Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2019

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

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Summer 2019
Publications Code 1MA1_3H_1906_ER

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

Introduction

Most students entered for this examination presented their working in a clear and logical way and worked accurately to demonstrate a good performance overall. Questions where this was not quite so evident included Q6 (surface area) and Q20 (simultaneous equations). Only a small proportion of students presented weak scripts, suggesting that most students who sat this paper were entered appropriately for the higher tier.

The paper gave the opportunity for students of all abilities to demonstrate positive achievement. All questions were accessible to some students but as you would expect there were relatively few students able to work confidently on all questions.
In particular, Q1 (Venn diagram), Q7 (use of a calculator), Q8a (Pythagoras's Theorem), Q11 (speed, distance, time) and Q18a (cubic expansion) were answered well by a large majority of students whereas Q14 (using areas and ratio), Q18b (solution of a quadratic inequality), Q20 (simultaneous equations), Q22 (circle problem) and
Q23 (trigonometry) proved more of a challenge to students.

The time allowed for the examination appears to have been sufficient for most students to complete the paper.

Report on Individual Questions.

Question 1

This question provided a good start to the paper. Nearly all students gained some credit for their answers with most students scoring at least four of the five marks available. Part (a) of this question requiring students to complete the Venn diagram was generally well done though some students did make careless errors when placing the numbers within set A and/or set B. A significant number of students wrote all of the numbers 1
to 9 in the region $(A \cup B)'$.
Part (b) of the question was answered quite well and many students benefited from the mark scheme which allowed a follow through from part (a). It was not unusual for students to gain part marks in part (a) followed by full marks in part (b). Some students reverted to using the sets listed rather than their Venn diagram to answer part (b). A common error was for students to give $\frac{6}{9}$ as their answer to this part presumably because students had confused intersection with union.

Question 2

This question was a good discriminator. About one third of students entered for the examination scored full marks for their responses to this question testing compound interest. Students generally used a multiplier approach though students frequently used an incorrect multiplier, for example 1.15 A very common error was for students to give 212272.71 as their answer, the total value of the savings after 4 years and not the interest earned over the period. This answer was awarded two of the three marks available. A great majority of students got at least one mark for the interest earned in the first year. Very few students lost the accuracy mark for not using correct money notation, that is for giving an answer to more than 2 decimal places.

Question 3

A majority of students scored full marks on this question. The most common error seen in part (a) was to give $30 < h \leq 40$ as the class in which the median lies. Common errors in drawing the frequency polygon included plotting points at the upper or lower boundary of each interval instead of the midpoint and joining the points with a curve, not straight lines. Points were generally carefully plotted at the correct heights.

Question 4

This question was quite well answered and descriptions of the things wrong with the time series graph were generally well described. There were a variety of possible acceptable answers but students needed to state them clearly and unambiguously. For example, “the axis does not start at 0” would not be worthy of any credit but “the y axis does not start at 0” would score a mark. Similarly, “the scale on the x axis” would not be enough but “it is not clear what the 2, 3, 4 on the x axis means” would get a mark. A number of students stated there should be a line of best fit drawn. This was not an acceptable response.

Question5

A good discriminator, this question attracted many concise and fully correct solutions. Despite there being a number of possible routes that students could take, there were also many incorrect or incomplete solutions. The most common approach was to use the total of the angles in a hexagon together with the relationship between angles *BCE* and *CDE* to work out the size of angle *AFE*. The most commonly seen alternative route was to use the symmetry of the hexagon to form two pentagons and work from there. A minority of students joined the points *F* and *C* and found the size of angle *BCE*. These students did not usually make significant further progress beyond labelling angles *BCD* and *CDE* as $2x$ and x respectively. A surprising number of students marked angles *BCD* and *CDE* as x and $2x$ respectively. In most cases, however, labelling of the diagram proved to be a help to students and is to be encouraged. About two in every five of students obtained full marks for their solution to this question.

Question 6

This question was also a good discrminator. Unfortunately, a significant proportion of students calculated the volume of the cylinder rather than the surface area and so could not be awarded much credit for their responses. However, there were many fully correct and complete solutions usually comparing the total surface area of the 3 tanks with the total surface area which could be covered with 7 tins of paint but sometimes comparing the number of tins of paint needed to paint the three tanks with the 7 tins of paint available to Jeremy. A good proprtion of students calculated the surface area of only one end of the cylinder or tried to combine the area of one or two ends with a volume or with an incorrect “area” found by calculating 1.6 by 1.8. It was pleasing to see that students often worked with exact expressions in terms of π, thus avoiding the need to round values in intermediate working and minimizing the risk of errors when calculating and writing down decimal values from calculators.

Question 7

This question was done well by the great majority of students who were awarded both marks. Some students gave an answer of 0.32 believing this was correct to 3 significant figures. These students were given full marks provided they had shown a more accurate version of the answer in the working space. The request to give the answer correct to 3 significant figures served as a guide to students and correct answers given to more than 3 significant figures gained full credit. Students are therefore advised to write down their full calculator display before rounding.

Question 8

A large proportion of students were able to score at least one mark for their responses to this question. Responses were usually clearly expressed.
Part (a) was answered well. The most common description of the mistake that Sarah made was to state that the first line should read $BC^2 = AC^2 - AB^2$ or equivalent, for example that she should be subtracting not adding the numbers. A common but unacceptable response was that the mistake was not to show the square root sign over the 100.
Part (b) was also answered well with most students stating that the scale factor is 2.5 and not 1.5 as required and many other students who explained that the length of one side of the enlarged triangle was incorrect together with a statement of what the length should be. The most common unacceptable response referred to *C* being the wrong centre of enlargement.

Question 9

This question was not well answered in general though there were many clear and concise responses which earned full marks. Many students were able to make a start by stating that 54 (6×9) machine days were needed to make all the boxes. A much smaller proportion of students could make further progress. The most common strategy used by students who successfully solved the problem was to identify that 42 machine days were needed in addition to the first 3 days and then that 42 machine days is equivalent to 7 days with all the machines working. A small number of students who used this approach gave 7 as their final answer instead of the correct 10 days ($3 + 7$). The most able students were able to identify that 6 machine days were lost in the first 3 days so one extra day in addition to the 9 days would be needed to make all the boxes.

Question 10

Examiners were able to award full marks to about a half of students for their answer to this question involving percentages. Most students showed a good understanding of the problem and calculated that the total interest added to Marie's account was £144. Not all of these students could express this as a percentage interest rate. The most common error was for students to express £144 as a percentage of £8144 instead of £8000. It was noticeable that a large number of students used a multiplier approach, interpreting 0.018 or 1.018 as a 1.8% increase. The most common errors seen were working out 20% of 8000, or using an incorrect reverse percentage process.

Question 11

Questions involving standard form are often well answered and this question was no exception. Students usually expressed their answer to part (a) as an ordinary number (130) with a small minority of students giving their answer in standard form (1.3×10^2). Most students worked in standard form and did not convert the distance and speed to ordinary numbers before dividing one by the other. The most common error seen in the method was for students to multiply the distance by the speed but this was not commonplace. However, there were a significant number of students who identified the correct calculation $(3.9 \times 10^7) \div (1.3 \times 10^5)$ but who expressed it without the brackets. This usually led to the incorrect answer 1.3×10^{12} because students were not careful about the order of operations when they used their calculator to evaluate their answer. These students could usually be awarded one of the two marks available.

Most students were able to gain the mark in part (b) for stating that their answer to part (a) would be increased or equivalent, for example that the signal will take longer to get to Mars.

Question 12

About two thirds of students were able to give an acceptable reason why $64^{\frac{1}{4}}$ is not equal to $\frac{1}{4}$ of 64, usually by explaining that $64^{\frac{1}{4}}$ can be interpreted as the fourth root of 64 or $\sqrt[4]{64}$ or by evaluating the value of $\sqrt[4]{64}$ as 2.828. The reason "$\frac{1}{4}$ of 64 is not the same as 64 to the power $\frac{1}{4}$" was not deemed sufficient to score the mark because it is the same as merely rephrasing the statement in the question.

Question 13

This question was successfully answered by about a half of all students. About two thirds of all students realised the need to multiply the measures of density and volume of both ethanol and propylene and so accessed the first two marks for these processes. Some students changed litres to millilitres before doing this. About a half of all students were able to move on from there to complete the calculation of the density of the antifreeze. The most common error seen by examiners was for students to use division rather than multiplication to work out $188 \div \left(\frac{60}{1.09} + \frac{128}{0.97}\right)$ or equivalent. The answer given, 1.005, was in the range of acceptable values but could not be awarded any credit.

Question 14

A small minority of students scored full marks for their responses to this question. Weaker students often showed little or no working and if they did show working, it was often characterised by assuming that the triangles were right angled and using trigonometry to fit such a situation. More able students often did realise that references to area in the question together with the diagram showing non right angled triangles suggested use of the formula $\frac{1}{2}ab\sin C$. However, some of these students tried to find the length of AE instead of using the ratio $AB : AE$ to express AE as an unknown variable, for example $3x$. Students who used $AB = x$ and $AE = 3x$ scored at least one mark and often went on to write down and solve an equation using the given fact that the sum of the areas of the triangles was equal to the area of the rectangle. Examiners were surprised at the number of students who equated the area of one triangle to the area of the rectangle which led to the incorrect final answer of 18.

Question15

Some students appeared to have little knowledge about the content covered in this question and either did not attempt the question or revealed little understanding through their responses to the question. In general, little working was seen and students may have benefited from writing down the transformations represented by the equations $y = \mathrm{f}(-x)$ and $y = \mathrm{f}(x) - 3$.
Very few students did this and so some denied themselves the award of a mark for showing an understanding of the types of transformation involved in the question. However, examiners were able to award a good number of students at least one mark for getting an x coordinate as −7 or a y coordinate as −1. Students who gave a final answer of (−10, −5) following on from an intermediate stage of (−7, −2) could not be awarded any marks because they had not discriminated between which coordinates were changed by which transformation. Some students attempted to substitute values for x and y, often 7 and 2 respectively. The best students did show a good understanding of the notation and transformations involved and gave a fully correct answer.

Question 16

This question discriminated well with many students being awarded each of the 0, 1, 2 or 3 marks available. Most students followed the strategy of finding second differences to help them find the term in n^2 and realised that the common differences of 4 meant they should write an expression for the nth term which included the term $2n^2$. Many students went on to give a fully correct expression but a significant minority of students gave $2n^2 - 3n$ as their answer. Students would be wise to check their answers to questions of this type by substitution.

Question 17

Matching the functions to the graphs in this question produced a good spread of marks with about a third of all students scoring each of the marks available. The graph of a trigonometrical function was identified correctly more frequently than the other graphs and the graphs showing one form of proportionality or another were the least well known.

Question 18

Students usually scored well on part (a) of this question requiring the expansion of a product of three linear expressions to give a fully simplified cubic expression. Errors were usually restricted to incorrect terms rather than a flawed strategy although some students omitted terms from their expansion. It was usual for students to earn two or three of the available marks. Less able students lacked a clear strategy and sometimes tried the multiply all three brackets together at once.

Part (b) of the question proved to be more challenging than part (a) and it was relatively rare for examiners to award full marks. Credit awarded to students was often restricted to the mark gained for taking the square root of each side of the inequality or, in the case of students who started by expanding the left hand side, for getting a quadratic equation or inequality with all the terms on one side. Very few students used the expected method of taking the square root of both sides, taking into account both square roots of $\frac{9}{25}$. Students who expanded $(1 - x)^2$ were more likely to gain two or three marks for their responses but only about a third of all students earned one or more marks. The best answers demonstrated a very good understanding of the topic together with the good practice of including a graph sketch with the rest of their working.

Question 19

Part (a) of this question discriminated well between more able students sitting this paper. Some students did not attempt the question and many weaker students restricted their answer to working out the value of D by substituting $u = 26.2$ and $a = 4.3$ This gained no credit. Of those students who did score marks, many of them scored just one mark for writing down at least one of the bounds for u or a. Students who substituted bounds for u and a into the expression for D were split between those who calculated [UB of u]^2 ÷ [2 × LB of a], the correct expression, those who calculated
[UB of u]^2 ÷ [LB of a] and those who calculated [UB of u]^2 ÷ [2 × UB of a].

Part (b) was not answered well and only a small proportion of students gave the correct answer of 80. Even fewer students were able to say why. The most common incorrect approach by far was to add their answer to part (a) to 78.6003 and then divide by 2, accompanied by an explanation of this being the mid-point or the average. Centres may wish to highlight this misconception.

Question20

This question also proved to be a good discriminator between the most able students. Many of the more able students were able to make a good start, realizing the need to make a substitution, usually using $x = \frac{7-4y}{3}$ from the second equation, to eliminate x from the first equation. Fewer students could carry out the substitution and expand $\left(\frac{7-4y}{3}\right)^2$ correctly to score the second method mark. Often the denominator of the fraction was ignored in this process. Students who rearranged $3x + 4y = 7$ often stopped at $4y = 7 - 3x$, then substituted this into $x^2 - 4y^2 = 9$ to give the incorrect equation
$x^2 - (7 - 3x)(7 - 3x) = 9$. A further error seen quite commonly occurred when students multiplied through their equation by 9 but forgot to multiply all the terms by 9.
Only the most able students could obtain a correct quadratic equation in the form
$ay^2 + by + c = 0$ (or $ax^2 + bx + c = 0$ in the cases where y had been eliminated). Some students who did not get a correct quadratic equation were able to score a further mark which was given independently for solving a three term quadratic equation. Full marks were scored in this question by only a very small proportion of all students who were entered for the examination. Some students who arrived at the correct 4 values were not awarded the final accuracy mark as the values were not clearly paired.

Question 21

Though a significant number of students did not attempt this question, a good proportion of those students who did attempt it scored full marks for a complete and correct solution. The most common errors made by those students who followed a correct method, that of finding the total number of onions weighing less than 60g or more than 120g, usually involved obtaining an incorrect frequency for the number of onions weighing between 120g and 135g or for the number of onions weighing between 135g and 180g, or both. This usually arose because of using an incorrect class interval . Students who used the strategy of finding that there were 420 onions weighing between 60g and 120g were generally more successful. Some students opted to work with percentages, either giving their final answer as a percentage, or rounding a recurring decimal to 1decimal place and hence introducing a rounding error. In these cases the final accuracy mark was usually lost. There were a significant number of students who used the heights of the bars to represent frequencies. This approach could not be awarded any credit.

Question 22

Fully correct answers to this question were seen only rarely. It was found to be the most challenging question on the paper. Having said that, a significant proportion of students were able to score at least one mark for a successful start by identifying that angle *OAB* is a right angle or for a correct process to find the radius of the circle. Few students could see how to use the coordinates of *P* in order to derive an equation by either using the equation of the circle or by using Pythagoras's Theorem. The evidence from students' scripts showed that more students took the former approach, quoting $x^2 + y^2 = r^2$ and then substituting $x = 3p$, $y = p$, $r = 8$ to get an equation in p. Unfortunately, the lack of of use of correct notation, that is a pair of brackets, meant that many students wrote $3p^2 + p^2 = 8^2$ instead of $(3p)^2 + p^2 = 8^2$. These students usually went on to simplify their equation to $4p^2 = 8^2$.

Question 23

This question was accessible to and discriminated well between the most able students sitting this paper. Students who had a good understanding of bearings together with applications of the sine rule and cosine rule were able to produce an accurate and concise solution to the problem. Of those students who gained partial credit for their attempts, many were only able to score either one mark for a correct process to find the size of angle *ABC* or two marks for getting as far as finding the length of *AC*. Some students who got as far as finding the size of angle *BAC* successfully gave this as their final answer. Finding the bearing of *A* from *C* instead of the bearing from *C* from *A* was also seen quite frequently.

Summary

Based on their performance on this paper, students should:

- check working for careless errors and to see that the answer given was specifically required by the question.
- practise problems involving the surface areas of solids.
- practise expanding brackets and collecting terms especially with quadratic functions involving fractions.
- ensure a good understanding of multipliers in problems concerning percentages
- practise solving quadratic inequalities.

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