GCSE

MATHEMATICS

8300/3H: Paper 3 (Calculator) Higher

Report on the exam

November 2022

Contents

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Summary

Overall performance compared to last year

The number of entries and the general performance on the paper were similar to the November 2021 series, where only a small proportion of the students were likely targeting the highest grades. Many of the more demanding questions had few fully correct answers, although there was evidence that students did have enough time to attempt all the questions within their capability: for example, Question 24 had a very low number of non-attempts which is not always the case at this point in the paper.

Many of the longer, multi-step questions discriminated across the range of abilities with students gaining part marks even if they were unable to correctly make progress to the final answer. Good quality working out with clear writing was seen on many papers. However, there are still students who either write too small, misread their own writing, miscopy values within the question or do not use a calculator when they should, leading to marks being lost which would likely be awarded to them if they were more careful.

Topics where students excelled

- identifying a correct power
- converting standard form into an ordinary number
- working with ratio in a money context
- using mean values and frequencies from a table in a calculation
- reading points from a graph
- substituting values into a formula
- calculating compound interest.

Topics where students struggled

- working with a sequence
- finding the gradient of a line without a diagram
- identifying a transformation from congruent shapes
- recalling the equation of a circle
- conditional probability
- manipulating three algebraic terms into a single fraction.

Common misunderstandings

- if x is 200% of y, then the values of y must be double x
- in a sequence, n can be a negative or decimal value
- to find the length of a side of a square when given the area, the value is divided by 2
- the angle at the centre of a circle is half the angle at the circumference
- a value decreasing by 35% uses a multiplier of 0.35
- sin 110.5 has a greater value than sin 109.5

Multiple choice questions

Multiple choice questions were not attempted by some students.

Which questions did students find most accessible

Question 1: finding the power of 2 which gives 32.

Question 2: changing a number in standard form into an ordinary number,

Question 3: expanding a single set of brackets.

Which questions did students find least accessible

Question 4: interpreting 200% in the context of an inequality.

Individual questions

Question 5

Many students significantly overcomplicated this question by thinking that Pythagoras' theorem or trigonometry needed to be used to find the area of the triangle, or that the trapezium should be divided up into two or three separate areas. Consequently, it was not as well-answered as would be expected for a question at this stage of the paper especially when assessing this topic. Calculating the perimeter or poor calculation of the area of the trapezium when using the formula were also commonly seen.

Question 6

This question was well-answered by a majority of the students who correctly calculated the amounts for Kim and Lisa and then showed that all three amounts summed to £240. No further comment or comparison was required to gain full marks. The most common error was 72 ÷ 11 as a first step.

Question 7

Part (a) was not well-answered with most students not using an algebraic approach (shown in the mark scheme as alternative method 2). Often 40 was written down as the value of x without appreciating that in fact $2x = 40$. Introducing a letter for the third term in the sequence rarely lead to any marks being awarded.

Part (b) was very poorly answered with only a small proportion of the students gaining the mark. Many responses referred to n as being negative or used a decimal value for n as an example.

Question 8

Most students answered this question correctly and there were very few non-attempts. Those who did not gain full marks either left their answer as a fraction when a decimal was required, or misunderstood how to calculate the total heights for each club and divided the mean height by the number of members.

Question 9

Students who drew a sketch of the relative positions of *P* and *Q* were more likely to get full marks on this question as they could visualise that the gradient was negative. The question was not well-answered and the majority of students did not score any marks or attempt it at all. There was evidence of incorrect recall of how to calculate the gradient from the change in x and change in y values.

Question 10

This question was not well-answered and it appeared that many students did not understand what they were being asked to calculate. Common errors included: dividing 50 by 2 and just adding 25 to 122 and 128; using 0.49 as the relative frequency of the extra 50 spins only; stopping work once the values 147 and 153 were found and not working out the values just for the extra 50 spins as required.

Question 11

This question discriminated across the range of marks and there were few non-attempts. Some students completed the calculations correctly but then failed to give their answer to 2 significant figures as required. Other common errors included: not dividing their equation for circumference by 2 for the length of the semicircle; adding 45 and 75 as a first step ignoring the semicircle; incorrect recall of how to find an average speed from distance and time values. The formula for the area of a circle was selected and used by a small number of students.

Question 12

It appeared that the word 'congruent' confused many students on this standard transformation question and they thought that an in-depth description of how the triangles were congruent point by point was required. More than one transformation being used, poor recognition that the transformation was a translation and incorrect vector notation were commonly seen in the responses. Those who tried to give lengthy descriptive answers often contradicted themselves or used language that was ambiguous, such as 'across' instead of specifically 'left' or 'right'.

Question 13(a)

Many students answered this question correctly and there were very few non-attempts. Those who did not gain the mark tended to either use incorrect statements, referred to the diagram only showing red, blue and green counters, or stated that the probabilities added to a whole number rather than specifically adding to 1. Students should be encouraged to write precise and concise statements when the question requires this type of response and reminded that incorrect or contradictory comments alongside a correct one will normally gain no marks.

Question 14(a)

A large proportion of the students gained no marks on this question as they made an error in the first stage of their working out when trying to find the length of an edge of cube X. Commonly these errors were: $784 \div 2$ or $784 \div 6$ or 784×6 or 784^3. Some students were also unable to correctly recall the formula required to work out density and an incorrect conversion of 10.976 kg to grams was often seen. Miscopying of digits onto the working lines from the question also occurred on a significant number of occasions.

Question 15

Part (a) was very well-answered with many students identifying the correct position on Graph A, reading the scale accurately and gaining full marks for the time of 10:26 am. However, misreading the position on the horizontal scale as 23 minutes was a common error.

Part (b) was well-answered with a good proportion of the students using both graphs correctly to find the answer of 80%.

Part (c) was not well-answered as only a handful of students realised that firstly a tangent needed to be drawn on Graph B at 90% charge and then the gradient must be calculated from this tangent. Students should be reminded that the word 'rate' in the question is telling them exactly the method they need to use when being assessed on this topic. A few responses which did have a tangent correctly drawn failed to gain the second mark as the scales on the graph were incorrectly read.

Question 16

In part (a) it is important that students practise how to form a proportionality equation from the statement given in the question. Many overlooked the word 'inversely' and therefore were unlikely to score any marks unless they worked through to gain the Special Case mark. Square root was often used instead of cube root, both in forming the equation or in calculating the value of the constant. Some students correctly found the value of the constant (28) but then did not proceed to substitute this into their equation connecting H and L.

Part (b) was not well-answered as the equation from part (a) needed to be used to find the value of H when $L = 2744$. A few students restarted the complete question in part (b) and were then able to evaluate the correct answer.

Question 17

This question was quite well-answered with the majority of students gaining some marks and a significant proportion were awarded full marks. The circle theorem was incorrectly recalled by some students who worked out that acute angle *BOD* = 16°, halving angle *BAC* instead of doubling it. Marks were lost if the right angle was not correctly positioned on the diagram or correctly identified in the working. A common error was 90 + 64 = 154 followed by 360 – 154 = 206

Question 18

Completing this question accurately was inaccessible to many students sitting this paper, although a significant number were able to gain one mark if they correctly expanded the brackets in the original equation. A number of students misread the question and thought there were two sets of brackets which needed expanding, ie $(9m + 4)(2m - 1)$. An incorrect expansion of the single bracket could still be awarded up to two method marks for correct rearranging and factorising seen. Common errors included: division by p or division by m or factorising the right-hand side as a first step; taking the square root of every term individually or collectively.

Question 19

It is likely that this topic had not been taught to many in the cohort as only a small number of students could correctly recall the equation of a circle and were also able to work out that the radius was 11. There were many attempts to use the equation of a straight line or to calculate the gradient between the two points.

Question 20

Part (a) was quite well-attempted but many students made basic errors through which they lost marks. The three probability values were often added or 3×0.9 calculated. 0.65 was also incorrectly used as one of the three probability values needed to answer this question.

Part (b) was one of the least well-answered questions on the paper with only a small proportion of students gaining any marks. It is important that students are reminded to read through the full question again when attempting part (b) in this style of assessment, to fully assimilate relevant information. Common errors included: working with three probability values instead of two; working with times; adding individual probabilities; using incorrect combinations of ‘leaves on time’ and ‘does not leave on time’ probability values.

Question 21

In part (a), each of the incorrect responses was equally popular in this question showing that enlargement using a scale factor between 0 and –1 was not widely understood or practised by this cohort.

In part (b), students who used the diagram to draw on correct construction lines were generally successful in identifying the centre of enlargement.

Question 22

Completing this question accurately was beyond the ability of many students sitting this paper, although a reasonable number were able to gain one mark if they found one correct term with a possible common denominator, typically this was $\frac{6}{3(x+1)}$. Manipulating the term containing $4x$ caused the greatest problem for those who attempted to go further with the question. It is always disappointing when a fully correct answer is seen and then the student introduces some incorrect further simplification or solving such that the final mark cannot be awarded.

Question 23

This question was well-attempted and a significant majority of students gained some marks. Those who worked in terms of pi were generally successful in getting full marks and the correct use of the given formulae allowed two marks to be awarded to many students. There was some evidence of poor calculator use especially when values should have been either squared or cubed and the calculation was performed incorrectly. Some responses showed confusion over which volume values should be subtracted to get the final answer. Finding the height of the small cone caused the greatest problem when it was not identified as being similar to the large cone – subtracting 3 or 9 from 30 was commonly seen.

Question 24

The full range of marks were awarded on this compound percentage question and it discriminated appropriately across the ability of the cohort. It was very well-attempted, particularly at this stage of the paper, with many responses showing clear, accurate calculations. Noteworthy points of feedback on this topic include: the use of simple interest methods gained no credit; build-up methods or year-by-year calculations often lost accuracy at intermediate steps through truncating or incorrect rounding; and 5200 + 4% is not acceptable as a method. Some students did not gain the final mark as they did not find both values at year 4 as well as both values at year 5. As this was a 'show that' question, it was essential that these four key values were correctly calculated and seen.

Question 25

This question was the least well-answered on this paper with the majority of students not attempting it or gaining no marks, thereby emphasising the high demand nature of a question assessing bounds within a given context at this point in the paper. Some students gained one mark by giving any of the six bounds or from identifying and using the correct equation for the area of the triangle without using any bounds. Most students who identified that bounds were needed to answer this question incorrectly used 110.5º as their angle in the formula. Other common errors included: using ½ × base × height for the area of the triangle, only using bounds for the lengths and not the angle, using lower bounds for the area calculation, using 7.24 or 13.64 as the upper bounds for the lengths, trying to find an upper bound after calculating the area, using Pythagoras' theorem or the cosine rule to work out the perimeter of the triangle.

Question 26

Part (a) was well-attempted and a good number of correct responses were seen, especially considering the position on the paper and the topic being assessed. When drawing a sketch of a graph students should be reminded to use a sharp pencil and only draw a single smooth curve. There is no need for them to create a table of values or to try and plot points.

Part (b) was less well-answered, although the majority of students did make an attempt to sketch the graph. Often the sketches were shown to incorrectly pass through (0, –1) or they passed near to (0, 0) instead of accurately passing through the origin as required.

Further support

Mark ranges and award of grades

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