AQA
Realising potential

GCSE
Mathematics

8300 1H: Paper 1 (Non-calculator) Higher

Report on the exam

November 2021

Contents

Summary

Overall performance compared to last year

The performance was similar to November 2020.

Topics where students excelled

- laws of indices
- product of prime factors
- standard form
- adding fractions
- completing a tree diagram
- units of density

Topics where students struggled

- equating coefficients in identities
- drawing a box plot
- written explanations
- probabilities from a tree diagram
- nth term of a quadratic sequence
- using the formula for the area of a non-right-angled triangle
- transformation of curves
- invariance

Multiple choice questions

Which questions did students find most accessible

On each of the multiple choice questions more than half of the students chose the correct option. The question with the most correct answers was Question 1.

Common misunderstandings

Question 1

The incorrect options chosen most frequently were a^8

Question 2

$\frac{4}{10}$ Presumably from students not understanding the inequality symbol.

Question 3

Hexagonal prism

Question 4

$y = k - x$

Question 14

$\frac{7}{2x}$ the standard error of adding the numerators and adding the denominators

Question 17

Subtracting $\begin{pmatrix} -5 \\ 8 \end{pmatrix}$ the wrong way

Question 20

cm^3/g

Question 24(b)

$\frac{2x^2 - x}{2}$

Individual questions

Question 5

Most students used a factor tree, but there were several instances of arithmetic errors. For example, 10 was often split into 5 and 5. Many students lost a mark by not writing their answer in index form, even though they had found three 2s and two 5s.

Question 6

Those students who converted the ages into months were generally correct, but many put 20 as the numerator of their fraction instead of the denominator. Some students added or subtracted the 28 and 20, although how that relates to the question is unclear.

Question 7

Some students ignored the instruction to use approximations and tried to use the given numbers. This inevitably resulted in no marks and a lot of time wasted. Most students who rounded did so correctly, with 0.49 being rounded to 1 the most common error. Of the sizeable number of students who arrived at $\frac{18}{0.5}$, a fairly large proportion gave the answer 9. Students find dividing by a decimal difficult, and it is a skill that would benefit from repeated practice.

Question 8

Strongest responses

The most successful students treated this in the same way as they would an equation, subtracting $3x$ and 6 from each side and then dividing by 2.

Weakest responses

As usual, common mistakes were adding $3x$ and 6 instead of subtracting and changing the inequality sign to an equals sign.

Question 8(b)

A fair proportion of students failed to include x in their answer, with responses such as $2 < 5$. Others thought there was a single solution, such as 3. Some students had their inequality signs facing in different directions, which they may have realised was illogical had they thought what this means.

Question 9

Many students simply made the coordinates of P positive, and many others added 2 and 6 to the lines of symmetry to get the answer (3, 11). A relatively large number of students gave answers with negative coordinates. Although the graphic is not drawn accurately it should be clear that this is not a possible answer, and students should be encouraged to consider how sensible their answer is in all questions.

Question 10(a)

Most students scored at least one mark be either working out 140 000 000 or converting one of the given numbers to standard form. It was common for students who multiplied the corresponding parts to get 14×10^7 to give that as their answer.

Question 10(b)

Strongest responses

Students who converted the numbers to 180 and 0.3 were much more successful when they converted them to 1800 and 3 before attempting the division. Students who divided the respective parts to get 0.6×10^2 were also usually successful.

Weakest responses

Many students converted the numbers to 180 and 0.3 but could not then do the division, with 6, 60 and 540 being the most common incorrect answers.

Question 11

Strongest responses

Students who annotated the graphic were usually more successful than those who didn't. Students who achieved the correct answer understood that half an hour at 62 mph is 31 miles.

Weakest responses

Many students try to use the time/distance/speed triangle when answering questions of this nature, when it is usually much more successful to just think logically. For example, 48 miles per hour for 15 minutes is just 12 miles as 15 minutes is a quarter of an hour. Students would do well to practice with that type of calculation. Here, many students multiplied 30 by 62, ending up with answers in the thousands of miles.

Question 12

Strongest responses

Students who set up a correct trigonometric equation and knew that sin 30 = 0.5 were generally correct.

Weakest responses

Many students set up a correct equation but did not know the value of sin x. The weakest responses were from those students who divided 30 by 10 to get an answer of 3.

Question 13

Strongest responses

Those students who were well practised in long division fared best when answering this question.

Weakest responses

Relatively few students knew to divide 5 by 6 here, with many dividing 6 by 5. Those who did try to divide 5 by 6 often gave the first digit as 1. Those who tried to work out 1/6 and then multiply by 5 usually went wrong with their value for 1/6, with 0.15 or 0.155… common incorrect values.

Question 15

Strongest responses

Students who expanded the brackets and equated coefficients were the most successful. Students who used the ratio 1 : 3 and knew that they multiplied to give 75 often got 5 and 15, leading to an answer of 20 for 2 marks.

Weakest responses

Most students tried to expand the brackets, with many going wrong by giving x x x = 2x and/or a x 3a = 3a. Those who were correct usually failed to realise that with identifies you can equate coefficients, so either tried to use the quadratic formula or simply substituted random numbers.

Question 16(a)

Most students knew that they had to go up to the curve from 21 on the horizontal axis, but many gave their reading as the answer and/or were not accurate in their reading to get both marks.

Question 16(b)

Generally, students showed little understanding of this topic. Very few showed any working on the cumulative frequency diagram to find the median and quartiles, and those who knew the shape of diagram that was needed often put the quartiles at 15 and 25 and the median at 20. A proportion of students gave the median as 21, presumably using the value given in part (a).

Question 18(a)

Strongest responses

The best responses simply said that the length of side AB must be greater than the sum of the lengths AC and BC.

Weakest responses

Students should realise that at this level their statements should give a full reason rather than simply stating a fact. So, answers such as ‘13 + 17 = 30’ is meaningless unless it is accompanied by an explanation of how this relates to 35. Similarly, answers such as ‘It is too long’ are only acceptable if accompanied by an explanation of why.

Many students used Pythagoras to try and work out the length of AB and others simply said it had to be 30 cm. A smaller number of students used angles in their statement, even though no angles were given in the question.

Question 18(b)

Strongest responses

The best responses said that the x and the 31 should be swapped or that you can’t have the sin of a side.

Weakest responses

Most students criticised the rearrangement of the equation, even though the rearrangement is correct, some said that she should be using cos or tan instead of sin and others said that it should be the inverse function.

Question 19(a)

Most students put 0.1 on the left-hand branch, but many failed to get the right-hand branches correct, with all kind of inexplicable numbers given.

Question 19(a)

Strongest responses

Those students comfortable with combined probability arrived at the correct answer with a minimum of fuss.

Weakest responses

Most students concentrated on the two ‘Fail’ branches, either adding or multiplying the two probabilities. Decimal multiplication proved difficult for many students.

Question 21

Strongest responses

Although there are many ways to work out the required expression the most successful students generally used the $2a = 6$, $a = 3$, $3 \times 3 + b = 7$, $c = -2$, $3 – 2 + c = 10$ method.

Weakest responses

Despite being told that it was a quadratic sequence most students gave an expression for the nth term of a linear sequence. They usually put 6 in front of n, with $6n + 4$ and $6n + 1$ popular. Most students scored one mark for working out the next two terms, although there were several arithmetic errors made in that calculation

Question 22

Strongest responses

Students with an understanding of negative indices generally wrote down $\frac{7^2}{5^2}$ and $\frac{49}{25}$ and then the correct answer. Some, however, were unable to correctly enumerate 7^2, with 14, 35 and 59 given.

Weakest responses

The modal approach was to change this to $\frac{(-5)^2}{(-7)^2}$. This led to a proper fraction, but many students managed to transform these into mixed numbers.

Question 23

Strongest responses

Successful students often showed precise and efficient working. The neatest method is perhaps to square everything first, swap y^2 and $x + 1$ and then subtract 1.

Weakest responses

Many students started by subtracting one from y and one from the root, getting $y - 1 = \frac{1}{\sqrt{x}}$. This incorrect method of moving a term from one side to the other was repeated regularly in other procedures. Other students thought that to remove the root sign on the right you put it on the left, getting $\sqrt{y} = \frac{1}{x+1}$. Students who correctly multiplied across for the first mark then forgot to square the y as well as the root and the 1.

Question 24(a)

Strongest responses

The most efficient way that students found to answer this was to treat it as an arithmetic progression or equation of a function. Working out the common difference or gradient soon led to the full answer.

Weakest responses

Many students were able to construct the simultaneous equations, but weren't able to progress from there, perhaps because of the way they had written them, often $c4 + d = 7$ and $c10 + d = 15$.

Question 25

Strongest responses

The most efficient way to answer this question is perhaps to convert $\sqrt{150}$ to $5\sqrt{6}$ and convert the denominator to $\sqrt{6}$. Dividing throughout by $\sqrt{6}$ gives 5 – 1, which is 4.

Weakest responses

Many students started by converting $\sqrt{150} - \sqrt{6}$ to $\sqrt{144}$. There were also much incorrect cancelling at all stages of the work, with some students correctly converting the denominator to $\sqrt{6}$ and cancelling the $\sqrt{6}$s (incorrectly) to leave $\sqrt{150}$.

Question 26

Strongest responses

The most successful students substituted $2f$ for d and manipulated the equation to get $6f = 5e$. As is often the case with linking such equations to ratio, a fair proportion of these students then gave the answer as 5 : 6 rather than 6 : 5.

Weakest responses

Some students did a large amount of manipulative algebra without ever substituting $2f$ for d, thereby making no progress. Students who made the correct initial substitution often then made a mistake when cross-multiplying, ending up with the numerators multiplying each other and the denominators doing likewise.

Question 27

Strongest responses

Students who used the sine formula for the area of a triangle and who knew the value of sin 60 often arrived at the correct answer.

Weakest responses

Some students found the perimeter of the circle instead of the area and many students used the 0.5 × base × height formula for the area of the triangle but used 5 for both the base and the height. Unusually, a fair proportion of students combined the angles and lengths in their calculations, for example dividing 60 by 5 to get 12. Presumably this was due to 12 being the required denominator, but students should have realised that this was an incorrect way to find it.

Question 28(a)

Strongest responses

Some students clearly knew what the graph should look like from the equation. Of those who didn't, the only ones to succeed were those who substituted two or more standard values of x into the equation and plotted the resultant points, which gave them the general transformation.

Weakest responses

A large proportion of the students made no attempt at this question. Of those that did the modal answer was a translation 90° left.

Question 28(b)

Strongest responses

The best graphs went through the points (0, 2), (90, 1), (180, 0), (270, 1) and (360, 2) and had the same curvature of the original.

Weakest responses

More students were successful with this part than with part (a). Those who realised that the curve started and ended at 2 did not always maintain the distance of 1 from the original curve. We particularly checked the point (180, 0). The modal incorrect answer was to simply overwrite the original curve.

Question 28(c)

Strongest responses

The best responses stated that the graph shown was $y = -\cos x$ or that $\cos(-x) = \cos x$.

Weakest responses

Many of the responses were very imprecise and mathematically woolly. At this level, students should be able to clearly convey a mathematical argument. For example, simply saying “Reflected in the y-axis’ does not say whether the graph has been reflected in this manner or if it should be.

Question 29

Strongest responses

Successful students usually drew the image and gave a full description of the rotation.

Weakest responses

Some students continue to give a combination of transformations, despite it being made clear in the instruction that it should be a single transformation. Others use the word ‘turn’, whereas at this level the word ‘rotation’ should be used. Students who didn’t try to draw the image were usually unsuccessful.

Further support

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