AQA
Realising potential

GCSE
Mathematics

8300/3H: Paper 3 (Calculator) Higher

Report on the exam

November 2021

Contents

Summary

Overall performance compared to last year

There was no evidence of time pressure with most students able to attempt the whole paper, although the proportion of questions with no responses rose significantly after question 25 as the level of demand increased. Questions 27a, 27b and 29 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 in some questions that students did not use a calculator and errors in basic arithmetic were frequently seen. Inaccurate recall and/or use of formulae once again limited the marks gained even when the method required to answer the question was clearly understood. Using pen on a diagram again caused problems if the student needed to change their answer. Some candidates still leave the multiple choice questions unanswered.

Topics where students excelled

- Factorising difference of two squares
- Solving a multi-step problem using a percentage and fraction
- Sharing an amount into a given ratio
- Solving a multi-step problem using length, area and ratio
- Substituting values into equations
- Expanding triple brackets

Topics where students struggled

- Converting pressure given the necessary imperial to metric conversions
- Ratio within a given context
- Drawing the front elevation and plan from an isometric diagram
- Volume of compound shapes
- Probability using algebra
- Finding the gradient between two points
- n^{th} term equations within a given context
- similar figures surface area to length problem
- vectors
- calculation using bounds
- iterative formula

Multiple choice questions

Which questions did students find most accessible

Question 1, question 2, question 4 and question 18 were well answered showing a good understanding of identifying a correct equation given a written statement, choosing the largest decimal number from a list, factorising a difference of two squares expression, and simplifying using the laws of indices.

Which questions did students find least accessible

Question 3, question 19 and question 23(a) were less well answered. The most common incorrect choice for question 3 was the intercept of $\frac{2}{3}$, $\sqrt{11}$ was the most common incorrect choice for question 19, and (2, 32) and (32, 2) were equally the common incorrect choices for question 23(a).

Individual questions

Question 5

This question was well answered with accurate calculations and correct working shown. Two marks were often scored by students who gave two numbers which summed to 23, with 22 and 1 being a common incorrect final answer when the range needing to be 19 had not been taken into consideration. Responses that did not score a mark generally started by working with only the four given values and the total value of 60 was not found or used.

Question 6

This question was very well answered with the majority of candidates scoring full marks with clear working and calculations shown. Some students did not use the Venn diagram to help them visualise the problem and subsequently their methods often muddled up the different categories for visitors. The main error was subtracting the 67 non-paying visitors from the 480 before calculating the 40% who visited the house and the museum. This lead to further problems because non-integer values for the number of visitors in each category were then generated. A number of careless arithmetic errors in calculating the total cost resulted in the loss of the final mark.

Question 7

Students who did not score in this question omitted to add the two parts of the ratio and starting working with 270 ÷ 2.6 The vast majority gave the correct answer of 120, but some candidates stopped when they calculated 195 and 75. A large number of arithmetic errors were again seen on this calculator allowed question.

Question 8

Many students only scored one mark on this question from 198 × 0.45 and overall it was not well answered. The units of square centimetres appeared to confuse a number of candidates as 6.25^2 often appeared in their working. This is a topic which should be practised and revised more accurately so that students know which values to multiply or divide by rather than performing random incorrect calculations and guessing at a method. The accuracy mark was not awarded for incorrect rounding to 14.2.

Question 9

This question was well answered by many candidates with correct method and calculations shown. The diagram was extensively used which should be encouraged. The final independent mark was often not awarded for one of the following reasons: incorrect simplifying from 52 : 68, no simplifying from 52 : 68, inserting cm^2 on the answer line, transposing the final ratio to 17 : 13. Failure to interpret the ratio correctly to find $x = 8$ as an initial step was the main error made by students who did not score any marks.

Question 10

Part (a) was not well answered with many students attempting to draw either a net of the solid shape, a different 3-dimensional view from A, or the plan. 2 x 2 or 3 x 3 squares were commonly seen drawn on the grid or a 6 x 4 rectangle.

Part (b) was also not well answered with many students attempting to draw either a net of the solid shape, views from all directions or a different 3-dimensional shape. Some drawings were reflections of the correct answer for which no credit was given. The large number of no responses at this stage of the paper was indicative that many candidates had not learnt or practised this topic appropriately.

Question 11

Many candidates mis-interpreted this question and after finding a correct prime number, proceeded to work out their prime number as a percentage of 125: for example, 23% of 125 with 28.75 on the answer line was a very common incorrect response which scored one mark. Incorrect lists of prime numbers which included 25 and / or 27 were frequently given, hence a significant number of students did not gain any credit. Build-up methods for working out a percentage were often seen and used incorrectly, so it continues to be important that candidates are fully equipped and confident to use correct calculator methods on this type of question.

Question 12

Incorrect recall of formulae prevented some candidates from scoring any marks and (n – 2) × 360 or (n – 1) × 180 or 180 ÷ n were often seen. Sometimes, working out stopped at 2340 or 24 which highlighted the need for accurate reading of the question by students to find ‘an interior angle’. Overall, this question was not well answered.

Question 13

Most candidates answered this question by considering two separate volumes rather than working out the cross-sectional area and multiplying by 15. Incorrect recall of the formula for the volume of a cylinder or not halving the volume of the cylinder were errors which were frequently seen and some students made no progress beyond calculating the volume of the cuboid as 1560 cm^3. Working out also showed attempts to find the surface area of the shapes or the length of the outside edges. The final mark was lost when students used a value for pi as 3.1 or $\frac{22}{7}$ rather than the more accurate values required or the pi button on their calculator, or they lost accuracy through premature rounding earlier in their calculations.

Question 14

This question was quite well answered by most candidates with clear working out shown and the correct box ticked. Students who used a build-up/build-down method for 10% often gained no marks as their arithmetic was incorrect, or they had mis-interpreted the question and added 10% to £13.20 Those who used 0.9 as a multiplier and 1.1 as a divisor to find £11.88 and £12 respectively were generally more successful in gaining full marks.

Question 15

This question was very poorly attempted with the majority of students gaining no marks. Most found it too challenging to set up the correct initial equation where the algebraic probabilities given in the table were summed and set equal to 1. Errors in basic algebra occurred often: for example, $10k - 0.15 = 1$ then written as $10k = 0.85$ Attempting to work in percentages rarely gained any marks as the initial equation was likely to be incorrect.

Question 16

The responses to this question were disappointing when considering the position in the paper and the relatively straightforward numbers that were given as the coordinates (all positive values). It is clear this topic is not well understood by most of the cohort and the method of correctly finding a gradient from two coordinates could not be recalled. A large number of scale drawings, diagrams or graphs on additional pages were seen which gained no credit and clearly used up a lot of time for the candidates. Some students who scored two marks for the correct gradient values were then unable to correctly remember or use $m \times m_1 = -1$ (or equivalent statement) to show that the lines were not perpendicular and *PQR* was not a right angle.

Question 20

This question was very well answered with the majority of students gaining full marks. When errors occurred they included: trying to merge the two equations but using incorrect algebra, finding $b = 48$, only writing $\frac{b}{8} = 2$ or $\frac{a}{b} = 24$ and making no further progress, finding $b = 16$ and then writing $\frac{24}{16}$.

Question 21

The responses to this straightforward histogram question were disappointing and only a small proportion of candidates gained full marks. There were many attempts to calculate an estimated mean or draw frequency polygons, cumulative frequency curves, or bar charts. Some students calculated frequency density values using the midpoints of each class. When correct frequency density values were given in the table, an incorrect histogram was then often drawn with the final bar extended beyond 50 or some of the heights of the bars incorrectly positioned. It is important that students learn to carefully distinguish between the methods for a frequency polygon, cumulative frequency curve and histogram so that, when they see a grouped frequency table, they do not default to any technique they can remember but accurately answer the question which is being asked.

Question 22

This question was not well answered and most candidates were unable to gain one mark for finding either $2n$ for the number of horizontal sticks or $n + 1$ for the number of vertical sticks. It is important that students learn to take their knowledge of finding an n^{th} term equation when given a simple row of numbers and apply the same technique within an unfamiliar context presented to them in an examination question.

Question 23(b)

Students who correctly answered this question more often wrote the given fraction as 16^{-1} to start with and then correctly matched the value of x with –1 Common incorrect answers were: 32, 1 or evaluating x as 0.0625 It is likely that some candidates did not link part (b) back to the equation of the curve given before the start of part (a).

Question 24

This question was mis-interpreted by many students who gave values of a and b such that their product was 3, for example: 6 and ½, or 3 and 1 were popular incorrect answers.

Question 25

This question was well attempted and many fully correct responses were seen. One mark was awarded for expanding any two of the three sets of brackets and students who successfully completed the question correctly, more often simplified their expression at this stage to reduce the number of terms in the next step of multiplication. Common errors included: attempting to multiply all three brackets at once, multiplying all combinations of two sets of brackets and summing the answers, incorrect simplification of algebra, incorrect arithmetic eg 6 × 5 = 35.

Question 26

This was a demanding question for many students and full marks were gained by a small proportion of the cohort. One mark was scored for the value 2.25 but, once this value was found, relatively few candidates understood the next step of working required finding the square root of 2.25 Some responses showed use of a formula for part, or all of the surface area of a cone, but often algebraic or rounding errors were introduced and these attempts predominantly failed to score any marks.

Question 27

Part (a): Students who correctly found the initial vector journey *HE* or *EH* more often went on to correctly find *DX* and gained full marks. Those who attempted to start with *DX* as given, made no correct progress and there was evidence of poor use of vector notation and limited learning of the techniques required to answer this type of question. Other incorrect methods seen included the use of Pythagoras' theorem or ratio.

Part (b): 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. Responses without any vector work gained no marks and disappointingly very few students were able to score the first easy mark for finding the vector journey *EG* or *GE*. The last accuracy mark was sometimes not awarded when the concluding statement / factorisation was either missing, inaccurate or unclear.

Question 28

Calculating with bounds continues to be a topic where many students struggle to score any marks even though the first mark was awarded for correctly writing down any one of the four upper or lower bounds. Responses of 4.72 ÷ 158 = 0.03 were often seen and students should be encouraged to consider if this calculation is actually worth 3 marks at this position in the paper, and then hopefully encouraged to think again about how to answer the question correctly. Students should also practise choosing which of their bounds are required to be used in the calculation. Common incorrect values for the bounds included: 4.719 paired with 4.721, 4.724; 157.9 paired with 158.1, 158.4

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: choosing a value for x, incorrect notation for identifying angles, starting with angle *ABO* and trying to work backwards, incorrect recall of circle theorems or angle properties of quadrilaterals and triangles. Some students who gained three marks for a fully correct proof did not give any / all of the geometrical reasons required.

Question 30

Part (a): Using an iterative formula continues to be poorly attempted by the majority of students even on a calculator allowed paper where the starting value is a positive integer. Some students wrote down unprocessed surds as their answers which scored zero, while others calculated r_3 and r_4 and gave them as their answers and subsequently gained one follow through mark. Answers should be given to at least 2 decimal places unless specified differently, and if more are written down they must be correctly transcribed from the student's calculator.

Part (b): Only a small proportion of students attempted this question as they would have firstly needed to attempt part (a) in order to use their calculator to continue the iteration until a stable value to 1 decimal place was reached. Some answers were given to 2 decimal places or more which did not gain the mark.

Further support

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