Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

November 2020

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

Most students who sat this paper seemed to have been entered appropriately for the higher tier. Responses were generally clearly and logically presented though a small proportion of responses to questions 4, 9, 17 and 19 appeared to lack a coherent structure. Where fully complete and correct solutions were not seen, examiners could usually award some marks for a student's working.

The paper gave the opportunity for students of all abilities to demonstrate positive achievement. All questions were accessible to some students and there were some excellent scripts attracting a high total number of marks. In a few cases of questions later in the paper, a significant number of less able students made no attempt to answer the question though there were not many scripts with a very low total number of marks. Questions 1 - 5 and 8 were answered well by most students. Questions 13 and 16 - 21 attracted fully correct solutions from only a small number of students. It was noticeable that questions involving the use and interpretation of graphs were generally not well answered. Centres and students may wish to spend more time on this aspect of the specification.

Report on Individual Questions

Question 1

This question provided a good start to the paper. Most students scored at least four of the five marks available and nearly all students gained some credit for their answers.

Part (a) of this question required students to use the index law for multiplication of powers of n. Nearly all students applied the law correctly. n^{15} was the most commonly seen incorrect answer.

Part (b) of the question was answered less well but nevertheless the great majority of students gained the two marks available. Examiners condoned answers of the form c^1d^3 and $c \times d^3$. It was not unusual for students who did not give a fully correct answer to get one mark for either c or d^3.

In part (c) students could usually find the critical value giving it as either 2.8 or $\frac{14}{5}$.

These students scored at least one mark. A significant number of students gave their final answer as 2.8 or as $x = 2.8$ instead of the correct $x > 2.8$

Question 2

This question was a good discriminator between less able students taking this paper. Many students at this level used "time = distance ÷ average speed" to get 1.25 hours and 1.5 hours before adding to get 2.75. A surprising number of students were, however, unable to convert this correctly to 2 hours 45 minutes. 2 hours 75 minutes and 3 hours 15 minutes were common incorrect answers seen.

Question 3

A majority of students scored both marks on this question. Where only one mark was scored, it was usually for the lower end of the interval and where the student had used 9.44 or 9.4 for the upper end of the interval.

Question 4

A good discriminator, part (a) of this question attracted many fully correct solutions. There were a number of possible routes that students could take to solve the problem. By far the most common route taken was for students to find the number of kilograms of grass seed needed for the 10m by 14m lawn ($9.\dot{3}$ kg) by first calculating the area that could be covered with 1 kg of seed. This route was usually successfully completed with students stating a correct conclusion from correct figures. A second popular route was to find the area which can be seeded with the 5 full boxes of seed (150 m^2) and compare it with 140 m^2, the area of the larger lawn. Of those attempts where a solution was not complete, at least one mark could usually be awarded for a correct process to find either the total amount of seed in 5 boxes or the area of one of the lawns.

A large proportion of students successfully answered part (b) of the question. Reasons given were usually based on finding and stating the area (135 m^2) which could be seeded with 9 kg seed or by comparing the 9 kg of seed now available with the $9.\dot{3}$ kg of seed needed for the larger lawn.

More than two in every five students obtained full marks for their solution to this question.

Question5

The vast majority of students successfully completed the tree diagram correctly to score the two marks available in part (a) of this question.

Part (b) was less well done. However, a good proportion of students also scored two marks here. A significant number of students indicated the intention to multiply $\frac{1}{3}$ by $\frac{2}{3}$ thereby scoring one mark but then evaluated this incorrectly. Showing the intention to add the fractions meant that some students could not be awarded any credit in this part of the question. A number of students thought they needed to consider two combinations, and gave an answer of $\frac{4}{9}$. Unfortunately, the additional work involved spoilt their method and no marks could be awarded.

Question 6

There were a good number of totally correct responses to this question. However, in part (a) some students attempted to solve the equations algebraically usually without success.

Part (b) was not answered well and a significant number of students did not attempt the question. Students who included correct solutions in an incorrect format, such as (0.6, 0) and (3.4, 0) or $0.6 < x < 3.4$ were given one mark on the basis that they had clearly used the intercepts of the x axis. One mark was also available to students who marked the two intercepts of the x axis on the diagram but not to those students who also marked extra intercepts, for example at (0, 2).

Question 7

This question was done well by a majority of students who were awarded all three marks. Some students merely found the mean of 16.2 and 16.7. This method could not, of course, be awarded any marks. Students nearly always scored three marks for a fully correct response rather than one mark or two marks for a partially correct response.

Question 8

In this question nearly all students realised that they needed to subtact 0.32 and 0.20 from 1 to find the total of the probabilities of taking a red counter or a yellow counter. These students usually went on to give a correct solution to the problem, most frequently by dividing 0.48 by 6 then multiplying by 300 to find the number of yellow counters. Where there were errors in working, it was usually where students divided 0.48 by 5 instead of 6 to find the probability of taking a yellow counter. The alternative route of finding the number of blue and/or green counters as a first stage was also used in a small but significant number of cases.

Question 9

Most students were able to score at least one mark for a start to finding the total volume by working out the volume of the cuboid measuring 10 cm by 12 cm by 20 cm. However, this was often as far as they could get. Attempts to find either the height of the isosceles triangle which forms part of the cross section or to find the slant height of the triangle were often flawed. In some cases the wrong trigonometrical equation was used and, in other cases, students assumed that they could use right angled trigonometry on the isosceles triangle. That said, a good number of students successfully completed the question to obtain full marks.

Question 10

This question involving standard form was quite well answered. In part (a) students were expected to work out an estimate for the number of times a person's heart beats in their lifetime. There was no expectation for students to round the 81 or 365 but the acceptable range in the mark scheme was constructed to allow for this. Students who did not give a correct answer often did not consider the number of days in a year and used 81×10^5 instead of $81 \times 365 \times 10^5$. Of those students who did show a complete and correct calculation, a significant number of them did not convert their answer correctly into standard form.

In part (b) many students gave the correct answer, 4.5×10^{-11}. Where mistakes were made, a common error was for a student to divide 2×10^{12} by 90 to get $2.\dot{2} \times 10^{10}$. Some students who wrote down a correct calculation, that is $\frac{90}{2 \times 10^{12}}$, went on to evaluate it incorrectly as $90 \div 2 \times 10^{12}$ instead of $90 \div (2 \times 10^{12})$. Disappointingly few students recognised that an answer of either 4.5×10^{13}grams or $2.\dot{2} \times 10^{10}$grams for the average mass of 1 red blood cell is unrealistic.

Question 11

This question proved to be a good discriminator. A high percentage of students were able to score at least one mark by correctly carrying out one or both of the two transformations and showing their results on the grid provided. About a third of students were able to describe the single equivalent transformation as a rotation of 180° with about a third of these students also able to give the correct centre of rotation. It was encouraging to see very few students describing more than one transformation. About half of the students who scored all three marks in part(a) understood the meaning of the term "invariant point" and were able to write down the coordinates of their centre of rotation as their response in part (b).

Question 12

Students usually scored well in this question requiring the addition of two algebraic fractions in part (a) and the expansion of a product of three linear expressions in part (b). The question was a good discriminator at the level set and tested skills and confidence in the area of algebraic manipulation and simplification.

About a half of students taking this paper scored at least two of the three marks available in part (a). They were able to decide on a common denominator and combine the fractions with accuracy. However, a large number of students then went on to make errors in simplifying their expressions. It was common to see a correct answer of $\frac{3x^2}{x^2-2x-8}$ spoiled by incorrect cancelling leading to an incorrect final answer. Examples of incorrect final answers seen quite frequently are $\frac{2x^2}{-2x-8}$, $\frac{3}{-2x-8}$ and $\frac{x}{-5}$. Another commonly seen error occurred when students obtained a correct result of the form $\frac{3x^2}{(x+2)(x-4)}$ only to make the decision to multiply out the brackets but then to do this incorrectly. Students should be advised that it is generally acceptable to leave the denominator in factorized form.

More students scored full marks in part (b) than in part (a) of this question. Errors in part (b) were usually restricted to incorrect terms rather than a flawed strategy although some students omitted terms from their expansion. Most students earned at least two of the available marks. Less able 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.

Question 13

This question was not generally well answered. However, there were a significant number of the more able students who were able to gain full marks.

In part (a) most students attempted to draw lines on the grid but only a minority of the scripts seen contained diagrams with at least two of the lines $x = 2$, $y = x + 3$, $2x + 3y = 6$ drawn correctly. This was the minimum requirement to gain any credit in this part of the question. The line $x = 2$ was often seen drawn incorrectly as $y = 2$. About one in ten of students obtained full marks in part (a).

Part (b) of the question attracted an encouraging number of responses which examiners could give credit for. To score the mark in part (b), students were expected to state that Geoffrey was not correct and give a reason for their response. Examiners accepted a range of possible reasons equivalent to stating that the point with coordinates (2, 4) was in fact in the region or that it satisfied the inequalities given. There were many excellent responses from students who clearly showed they had a very good understanding of the situation by referring to the equals signs in the inequalities or to the solid lines in the diagram.

Question 14

This question was answered well by a significant proportion of students who produced a logically written and accurate solution, accompanied by clear reasons. Just under a half of all students scored some marks for their answers. However, many students either did not attempt the question or used incorrect assumptions or results. Most common among these were assuming that angle *BDE* and angle *BFE* were right angles or that "opposite angles of a cyclic quadrilateral are equal" leading to the belief that angle *DBF* was 100°. There were two possible routes to a correct solution and both were used by a good number of students. Students who scored part marks usually either failed to give adequate reasons for their working or could not complete the last stage in their reasoning to find the size of angle *ABD* successfully. A typical example of this was where a student successfully found the size of angles *DBF* and *BFD* but could not recall or use the alternate segment theorem.

Question15

About a quarter of students provided a clear proof in answer to this question. Sometimes the lack of any indication that values used were recurring decimals spoiled a student's working. Examiners accepted a dot above a 3 (eg $73.\dot{3}$) or dots at the end of a number (eg 73.3…) to signify a recurring decimal. Terminating decimals such as 73.33 were not accepted as part of a proof. A small number of students resorted to a purely numerical approach dividing 11 by 15 to show this gave $0.7\dot{3}$. This approach could not, of course, be given any credit and students are advised to follow the request to "prove algebraically" in similar questions set in the future.

Question 16

Many students worked out an estimate for the distance the car travelled by drawing a triangle under the curve, perhaps the expected approach. Working written by these students was generally accurate and the answers 132 and 135 within the given range and scoring two marks in part (a) were common. Unfortunately, as many if not more students merely multiplied either 8.8 or 9 by 30. This estimate was viewed as being too far from the actual distance travelled and did not convince examiners that students realized that the area under the curve gives the distance travelled. Some students used more than 1 triangle, for example using 2 strips and requiring the student to find the total area of a triangle and a trapezium. This method, an example of one providing a better estimate than when using a single triangle, was, of course, awarded full marks provided it was accurately carried out.

Answers to part (b) were often well expressed. The mark was awarded for a clear answer linked to an acceptable method for estimating the area in part (a). Vague answers such as "an underestimate because of the curve" could not be given the mark. Some students based their answers on the effects of rounding values of the speed rather than comparing the estimate calculated for the area under the curve with the exact area.

Part (c) was answered correctly only by better students who focused on the need to draw the tangent to the curve at time 60 seconds or on calculating the gradient of the curve at this point (or both). Many students attempting to answer this part of the question restricted their answers to a discussion of rounding. This was not accepted as an explanation worth crediting.

Question 17

It was relatively rare to see a fully correct solution to this question with the consequent award of 4 marks. However, many more students were able to access the two marks for correct processes to work out the frequencies represented by each bar. These marks were given provided that these frequencies were linked to the method leading to the student's final answer. As is often the case with a question involving a histogram, weaker students often used the heights of the bars as frequencies and so no marks could be awarded.

Question 18

Very few students showed a full understanding of what was required to answer this question. The award of any marks was generally limited to the one mark for the appreciation that finding the lower bound for the length of the cube requires a bound (11.25) to be used for the length of the diagonal *AH*. About a half of all students gained this mark. It was rare to see students use Pythagoras' rule correctly in this context of three dimensions. Students who tried to make further progress often either assumed incorrectly that the lengths of *AF* and *FH* were equal or that the size of angles *FAH* and *FHA* were both 45°.

Question 19

There were some excellent responses to this question from the most able students taking this paper but these were few and far between. Able students who were unable to get as far as the given result were sometimes able to score some marks for successfully finding expressions for the area of part of a hexagon or for a whole hexagon, whether it be *ABCDEF* or *FGHIJK*. Where this applied, students usually used trigonometry to find the height of a constituent triangle and then its area by using $\frac{1}{2}$ × base × height or they found an area using the formula $\frac{1}{2}ab\sin C$.

Some weaker students used the given result and tried to justify it by using substitution or by algebraic manipulation whilst other students seemed to think that the question revolved around finding angles of a polygon. No marks could be awarded for these approaches.

Question 20

This question was often not attempted but it also proved to be a good discriminator between the most able students. The most common incorrect answer seen was 98. Less than 1 in 10 of students were able to give the correct answer.

Question 21

Though a significant proportion of students did not attempt this question, many of those students who did attempt it scored 1 or more marks, usually for a correct first step in either part (a) or part (b) or in both parts.

In part (a) many students isolated terms in one variable, usually showing $4c = 3d$. However, a great majority of these students then gave the final answer 4 : 3 rather than the correct answer 3 : 4.

Part (b) was done less well but some students scored one mark, usually for taking all terms to one side of the equation. Hardly any students made any progress by using the method of dividing throughout by one variable. A few students included factorisation as part of their solution in part (b). Success here led to the award of at least two marks in this part.

Summary

Based on their performance on this paper, students are offered the following advice:

- Check on the answers to calculations, so for example you should expect the mass of a red blood cell to be a small number
- practise less straightforward cases of finding the volume of a prism
- learn standard techniques involving combined transformations, for example the identification of the single equivalent transformation
- improve your skills in dealing with algebraic fractions, particularly in deciding when a fraction is in its simplest form and cannot be "cancelled" further
- practise questions which involve the use and interpretation of graphs, for example questions 6, 11, 13, 16 and 17 on this paper

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