GCSE

Mathematics

8300/3H: Paper 3 (Calculator) Higher

Report on the exam

June 2022

Contents

Summary

Overall performance compared to last year

There was an improved overall performance compared to June 2019. There was no evidence of time pressure with most students able to attempt the whole paper. The quantity of no responses was considerably reduced compared to previous papers as the level of demand increased, possibly reflecting the fact that students had prior knowledge of which topics would be examined.

Questions 12(a), 12(b), 16(a), 18 and 26(b) proved to be more challenging: 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, and the clarity of some handwriting was poor. It was apparent in some questions that students did not use a calculator and errors in very basic arithmetic were frequently seen. Inaccurate recall and inaccurate use of formulae were less of an issue in this examination as students had access to the Insert. Using pen on a diagram again caused problems: for example, if the student needed to change their answer on the box plot. Some students still leave the multiple-choice questions unanswered.

Topics where students excelled

- Identifying the smallest decimal
- Vector subtraction
- Analysing scatter plots
- Finding an angle using trigonometry
- Percentage increase
- Simplifying basic surds
- Analysing and drawing a box plot
- Calculating with population density
- Product rule for counting
- Calculating compound interest
- Finding an angle using the sine rule
- Expanding triple brackets

Topics where students struggled

- Finding the coordinate of a turning point
- Calculating and interpreting compound measures for speed, distance and time in different units
- Calculating and correcting an error using bearings
- Using a scale diagram and estimating volume
- Using circle theorems in a multi-step ‘show that’ question
- Using exponential and quadratic graphs to find coordinates
- Using a histogram within a given context
- Finding the HCF and LCM when given the product of prime factors for two different numbers

Multiple choice questions

Which questions did students find most accessible

Question 1, question 2, question 3(a), question 3(b), question 10 and question 13 were well answered, showing a good understanding of the following topics:

- Identifying the smallest decimal number
- Subtracting two column vectors
- Analysing four scatter graphs
- Knowing the error interval when a mass is given to 1 decimal place
- Simplifying two surds

Which questions did students find least accessible

Question 11 and question 22 were less well answered. The three incorrect choices for question 11 were equally popular, and $3x^3$ was a very common incorrect choice for question 22 where students had multiplied the two functions instead of finding the composite function.

Individual questions

Question 4

This question was well answered, with most students identifying that trigonometry was being tested and that the tan function was required. Some students chose an approach that used either Pythagoras' theorem or the sine rule which made their method more complicated than necessary. There were many instances of poor notation with tan 2.5 or tan = 2.5 commonly seen. The 10 cm and 4 cm sides were sometimes assigned incorrectly as adjacent and opposite respectively when finding angle x thereby limiting the number of marks which could be gained.

Question 5

This question was quite well answered with the majority of students scoring full marks with clear working and calculations shown. Some responses stopped at 180% or 1.8 and did not give the percentage increase as the final answer. Students scoring part marks were generally not using the total hours for each weekend from the table or were making basic arithmetic errors. Some methods also showed the use of the fractions $\frac{5}{14}$ or $\frac{9}{14}$ or $\frac{5}{9}$ or $\frac{4}{9}$ or the percentage increase and consequently only scored the first mark.

Question 6

In part (a), most students correctly identified the roots as –1 and 5, although some wrote their answers as coordinates or swapped the signs on the answer line and then did not gain the mark.

Part (b) was not well answered with a minority of students scoring both marks. There were many errors seen when substituting the value of x into the equation with (2, –7) a common incorrect response. Some students attempted to measure or read off from the graph, or use a completing the square method, generally with limited or no success. There were also a significant number of no attempts which possibly indicated that the term 'turning point' was not understood.

Question 7

Many students scored full marks on this question with most others gaining at least partial credit showing it differentiated well across the range of abilities on this tier of entry. Two marks were frequently earned by students correctly identifying 256 as the eighth term for the geometric progression and the common difference as 3 for the arithmetic progression. These students were then generally unable to form an equation and progress further with the question. There were some poor attempts at evaluating 2^8 on this calculator allowed paper with $2^8 = 16$ seen in many responses.

Question 8

The majority of students only gained two marks on this question because they assumed the total capacity for fridge-freezer B was 294 litres, and they had not read carefully that this was only the capacity for the fridge. This error led to the final answer of 132 and 88.2 being given by over half of the cohort. Working out was shown clearly by most students who separated their calculations for A and B making their methods easy to follow and mark. This is a clear improvement on previous series and should be encouraged in the future.

Question 9

Questions involving speed, distance and time are generally not well answered by students, and this continued to be apparent on this question where a significant number of responses were awarded no marks or only one mark. Some students made several attempts using different approaches and different unit conversions with limited success. Correct calculations were seen, and then sometimes an incorrect decision was made saying that Adil had won the race, most often occurring when the times to complete the race were being compared. It should be noted that students who knew how to convert between the different units of time and/or distance usually scored full marks as they appreciated what their calculated values meant in the context of the question.

Question 12

Part (a) was not well answered, with a small minority of scripts being awarded both marks and the majority not gaining any credit. The topic of bearings continues to challenge students in the Maths GCSE. Common incorrect approaches included: using Pythagoras' theorem and working out the length *AC*, giving reflex angle *ABC* = 270°, measuring the angles, giving the bearing of *C* from *A*. The angle of 45° was not identified by many students and those who did were often then unable to use this to find the true bearing of *A* from *C* as required.

Part (b) was also not well answered with many explanations focussing on how to measure bearings in general rather than specifically commenting on why Mia must be wrong. Some responses overlooked that they could have measured the scale diagram and given the accurate bearing as their answer. Many responses said that the bearing should be 292° where they had calculated 360° – 68° from misunderstanding how to use bearings. Other common incorrect responses included: stating the angle must be obtuse (anticlockwise angle from *D*), the use of compass points (eg NE, south-west), measuring a bearing which was outside of the acceptable tolerance [246, 250]°.

Question 14

This question was very well answered, with most students being awarded 3 or 4 marks. Box plots were generally neatly and accurately drawn in pencil using a ruler, although some students still produced hand drawn diagrams in pen which then had a tendency to be out of tolerance and difficult to mark. A few students did not use the printed grid for their box plot or superimposed their answer on the printed box plot for Class A. The main error that was seen was in calculating and then plotting the upper quartile as 20.5 when the interquartile range was incorrectly calculated as 8 + 1.5 instead of 8 × 1.5

A small number of box plots were missing whiskers or contained more than one median line.

Question 15

Most students answered this question fully correctly and understood how to rearrange and use the given formula for population density. Students who did not score any marks generally calculated 168 720 ÷ 278 as their first step of working or just gave 606.9 as their final answer. There was often evidence of premature rounding when students answered the question using Alternative methods 2 or 3. Miscopying of the six-digit numbers given in the question was frequently seen, but the method marks were still available to be awarded to these students.

Question 16

Part (a) demonstrated whether students had learnt the formula required to calculate the volume of a cylinder and in general this was correctly recalled and used in this question by the majority of students. However, a large proportion of the cohort either completely ignored the scale diagram element and used a radius of 3 cm in their calculation instead of 1500 m or tried to incorporate a scale diagram adjustment after finding the area of the circle. Consequently, there were significantly fewer correct responses than might have been expected on a question on this topic at this stage of the paper.

Part (b) was not well answered with the majority of students not gaining any credit. Although marks could be awarded if any box was ticked, there needed to be a correct, relevant accompanying comment, and this was often missing in the responses. More of the students could explain how the change of depth would reduce the volume but then struggled to explain coherently that if the area of the reservoir was larger then the volume could be greater.

Question 17

Part (a) showed good learning of this topic when compared to previous assessments of the product rule for counting. There were few responses which were not fully correct and only a very small number of non-attempts. Students writing out lists of combinations are highly unlikely to score any marks due to it being very inefficient and a high potential for errors.

Part (b) was very poorly answered with most students not gaining a mark from either a correct answer or correct follow through from part (a). It appears that many students assumed this to be a 'both-and' probability question where individual probabilities should be multiplied and

$\frac{1}{160} \times \frac{1}{160} = \frac{1}{25600}$ or $\frac{2}{160}$ were very common incorrect answers.

Question 18

This question appropriately discriminated across the range of abilities of the students, and those who had learnt how to correctly approach a 'show that' question, and could recall the relevant circle theorems, were able to access most, if not all, of the marks. Some students started with the given ratio of 3:1 and, once they found angle $ACO = 7^\circ$, attempted to work backwards to angle *ABO*. As such, they were unlikely to gain more than two marks using this approach. Marks were lost when angles were not correctly identified either on the diagram or in the working: for example, stating $O = 56^\circ$ is not sufficient on its own to gain a mark. Additionally, some circle theorems were incorrectly recalled, and some students incorrectly assumed triangle *ABC* was isosceles or triangle *BOC* was equilateral.

Question 19

Part (a) was well attempted with a good proportion of the students gaining full marks using correct algebra and showing sufficient working. There were few part marks awarded and the main errors arose from: working with perimeter, poor use or no use of brackets, inaccurate setting up of the equation from the diagram and subsequent poor rearranging, attempting to work back from the given equation, no attempt to rearrange their equation to the given form.

Unfortunately, after the exam, we found that there was a mistake on the modified question papers. In part (a), the value on the left edge was incorrect. This mistake only affected the modified question papers – the standard papers were correct. To make sure no students sitting a modified question paper were disadvantaged by this, we've looked at all the student responses to this question and we've estimated marks for question part (a) for any student who got less than full marks for it.

Part (b) was mis-interpreted in many responses which failed to link the final answer to the original question, thereby writing 9 and –10 on the answer line, instead of 9 only and discarding the negative solution because of the geometrical context of the question. Many candidates did not factorise the equation as directed and used alternative methods such as the quadratic formula, completing the square or trial and improvement.

Question 20

This question was very well answered considering its position on the paper, and the majority of students gained full marks with very few non-attempts seen. Some students used an incorrect number of years with their chosen starting value. Those who used a year-by-year calculation approach often introduced rounding errors and then had potential to lose the final accuracy mark. The main error on this question (for which there were no marks) was the use of a simple interest method where £48.96 was multiplied by 4 and then added to the starting amount.

Question 21

This question using the sine rule was answered more accurately than in previous series owing to the students being told to use the sine rule and having access to the formula in the examination paper Insert. Most of the students scoring one mark were able to substitute the values into the correct positions in the formula but were then unable to progress further as they could not correctly rearrange it to make $\sin x$ the subject. Some premature rounding to 0.7 was seen which then gave a final answer outside of the acceptable range. Other students thought that 25.589… was the final answer or were unable to evaluate x from $\sin x = 0.664\ldots$

Question 23

Many students gained at least one mark on this question by correctly substituting $x = 5$ into both equations using Alternative method 1, which was the preferred approach. A good proportion of them continued further and gained full marks using the method of equating $60 - c$ and $15 + d$. Some poor rearranging at this stage lost the final accuracy mark with minus signs being ignored or incorrectly processed. Students who tried to set up and solve simultaneous equations rarely gained any marks after possibly scoring the first method mark, as they found they had a set of equations which could not be uniquely solved. They often then resorted to trial and improvement to guess pairs of values for c and d.

Question 24

This was a demanding question, but there were a significant number of fully correct solutions from the more able students that used correct algebra and showed good understanding of the principles being assessed. However, for many of the cohort, it was a challenging question, and in general either full marks or no marks were awarded. A few students scored one mark for either finding k = 3 or p = 9, but they were then unsure what to do with these values and made no further progress. Other common errors included: incorrectly substituting r and 43.44 into the equation for y, incorrectly rearranging $r^2 + 5 = 43.44$ to $r^2 = 48.44$, working out $\sqrt[81]{4}$

Question 25

The responses to this relatively straightforward histogram question were somewhat disappointing. A significant proportion of the cohort were unable to score the first mark which was awarded for any correct frequency value seen either on the diagram or in the working. Some students mis-interpreted the 'less than 122 grams' as meaning they only needed the area up 121 grams. Attempts at counting small squares were generally unsuccessful. It was disappointing to see so many mis-reads of the vertical scale where the height of the first bar was incorrectly read as 0.3 or 3. There were also many instances of 0.6 × 10 = 60 or 6 + 8 = 12 seen on this calculator allowed paper. These were very basic errors which lost marks for students who probably knew how to answer a histogram question correctly. The relevance of the sample of 80 tubes was often overlooked and final answers of 14 were frequently given. Other common errors included: ignoring the histogram completely and only working out 28000 ÷ 80, adding the heights of the four bars, confusion with other graph work using midpoints, cumulative frequencies, or an estimated mean calculation.

Question 26

Part (a) was quite well answered with many students correctly giving the answer as 13 from using a variety of different acceptable methods. The use of a Venn diagram was helpful for some students, although this alone was not sufficient to gain any part marks. Some confusion between HCF and LCM was apparent as usual and students who gave a non-integer value, non-prime value or negative integer value as their final answer did not understand the topic being assessed. A common error seen was $a^3 = 169$, which was incorrect working and was not awarded a method mark.

Part (b) was not well answered or attempted and was a demanding question for many of the cohort. Students were unlikely to score marks on part (b) without gaining credit in part (a) and marks from follow through were rarely awarded. Venn diagrams were again used correctly by some students to help answer this question, but this was a minority.

Question 27

This question was well answered with relatively few non-attempts for the last question on the paper. A large proportion of the students were awarded full marks for their accurate expanding of brackets and their correct simplifying of algebra. The main errors arose from: inaccurate transcription of the original question onto the working lines, trying to expand all three sets of brackets at once, inaccurate expanding at the second stage of working, inaccurate simplifying after the first two method marks had been scored, basic arithmetic or algebraic mistakes: for example $–7 \times 8 = 56$ or $–3x – 4x = –x$

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