GCSE

Mathematics

8300/3H: Paper 3 (Calculator) Higher

Report on the exam

November 2020

Contents

Summary

Overall performance compared to last year

There was no evidence of time pressure with most students able to complete the whole paper, although the proportion of responses with no attempts increased significantly for the highest demand questions. The final three questions proved to be very challenging for all but the most able students on this tier. However, most students were able to access the majority of the lower and medium demand questions and were rewarded for good use of mathematics demonstrated at different levels of ability. Students did not always show working when instructed to do so. It was apparent at times that some students did not use a calculator. Inaccurate recall and/or use of formulae once again limited the marks gained when some students clearly knew the method required to answer the question. Some candidates still leave the multiple choice questions unanswered.

Topics where students excelled:

- Finding the lower bound
- Calculating the hypotenuse of a right-angled triangle using Pythagoras' theorem
- Similar triangles
- Using relative frequency
- Drawing a box plot from given information
- Finding an angle using a circle theorem

Topics where students struggled:

- Finding the upper bound
- Constructing an angle bisector within a given context
- Expanding brackets for a linear expression
- Using the median to complete a frequency table
- Solving a linear inequality
- Converting units for pressure
- Probability within a given context
- Vectors
- Finding the rate of change from a non-linear graph
- Equation of a perpendicular line
- Area of a non-right-angled triangle with cosine rule
- Inverse and composite functions

Multiple choice questions

Which questions did students find most accessible?

Question 2, question 3 and question 19 were well answered showing a good understanding of identifying parallel lines from their equations, working out one number as a percentage of another, and identifying the inequalities which describe a shaded region on a sketch.

Which questions did students find least accessible

Question 1, question 4 and question 25 were less well answered. 'A and B' was the most common incorrect choice for question 1, ½ was the most common incorrect choice for question 4, and 3 was the most comment incorrect choice for question 25.

Common misunderstandings

Question 8

Some students write 45 minutes as 0.45 and then use this decimal in their further calculations.

Question 16

When calculating the estimated mean from a grouped frequency table, many students divided 125 by the number of groups (3) instead of dividing by the total frequency (20).

Question 20(b)

Many students knew how to find the interquartile ranges from the box plots but incorrectly interpreted the larger value as implying that the data was more consistent.

Question 30

Students incorrectly interpret the composite function notation gf(x) as the multiplication of the functions g(x) and f(x).

Individual questions

Question 5

Part (a) was correctly answered by the majority of students although a few responses of 1750 and 175000 were given.

Part (b) was not well answered and the incorrect response of 18500 was commonly seen. Students should be careful when finding the maximum possible number for discrete data or when a question is set within the context of money.

Question 6

This question was answered extremely poorly with the majority of students not understanding they were required to construct the angle bisector between lines *AB* and *BC*. Very few accurate arcs of equal radii were seen cutting *AB* and *BC* which would have gained them the method mark. Some students still attempt constructions without the use of a compass for which they will receive no credit.

Question 7

This question was very well answered with a significant majority of students gaining full marks. A few attempts were seen using trigonometry even though the question required the use of Pythagoras' theorem. A small number of students used 32 and 60 as angles and showed no knowledge of the correct method. There was no evidence of scale drawings being used for which no credit would have been given.

Question 8

Students continue to find questions involving distance, speed and time a challenge to interpret and answer correctly. The time difference between 11.15 and 10.30 was sometimes calculated as 0.85 or 45 minutes was subsequently written and used as 0.45. Some students attempted the question using a build-down approach showing 6 miles in 30 minutes, 3 miles in 15 minutes, therefore 9 miles in 45 minutes. To help gain credit on this topic, students should be encouraged to write down the units of each number as they progress through the question – too often it was unclear whether their values were for a distance, speed or time. Very few candidates used alternative method 2.

Question 9

Students either knew how to work with similar shapes or failed to gain any credit. Common incorrect answers came from using the difference between two of the given lengths, for example 4 or 8. Some students correctly found a scale factor of 0.8 or 1.25 but then either divided by 0.8 or multiplied by 1.25 and gave their answer as 15. By looking at the diagram carefully, they should have observed that the length of a must be lower than 12cm so an answer of 15cm cannot be correct.

Question 10

This question was not well answered with most students gaining only one mark owing to incorrectly expanding the second bracket as $-5c - 1$ which then lead to a final answer of $3c + 11$. A few responses showed a fully correct answer but further incorrect working meant the accuracy mark was not awarded, for example $3c + 13 = 16c$. A minority of students misinterpreted the question and attempted to multiply the brackets by each other.

Question 11

This question was very well attempted with many fully correct responses. A few students stopped after calculating the relative frequency of green as 0.2 assuming this was the final answer. It is important that the question is read carefully to determine if it is the relative frequency which is required or a number of outcomes.

Question 12

For the position on the paper and level of demand, this question was very poorly attempted with only a small minority of students achieving full marks and a significant number made no attempt. A set of positive integers which summed to 11 was the most popular way of gaining one mark but candidates did not choose individual values that would also give a median of 3.5 and without repetition. Algebraic methods were attempted but these were often confused with the method of finding the mean from a frequency table and rarely gained any marks.

Question 13

Part (a) was quite well answered with the majority of students gaining at least one mark and many fully correct answers were given. Marks were predominantly lost when a^2 was written as a, or the fraction of 50/40 was not simplified to 5/4. Full marks were not awarded if incorrect further working was seen. Cross-multiplication of the fractions was commonly seen by students who were using a method of fraction addition as their first stage of working.

Part (b) was also quite well answered with students correctly identifying the error in the method of simplifying which was given. Incorrect evaluations included referring to: solving the expression, simplifying the numerator first, adding 10 before dividing, dividing both sides by 2, the method is wrong. A question of this type is best answered by stating what should / needs to be done, without making contradictions.

Question 14

This question was very well attempted with few candidates gaining no marks and a significant majority giving a fully correct solution. The main error occurred when students transposed the values for the length and width but a special case award was given if an otherwise fully correct method was used. Some students did not gain the final mark as they did not explicitly compare 87% with 75% or state that the reduction in perimeter was 13%. On this calculator allowed paper, build-down methods were occasionally incorrectly used to find the percentage reductions and some basic arithmetic errors were seen: for example 40 – 4 = 34. Some students increased the lengths instead of decreasing them as the question required.

Question 15

Solving a linear inequality continued to be an area of weakness for many students and this was highlighted in the very poor responses that were given for this question. The candidates who used an approach from alternative method 1 were more successful in gaining at least one mark, as those who tended to attempt multiplication by 3 as their first step of working (alternative method 2) generally did not multiply 11 by 3 and showed $12 > 11 - x$. Some students ignored the inequality completely and treated the question as solving a linear equation whilst others gave an answer with an inequality in the wrong direction. The effect on an inequality of multiplying or dividing by a negative value should be reinforced to students.

Question 16

Students either knew how to work out an estimate of the mean from a grouped frequency table with many fully correct solutions seen or they failed to gain any credit. Incorrect midpoints or products were often written in the table, and 125 ÷ 3 was too often incorrectly given as the next stage of working out. If correct values were given in the table but a different method / values used in the working, this was marked as choice. Some students used the blank column in the table for cumulative frequency, misunderstanding what was being asked in the question.

Question 17

In this question, many students scored the first method mark but were unable to progress to correctly forming an equation using the relationship between the shaded and large rectangles. Some candidates used perimeter and those who attempted a trial and improvement approach did not progress to a correct answer. Incorrectly multiplying out brackets and omitting brackets prevented some students who understood how to answer the question from gaining more marks.

Question 18

This question was attempted by the majority of students and alternative method 1 was most popular. Many gained the first method mark for 13.5 but a disappointingly small proportion were then able to go forward and complete the question correctly. Misunderstanding of how to convert from square inches to square centimetres was the main issue with many responses showing division by 2.54 only, or multiplication by 2.54 or 2.54^2 once 13.5 was found.

Question 20

Part (a) was very well answered with accurate and neat box plots drawn on the grid mostly using a ruler. A small number of students made a poor or no attempt, despite there being a box plot drawn on the next page in part (b).

The responses in part (b) were slightly disappointing after the excellent answers seen in part (a). A sizeable proportion of students gained one mark for correctly finding one of the interquartile range values although a large number of arithmetic errors were present: for example, 15 – 12 = 2 or 19 –

13 = 7. Interpreting the interquartile range values was problematic for many candidates and a significant number of responses stated that the larger interquartile range indicated more consistent scores. Some students used the range as a measure of consistency and some omitted to work out the values of the interquartile ranges even though the question guided them to do this.

Question 21

Part (a) was very well answered with many students marking correct values on the diagram in correct positions and showing their working out appropriately. Those who gained no marks predominantly assumed that *AB* = *BP* so that angle *ABP* = angle *APB* = 54.5 degrees, or they assumed angle *ABP* = 90 degrees leading to angle *APB* = 19 degrees.

Part (b) was less well answered by students, although most of them gave an attempt and appeared to be partially remembering circle theorems. 204 + 78 ≠ 360 and 'no' was a common incorrect method and assuming there was a line of symmetry in the diagram often occurred as part of an incorrect response.

Question 22

This question was not well answered and few students gained any credit after the first method mark was awarded, for giving any one of the four probabilities which were required to answer the question. Some responses ignored Group Y completely whilst others attempted to convert Group X to a ratio and then merge ratios from both groups. Addition of probabilities and other incorrect methods based on non-replacement probability techniques were commonly seen. Students who gave their answers as fractions only but not in a comparable form were not given the accuracy mark.

Question 23

This question discriminated across the different ranges of ability where a good proportion of students gained the first mark for showing JN = 6**b**, others progressed to find JK = 10**b** – 7**a** and some went on to fully answer the question correctly. Poor labelling of vectors within working and overlooking the direction of a vector gave rise to some marks being lost and the accuracy mark was not awarded if the final answer was unsimplified. At this stage of the paper, some students have reached the limit of their understanding of higher tier topics and the proportion of non-attempts and zero marks scored increased noticeably.

Question 24

Part (a) was extremely poorly answered with the vast majority of students not scoring or not attempting the question. Only a small number of candidates understood that a tangent must be drawn at $x = 2$ and the gradient calculated from their line. Some drew a line connecting points *A* and *B* and calculated the gradient of that line. When a tangent was drawn, generally a correct gradient was subsequently worked out. It is important that students understand that if they are asked to 'work out a rate of change', this implies they must find the gradient of the tangent to the curve at a given point.

Question 26

Students either knew how to prove algebraically that a recurring decimal could be written as a fraction or they failed to gain any credit. Alternative method 1 was used in all but a handful of responses and was clearly the preferred method of teaching to the students who attempted this question. Some good, clear, precise and concise fully correct answers were shown and the more successful students lined up the decimal point and recurring digits for each subsequent stage of working. The accuracy mark was awarded only if $x = \ldots$ was shown somewhere in the method. Unsuccessful attempts tried some numerical division or manipulation of the fraction – neither of which gained any marks.

Question 28

This high demand question was beyond the ability of all but the most able students, demonstrated by the large proportion of non-attempts and zero marks awarded. Fully correct (4 marks) or partially correct (2 marks) scores were generally gained by those who made progress in this question, and they showed a good understanding of how to find the gradient and equation of a line perpendicular to one which is given. Errors occurred when finding where line B intersected the x-axis as many students substituted $x = 0$ into their equation instead of $y = 0$.

Question 29

This high demand question was beyond the ability of all but the most able students, demonstrated by the large proportion of non-attempts and zero marks awarded. For those who gained marks, the question further discriminated across the range of abilities at this high grade. Common basic errors included: not halving the diameter (from the cosine rule) before finding the area of the semi-circle, not halving the area for the semi-circle after using πr^2, incorrect recall of formulae even though the method to answer the question was understood. Students who scored zero marks generally incorrectly attempted the question using Pythagoras' theorem and the area of a triangle from using ½ × base × height.

Question 30

This high demand question was beyond the ability of all but the most able students, demonstrated by the large proportion of non-attempts and zero marks awarded. For those who gained marks, the question further discriminated across the range of abilities at this high grade. One method mark was awarded to a good number of students for either finding the inverse function or the composite function. The next mark for equating the two correct functions was gained by quite a few students, but the final two marks were only given to a very small proportion of the candidates. Some students had correctly completed all the function manipulation in the question and then were surprisingly unable to factorise and solve the final equation $x^2 + 6x = 0$. Common errors on this type of question continue to be: the inverse function written as a reciprocal or $-\mathrm{f}(x)$, and the composite function written as the multiplication of the functions.

Further support

Mark ranges and award of grades

Grade boundaries and cumulative percentage grades are available on the results statistics page of the AQA Website.

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