Questions matter

GCSE
Mathematics

8300/3H Paper 3 (calculator) Higher

Report on the Examination

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Contents

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Summary

Overall performance compared to last year

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. There were very few non-attempts throughout the whole paper, even for the questions of highest demand.

Access to the formula sheet helped eliminate some errors owing to incorrect recall but in this paper, the volume of a cylinder was poorly remembered. Minimal miscopying of the formulae was seen. Some students were able to attempt higher demand topics which would normally have been too challenging for them to answer.

Students must continue to be encouraged to show their working clearly. Presentation and setting out of working were occasionally poor and for some students their digits 4 and 9 were often indistinguishable. Handwriting smaller than the font size of the printed question was very difficult to read and often illegible. Students must use HB pencil on diagrams and cross out work they do not wish to have marked with a single line when they have had more than one attempt. Where appropriate, a ruler was used more often on graphs and diagrams than in previous series. Drawing an accurate, smooth curve through six points was poorly completed. Diagrams drawn in pen which needed to be corrected caused problems for many students.

Miscopying numbers that were given in the question was commonly seen, especially when there were four or five digits. Some students miscopied their own work from line to line within a question. Premature rounding lost the accuracy mark in some questions.

It was apparent in some questions that a calculator was not used and errors in very basic arithmetic were frequently seen. Calculators were sometimes not in the correct mode for degrees when used for trigonometry. Writing ‘ans’ in working did not gain method marks without a numerical answer being seen.

Topics where students excelled

- converting pounds to kilograms
- solving algebra with a geometric context
- using and calculating with a pie chart
- finding the nth tern of a linear sequence
- using ratio in a multi-step problem involving money
- finding a missing side using the sine rule
- finding the nth term of a quadratic sequence

Topics where students struggled

- converting centimetres to kilometres
- writing one number as a fraction of another
- using information from a Venn diagram to find a missing value
- finding the equation for a parallel line
- drawing an accurate curve through six points
- finding an upper bound to the nearest 5kg
- writing an algebraic argument
- recalling when to use dotted or solid lines when plotting inequalities
- commenting on terms generated from a quadratic expression in the context of prime numbers
- recalling the formula for the volume of a cylinder
- finding the correct regions when solving a quadratic inequality

Individual questions

Question 1

Most students answered this question correctly. Some used a lengthy build-up method and tended to mix their units which resulted in an incorrect answer. The accuracy mark was not awarded if incorrect further working was seen after 3.75 kg was calculated.

Question 2

The most common incorrect choice was –3 which showed a misunderstanding of the definition of an outlier.

Question 3

Many students reversed the answers for sector and segment. Only just over half of them chose the three correct words. Some students had two lines from a left-hand box which was marked as a choice of answers. It would be beneficial if this type of question was answered using pencil, so that a change of answer could be completed more easily.

Question 4

This question was answered correctly by a significant majority of students. Clear, concise and correct working was often shown. Some incorrect rearranging after the first method mark was awarded stopped some students from progressing further in the question. Common errors included:

- summing the sides to equal 180, or making one side equal to 60
- starting with $6x - 8 + 2x + 12$ and making no further progress
- finding $x = 5$ and then giving $5 + 5 + 5 = 15$ for the total perimeter

The question was overcomplicated significantly when students tried to use the sine or cosine rule, trigonometry, Pythagoras' theorem or the equation for the area of a triangle – none of which were necessary to answer the question correctly.

Question 5

Most students were awarded full marks and all three alternative methods were used equally often. Using alternative method 3 gave some inaccurate final answers owing to premature rounding to 0.16. A common error was to use 30 matches in total instead of 60. Students who introduced percentages into their calculations unnecessarily, tended to struggle to achieve a correct final answer.

Question 6(a)

Just under half the students were awarded full marks with a significant number gaining only two. Converting from centimetres to kilometres incorrectly or not at all were the main reasons for not obtaining a correct final answer. Many students calculated $5.5 \times 200\,000 = 1\,100\,000$ and made no further progress. Common errors included:

- using a distance of 6.5 cm for BC
- using angles
- using Pythagoras' theorem

Question 6(b)

Some students measured the angle and gave an answer of 134 or 136. The question asked to 'write down' the bearing, so a measurement which was not 135 did not gain the mark. Common incorrect answers included 045 or 315.

Question 7(a)

The majority of students gave the correct answer. Some included the words 'days' or 'weeks' on the answer line which were not accepted. Incorrect answers included $1\frac{3}{4}$, $\frac{4}{7}$ and $\frac{14}{8}$

Question 7(b)

Most students gave the correct answer but a significant proportion used an incorrect conversion for centimetres to metres or vice versa. A common error not using any conversion of units at all, gave an answer of 0.04875

Question 7(c)

Most students gained at least one mark for writing the fraction $\frac{2}{10}$ but many were unable to progress to a correct final answer. A very common incorrect method was $\frac{1}{5} \times \frac{7}{10} = \frac{7}{50}$

The accuracy mark was not awarded if decimals appeared in the final fraction.

Question 8

This question was very well answered by the majority of students. Those not gaining full marks often gave their answer as $4n + 2$, $4n$ or $n + 4$. Common misunderstandings included:

- assuming there were three terms between 6 and 18 rather than two
- trying to fit the sequence to a quadratic nth term

Question 9

Many students gained full marks on this question. Finding two thirds of Cat's amount was a common incorrect first step of working. Other calculation errors included:

- 420 ÷ 17
- 420 ÷ 5 × 12
- 280 ÷ 25 using alternative method 2, after correctly finding 8 as the missing part of the ratio

Question 10

Students often started their working by using 60 instead of 100, as they assumed that set A contained 30 items and not 50. Some reached an answer of 44 but proceeded with further incorrect working by subtracting the 20 seen in the intersection. Two very popular incorrect answers were $30 - 26 = 4$ or $60 - 56 = 4$. The overall performance on this question was disappointing and it should have been accessible to more students.

Question 11(a)

This question was not well answered with a significant number of students just rearranging the given equation to $y = 2x + 9$. Some gave an answer with a gradient of $-\frac{1}{2}$, confusing parallel lines with perpendicular lines. Other common incorrect answers included:

- $2y - 4x = 18$
- $y = 2x + c$
- $y = -2x + 9$

Question 11(b)

The majority of students were correct, but with a surprising number of non-attempts.

Question 12

This question discriminated across different levels of ability with a spread of marks being awarded. Just over half the students gained full marks. All the common errors regularly associated with calculating an estimated mean were seen. These included:

- using incorrect 'midpoints', especially for the last two groups
- using upper bounds or class widths in calculations
- working out frequency density values
- dividing their sum by 4 or working out $80 \div 4$
- an incorrect percentage change calculation, often using $\frac{6}{31}$ or $\frac{25}{31}$

Question 13(a)

The vast majority of students completed the table correctly, but a few arithmetic errors were seen. If their values were not increasing, follow through marks in part (b) and (c) were not available.

Question 13(b)

A significant proportion of students were awarded at least one mark for plotting the cumulative frequency points correctly within the acceptable tolerance. However, the standard of polygon or curve drawing continues to be poor. Common errors included:

- curve not starting at either (0, 0) or (20 000, 44)
- curve continuing upwards after (120 000, 90)
- curve 'sketched' rather than a single, smooth line
- curve out of tolerance, especially at point (60 000, 80)
- drawing a bar chart
- using a pen so any errors were very difficult to correct
- using a line which was too thick, covering more than one square

Question 13(c)

Most students gave a value within the acceptable range of [56, 60] either by using their graph or estimating from the grouped frequency table. The accuracy mark was not awarded if further incorrect work was seen: for example, 58 read from the graph, then $90 - 58 = 32$. A small minority of students interpreted this question as requiring a gradient to be taken from the curve at 32 000.

Question 14(a)

The majority of students were awarded at least two marks for this question with a good proportion gaining full marks. An incorrect upper bound for 190 kg was the most common error, with 195 kg predominantly being used by those who scored two marks. Some students did not use any bounds and just added the three quantities given in the question. It would be preferable if recurring decimal notation was not used, as this often leads to errors in the calculation and final answer.

Question 14(b)

This question did not perform well, with fewer than expected fully correct answers. However, part marks were scored by the majority of students. Those who did not gain any marks tended to draw a distance/time graph. Other common errors included:

- non-linear units shown on the axes
- incorrect or no labelling of the axes
- axes not starting at (0, 0)
- a horizontal line drawn beyond 2 hours 30 minutes
- 8.33... miles per minute used but plotted incorrectly on their chosen scale
- a diagonal line drawn on speed/time axes from (0, 0) to (2 hours 30 minutes, 500)

Question 15

Some students attempted to write lists of possible combinations rather than using the product rule for counting. This took a long time and rarely resulted in them gaining any marks. The question discriminated well across the range of abilities with many students scoring part marks. Most understood that odd integers gave five choices, but incorrectly thought that even integers gave only four choices by missing out 0. Common incorrect calculations were $1 \times 4 \times 4$ for Amy and $5 \times 5 \times 5$ for Becky. Some addition of three integers was seen.

Question 16

Very few students gained full marks and this question had the largest number of non-attempts and greatest proportion of zero marks on the whole paper. Those who substituted values of 2, 4 and 6 into the equation with a correct evaluation seen were the most successful in scoring marks. Those who used a positive/negative number approach tended to get tied in knots in their explanation, or missed out crucial details. Common errors included:

- expanding the brackets
- incorrect evaluations of the brackets
- adding their evaluations from the brackets
- referring to -3, -5 and 6 or -90 only or using $x = 0$

- stating facts about multiplying positive and negative numbers with no reference to the context of the question
- only considering the product of two brackets
- making no reference to multiplication

Question 17

This question was correctly answered by a significant majority of students and there were very few non-attempts. Some calculators were in an incorrect mode for working in degrees. The main error was incorrectly rearranging the sine rule for x after correct substitution of the values. Some premature rounding of 12.232... gave a final answer outside the acceptable range. Miscopying of 6.3 as 63 was surprisingly common.

Question 18

More than half the students gave a fully correct answer which showed good learning of the technique to find a quadratic nth term expression. One mark was awarded to many other students who correctly identified the second difference as 4, either stated explicitly or shown on a diagram / in a table of values. Some students showed the correct coefficients $a = 2$, $b = 3$ and $c = 1$ in the working, but gave an nth term expression as their final answer which used other values.

Question 19

This question discriminated well across the range of abilities at this stage of the paper, with a good spread of marks awarded and few non-attempts seen. Very few lines were hand drawn which was a pleasing improvement from previous series. Common errors made by students who did not gain full marks included:

- incorrect use or no use of dotted lines
- use of dotted and solid lines reversed
- incorrect region or no region identified/shaded
- extra vertical and horizontal lines plotted, typically at 1, 4 and/or 5
- straight lines drawn out of an acceptable tolerance, particularly at (–2, 0)

Question 20(a)

A significant number of students gave a fully correct response and others gained one mark for correctly finding one factor. Students who did not score a mark tended to:

- try and complete the square
- create solutions on their calculator and work back to factors incorrectly

Common incorrect answers were $n(3n + 5) + 2$ and $(3n + 1)(n + 2)$

Question 20(b)

Few students gave an acceptable reason why none of the terms in the sequence were prime numbers. Many stated facts about prime numbers that were not relevant to the question or were incorrect. Some correctly commented that the sequence only gave even numbers but made no reference to 2 not being in the sequence, or equivalent. Other common statements which did not gain a mark included:

- the numbers will be a multiple of 3, 5, and 2
- square numbers cannot be prime
- even numbers cannot be prime
- +2 will always make it even
- the terms are all divisible by 2

Almost no students referred to the factorised form of the quadratic from part (a) in their reason.

Question 21

This question was attempted by most students although for many the geometrical knowledge and algebraic skills required were too demanding for them to score a mark. There was an improved consistent use of pi in the working of many students. The cylinder was often considered to be a cuboid. Incorrect recall of the formula for the volume of a cylinder prevented other students from gaining more than one mark. Some students measured the diagram to find a value for the radius which they then used. The difference between the cylinder volume and the volume of the spheres was sometimes calculated rather than writing them as a fraction of each other.

Question 22

Many students were able to rearrange and solve the quadratic equation correctly and were awarded three marks. Students who used a sketch of the quadratic curve tended to be more successful in finding the correct final inequalities. The inequality notation used for the final answer was often incorrect. Other common errors included:

- incorrect rearrangement from the starting inequality
- trying to square root both sides of the starting inequality or rearranging to $x =$...
- no inequality in the final answer
- final inequality chosen as $-4 < x < 1.5$
- incorrect inequality notation used, for example $1.5 < x > -4$
- $x < -4$ often written as $x > -4$
- incorrect substitution into the quadratic formula, for example using $b = 12$ or $c = -5$

Question 23

Many students made at least one correct criticism of the graph, the most popular was to identify that the roller coaster was not shown as starting at ground level. Some students commented about the same criticism twice using slightly different wording. Incorrect criticisms which were frequently seen included:

- there should be labels or a title
- needs more measurements
- needs more numbers
- graph is inaccurate
- should be a straight line of best fit
- should start or stop at 98 m

Question 24

This question was very well answered considering its position on the paper, with almost half of the students being awarded full marks. It performed considerably above expectation and showed that the topics being assessed had been learned thoroughly. Some miscopying of values from the diagrams prevented the accuracy mark being given. Part marks tended to be gained when 26.355 ÷ 2.5 was used without squaring the length scale factor. Common errors which resulted in no marks being awarded included:

- trying to use trigonometry, Pythagoras' theorem or $\frac{1}{2}$ × base × height
- assuming triangle *ABC* was isosceles
- trying to fit the question to the sine or cosine rule
- using 6 cm and 4.4 cm for a scale factor of 6 ÷ 4.4

Further support

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