GCSE

Mathematics

8300/3H: Paper 3 (Calculator) Higher

Report on the exam

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Contents

Summary

This was the first series with changes made to the assessment. Multiple-choice questions were removed from the start of the papers and efforts were made to ensure that more of the beginnings of the papers were accessible to all at higher tier. We have worked hard to ensure that ramping of demand, wording of questions and the contexts used are appropriate. This has led to an increase to some of the grade boundaries. As a result we feel students were better able to demonstrate their mathematical knowledge and appeared to have a more positive examination experience.

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 in the first half of the paper.

Access to the formula sheet eliminated errors owing to incorrect recall and minimal miscopying of the formulae were seen. Some students were able to attempt higher demand topics which would normally have been too challenging for them to answer; for example, where the sine or cosine rule were required.

Students must continue to be encouraged to show their working clearly. Presentation and setting out of working were often poor. Handwriting smaller than the font size of the printed question was very difficult to read and often illegible. Students must use 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.

It was apparent in some questions that a calculator was not used and errors in very basic arithmetic were frequently seen.

Topics where students excelled

- Converting a decimal to a fraction
- Solving a linear equation
- Sharing money in a ratio
- Trigonometry
- Estimation calculation
- Using a relative frequency to find a number of outcomes
- Pythagoras' theorem and area of a triangle

Topics where students struggled

- Using a map ratio with conversion of units
- Drawing a smooth quadratic curve
- Interpreting results from a biased spinner
- Distance-speed-time calculations in a given context
- Taxation and National Insurance calculation
- Solving a composite function equation
- Algebraic proof
- Interpreting a 3D shape from front and side elevations
- Enlargement with a negative fractional scale factor

Individual questions

Question 1

This question was answered correctly by the majority of students giving them a good start to the paper. The most likely incorrect answers were either –3.5 (x-axis intersection) or 2 (gradient).

Question 2

There was a very high proportion of correct responses on this question and those who did not gain the mark generally gave an answer which included a decimal or the answer $\frac{3}{16}$. It would be helpful if notation for fractions was improved with a clear horizontal dividing line between numerator and denominator. Many diagonal dividing lines were seen and sometimes near vertical lines eg 15|8

Question 3

Most students gained full marks on this question and showed correct steps of rearranging. Some students interpreted this as a simultaneous equation question. Common errors included:

- $8x = 30$
- $8x = 8$ followed by $x = 1$
- $2x = 30$

Question 4

Many answers to this question either ignored the conversion of centimetres to metres or performed it incorrectly. Therefore, the majority of responses scored only one mark and those students who divided by 4.5 gained no credit.

Question 5

Some students interpreted this question using a simple interest method and were able to gain one mark if they showed 40 000 or 960 000. Those using a year-by-year method often lost accuracy in the intermediate steps of working out, or inadvertently calculated the number of hedgehogs after 4 or 6 years. It is important to remind students that stating “4% of …” is not sufficient to gain any method marks. Common errors in calculations included:

- using $\times 1.04$ or $\div 1.04$
- using 0.4 for 4%
- $1\,000\,000 \times 1.04^{-5}$

Question 6

This question was not answered well considering its position on the paper and the mathematics being assessed. There was evidence that it was over-complicated by some students who interpreted the question as requiring surface area to volume scale factors rather than a straightforward visual observation. The best responses had a written reason which was precise and concise. Contradictory statements were often given when too much writing or over analysis of the problem was attempted. Ticking an incorrect box automatically scored no marks.

Question 7(a)

Most students correctly calculated the missing coordinates, but some created their own linear function (eg $y = -x$) by looking at a perceived pattern in the table rather than substituting into the given equation. The coordinate at $x = -2$ was most likely to be incorrectly calculated as –8. Some students then attempted to extend the printed graph paper to accommodate this point, rather than appreciating that the value they had calculated was incorrect.

Question 7(b)

Generally there was good accuracy when plotting points on the graph but the quality of the smooth quadratic curve was disappointingly poor. Many students drew curves which did not pass through their plotted points or used straight lines or multiple (feathered) lines. Curves which were completed in pen and subsequently altered were difficult to assess and rarely scored full marks. Students must be encouraged to use a sharp pencil to draw a single, smooth quadratic curve when answering this type of question.

Question 8

This question was answered very well by a large majority of students who used alternative method 1. Clear working out and a correct final decision were shown as required. A few responses lost a mark as either an incorrect decision or no decision were given. Those who gained no credit generally started the question by either calculating 2450 ÷ 2 or 2450 ÷ 5.

Question 9

There were many arithmetic errors on this question which reduced the proportion of students who gained full marks. It was also notable how many miscopying errors occurred, particularly with 255^{o} becoming 225^{o} at a subsequent stage. Some students over-complicated the question by converting to percentages rather than working in degrees, and then lost accuracy in their working out. A common error was using the value 132 as an angle or for the number of people on a Thursday or Friday.

Question 10

Whilst the majority of students answered this question correctly using trigonometry, there were a considerable number who attempted to use the sine rule from the formula sheet. This approach often gained no marks as values were substituted incorrectly into the formula. Other incorrect methods included:

- using $\tan^{-1}$
- using 32° and then choosing sin or cos and using them incorrectly
- $\tan 58 \times 46$ being calculated as $\tan(58 \times 46)$
- calculating $58 \times \tan 46$

Question 11(a)

Clear working out was shown in the majority of answers and most students gained full marks. Rounding to 1 decimal place rather than to 1 significant figure was seen. Calculation of the exact value without any rounding was another common error amongst those responses which did not score. Some students evaluated $(\sqrt[3]{8.34})^2$ first and then rounded it to 1 significant figure before estimating the final value.

Question 11(b)

Students appeared to have difficulty giving a clear reason why the estimate must be more than the exact value. Lots of contradictory statements were given and the estimated value and exact value were often confused within the written reason. Common incorrect reasons included:

- rounding down gives a smaller answer
- rounding down makes the exact result greater
- because she has rounded to 1 sf
- because she is using whole numbers

Question 12(a)

Most students did not realise the significance of the spinner being biased. They incorrectly stated that Cary had the best estimate for the probability of spinning red, as one quarter of the spinner is shown as being red. Common incorrect statements when Ben was chosen often referred to a higher probability of getting red when there are more spins.

Question 12(b)

Students who evaluated $0.185 \times 80 = 14.8$ correctly often then gave a correct statement identifying that you cannot have a non-integer number of spins, or equivalent. Some compared 0.185 to 0.25 or calculated that he had 20 red spins (from 0.25×80) which showed a misunderstanding of the question. The correct calculation was also seen without a supporting statement which did not gain a mark.

Question 12(c)

This question was answered very well with most students showing correct working. Those students who did not gain full marks tended to make one of the following errors:

- worked out 75% of 125
- evaluated 125 – 32 = 93 or 125 ÷ 0.32 or made an arithmetic error eg 1 – 0.32 = 0.65
- calculated the number of red spins (40) and then stopped

Question 13

Assessments involving distance-speed-time calculations can cause difficulties for students and this question was no exception, although a significant majority of the cohort scored 3 or 4 marks.

Conversion between different time formats was the primary source of error. Rounding of $3\frac{2}{3}$ hours to 3.6, 3.7 or 4 hours caused a loss of accuracy for the latter part of the question. Other common incorrect time conversions were:

- $3\frac{2}{3}$ hours became 3 hours 36 minutes
- 328 minutes became 3 hours 28 minutes
- 5.46 hours became 5 hours 46 minutes

Students who scored 3 marks generally completed all the calculations correctly but then made an incorrect decision about Charlie being home by 2.30 pm or omitted to make a decision. Most answers showed clear step by step working. A few students were not awarded a method mark when 3.6 appeared with no supporting working or evidence of a more accurate value.

Question 14

This question was not answered very well by a significant proportion of students although most of them made an attempt. Many students used a build-up approach particularly for the 13.25% calculation and some rounded to 13.5% or even 13% thereby making the question considerably easier. Build-up rarely gave a fully correct answer and use of the phrase "13.25% of …" was not sufficient for a method mark. Miscopying of the three values given in the question was common. The main sources of calculation error included:

- not adding the tax-free allowance to £25 930
- not subtracting the National Insurance allowance of £9880
- using a multiplier of 0.8675 for the National Insurance

Question 15(a)

Some students could not access this question at all. There were many inaccurate values read from the graph for the frequency density. Arithmetic errors occurred when adding the frequency values which was disappointing to see on a calculator allowed paper. Final answers of 152 showed that the question had not been read carefully enough.

Question 15(b)

This question was answered well with most responses showing a box plot in the correct format neatly drawn with a ruler. Some students misread the horizontal scale and some incorrectly added a line at 9 miles to indicate the interquartile range. The box plot should be completed using a sharp pencil as errors made when using a pen are very difficult for the student to amend.

Question 16

This question required knowledge of ratio, Pythagoras' theorem and the area of a triangle, so it was pleasing to see that a significant majority of responses were fully correct. Those students who only scored one mark found the length of c correctly using the ratio, but were then unable to progress further. Use of the sine rule unnecessarily overcomplicated the question and was often applied incorrectly. Common errors included:

- dividing 16 in the ratio 4:5
- finding b as 12 cm and not progressing to calculate the area
- working out the area as 12×16 without any division by 2
- assuming the triangle was isosceles
- incorrectly applying Pythagoras' theorem as $16^2 + 20^2 = b^2$

Question 17

This question was attempted well by students and a majority gained full marks. This type of question was slightly more straight forward than the subtraction of two algebraic fractions or working with an algebraic denominator. Some good algebra was shown with neat setting out although a few basic errors in expanding brackets occurred. Incorrectly manipulating or completely ignoring the denominator were the main errors: eg $3x + 58 = 4$ giving an answer of $x = –18$. Multiplying the first fraction by 2 and the second one by 5 or multiplying the right hand side by 10 and the left hand side by 100 were commonly seen. Students who attempted to use a denominator other than 10 rarely progressed through to a fully correct solution.

Question 18(a)

There was much improved performance on this composite function question when compared to previous series with a significant proportion of students gaining full marks. The main error was multiplying the functions together rather than substituting g(x) into f(x). Students who scored part marks generally expanded the brackets incorrectly with two errors after gaining the first method mark or simplified the fully expanded expression incorrectly.

Question 18(b)

Many students attempted this question by evaluating fg(–5) instead of setting up an equation to solve fg(x) = –5 Those who did form a correct equation were then generally successful in obtaining the correct solutions by using the quadratic formula or factorisation. Provision of the formula to students in this series enhanced the accuracy of responses for this question compared to when learning and accurate recall were required.

Question 19

There was an improved performance on this question compared to previous series with many responses showing a correct, clearly set out step-by-step algebraic proof. Students who gained no marks were generally only trialling numbers or attempting an algebraic approach using two variables. Missing brackets were commonly seen, eg $x \times x + 6$ and this resulted in a mark not being awarded for those who made no further progress with the question. The final accuracy mark was not given to students who stopped at $(x + 3)(x + 3)$ for example, or who missed out the factorisation stage completely.

Question 20(a)

Many students correctly answered this question but a significant proportion omitted to state that the equation was correct and did not gain a mark. Some just gave a coordinate answer and overlooked showing substitution into the equation as required. Sometimes the values of D and E were reversed, or pairs of values were chosen which were not shown on the graph.

Question 20(b)

This question performed as expected for assessing proportionality. Those who read and interpreted the first line and set up a correct proportionality equation were then able to go on and potentially score full marks. However, incorrectly using the initial ratio to find the value of G prevented some from progressing further than scoring the first method mark. Many values of $G = 6$ (from $4 \div 2 \times 3$) were seen which lead to a final answer of 3:2. Students using alternative method 2 rarely scored more than one mark as they were unable to work beyond finding 6.25.

Question 21

This question proved to be a challenging one for most students with very few fully correct responses seen. A correct area for the side elevation was awarded a method mark and this was gained by many students. Some of them proceeded to correctly work out the maximum number of cubes for the solid shape as 792. Understanding how the shape would look for the minimum number of cubes required greater spatial skills and 174 was a common incorrect answer. The question was mis-interpreted by some pupils who read the words ‘maximum’ and ‘minimum’ and then proceeded to attempt some upper bound and lower bound calculations on the number of cubes.

Question 22

There were many answers which used combined transformations and these automatically gained no marks – rotation with enlargement being a very popular incorrect interpretation of this single transformation. The scale factor was often given as either $\frac{1}{2}$ or –2 and students who did not use the diagram to help find the centre of enlargement generally guessed it as (6, 4). Accurate learning of this topic must be encouraged including the correct use of the word ‘enlargement’. ‘Reduces’, ‘gets smaller’, ‘shrinks’ or ‘negative enlargement’ are not acceptable alternatives.

Question 23(a)

The students who correctly identified that the cosine rule was the easiest way to answer this question generally gained at least one mark. However, many of these failed to gain the second mark as they did not explicitly show the square root stage, which was a requirement for this 'show that' question. 78.9(…) was also not shown in some responses and attempts to use right-angled trigonometry were rarely correct.

Question 23(b)

Owing to the provision of the sine rule and cosine rule formulae, more students than might have been expected were able to gain some method marks on this question. Those using the cosine rule were more likely to struggle with the required rearrangement of the formula. After angle *ACB* or angle *BAC* were correctly calculated, many students were either unable to work out the bearing of *A* from *C* or overlooked this last part of the question.

Further support

Mark ranges and award of grades

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Enhanced Results Analysis (ERA)

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Contact us

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Tel: 0161 957 3852

Email: maths@aqa.org.uk

aqa.org.uk