to how they related this to the proportional part of the question. Of the candidates who were able to recognise the proportional connection, they often left their final solution as 1 ÷ 2.5 and lost the final accuracy mark.

Question 20

A minority of candidates incorrectly took the square root of the first equation to give $x + y = 5$ or attempted to square the second equation. They were therefore unable to gain any marks.

Most candidates correctly rearranged the second equation and substituted $y = 13 + 3x$ into the first equation, thus gaining the first method mark. They then usually expanded this correctly for further credit although a significant number of candidates expanded $(3x + 13)^2$ as $9x^2 + 169$. A minority of candidates failed to write the quadratic in a form that could be solved, but tried to solve their expression equal to 25. A quadratic equation was presented by many attracting the third method mark, frequently the correct quadratic equation, but the factorisation proved to be beyond many. Even those who managed to factorise found it difficult to proceed to the four values in the final solution. Many attempted to use the quadratic formula rather than factorise which resulted in the usual confusion over signs, though this was eased as all the terms of the quadratic were positive. Very few successful attempts at completing the square were seen. The final mark was rarely awarded as it involved finding all four correct values given as two associated pairs. For a complex question it was reassuring to see so many candidates have the confidence to make a real effort and often pick up most of the marks.

Question 21

Very few candidates were prepared for this question. It was common for candidates to gain two marks for attempting to use the information given in the question, that is *AB* = *CD* and *ABC* = *BCD* but they usually omitted to state *BC* was shared or common to both. Many used the wrong pair of triangles for their congruent pair and some thought that the equal symbols on *AB* and *CD* meant they were parallel. Candidates often omitted essential detail to complete a formal proof for congruence so failing to get the final mark.

Question 22

This question was set as a differentiator for those aiming for grade 9, so it was not unexpected to find that many candidates did not answer the question at all. Others found every angle going in order to get something down on paper. Several candidates tried to use circle theorems to help them, particularly 'the angle at the centre is twice the angle at the circumference' even though there was no circle. Some attempted to work backwards, but unless they realised a connection with the Cosine Rule it was unlikely any marks were earned. Some thought that the 10 cm was the length covered by *BAP*, so that $AP = 10 - x$.

Some candidates picked up a mark for stating cos 30 = $\frac{\sqrt{3}}{2}$, but not all of those who wrote down a value for cos 30 got it correct. Some didn't know the cosine rule well enough, or couldn't rearrange it to get cos *PBQ*. At this level, candidates need to either label their diagrams clearly or use proper terminology for the sides and angles in the formula in order to make their work easier to follow. Many stuck to the a, b and c in the formula $a^2 = b^2 + c^2 - 2bc\cos A$ despite these letters being used for other lengths/angles on the diagram.

There was some assumption that cos *PBQ* = cos 30. It was either substituted on the LHS of the formula they had to prove, or substituted in to the cosine rule they were using to find *PQ*, usually shown as $PQ^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \times \cos 30$, despite the sides of length 10 and the angle 30 being from different triangles. Despite all of the above, there were some extremely well presented solutions.

Summary

Based on their performance on this paper, students should:

- present their work logically and in an organised way on the page, sufficient that the order of the process of solution is clear and unambiguous
- include working out for all questions where appropriate
- practise their arithmetic skills and learn multiplication tables; these are essential particularly on a non-calculator paper
- practise algebraic manipulation and derivation, percentage calculations and application of ratios and proportion
- spend more time ensuring they read the fine detail of the question to avoid giving answers that do not answer the question.

Grade Boundaries

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