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GCSE (9-1)

Examiners' report

MATHEMATICS

J560
For first teaching in 2015

J560/04/05/06 November 2019 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 4 series overview

General Comments

This calculator paper is the first of the three papers taken by Higher candidates for the GCSE (9-1) Mathematics specification.

The entry for this paper was low. A few candidates were trying to improve a high grade whilst the majority were trying to achieve a grade 4 or 5. The effect of the entry on the scores were to skew them slightly.

The problem solving questions were usually well answered, partly due to the fact that they targeted the lower grades available in this paper, but the flow of work was sometimes difficult to follow.

In the questions that did not involve problem solving, candidates still struggled to obtain the required answers.

Questions involving the use of calculators contained many errors; too often intermediate figures were truncated too prematurely, indeed the final answer was often truncated instead of rounding it up.

Questions

Question 1 saw a number of methods adopted. The most successful method was to show that 90 cards can be produced in 3 days usually by finding that 1 card takes 16 minutes and dividing the total time in minutes (1440) by 16. Many candidates do find it difficult to convert between units of time.

In Question 2, many candidates were unable to correctly work out the expression using a calculator. Most of the errors centred around the square root which sometimes was not applied and other times they did not square root both values in the denominator of the fraction.

In Question 3, the most common approach was to build up the times until a common time was found. However, there were a surprising number of errors in repeating the addition of 25 and 45.

In part (a) of Question 4, candidates had to show that Bob required 500 kg of sand. However, many used the 500 to establish the result which cannot be rewarded with full marks. In part (b), the candidates were often unable to work out the number of bags of each component Bob required to make the concrete. This question also required candidates to set their working out clearly.

In Question 5, most candidates knew how to expand double brackets. However, errors were made in the manipulation, particularly $+ xy – 12xy$ which was often simplified to $– 13xy$.

In Question 6, candidates were required to multiply the ratios to make the 'sherbert' component in both ratios equal. Those who divided down ran into infinite decimals which were best handled using fractions.

The first three parts of Question 7 were usually well answered. In part (d), some candidates were unable to correctly count the number of students that had a lower Test 1 score than Test 2 score. However, they could produce a correct percentage from their figure. This part also highlighted the tendency of candidates to truncate decimals, for example 41.666… was often truncated to 41.6 rather than rounded up to 41.7.

Question 8 required two linear simultaneous equations to be written down and solved. Some candidates could not write the two equations down, despite the fact that the question was set out to aid this method. The candidates who tried to guess the answers usually failed in this approach.

In Question 9 part (a), many candidates did not write down the equation and got the order of operations incorrect. The × 3 often did not include the − 4 term so $3k - 4 = k$ was often seen. In part (b), candidates did not use the inverse of the operations and in part (c) they demonstrated that they could not work backwards through the diagrams.

Question 10 was also well answered. In part (a), some candidates wrote 169 950 from the next year, 2011. In part (b), a few wrote 1.03 instead of 3.

Question 11 was an attempt at proof and it was not well answered at all. In part (a), very few candidates stated that there was no information about the sides. In part (b), the discipline of proof was missing. It is not sufficient to state that two sides are equal or they have equal angles, without clearly stating which sides or angles are equal, using the correct notation, and then justifying those statements.

Question 12 proved too difficult for most of the candidates. Part (a) required a reading at frequency 30, however many read from frequency 35. In part (b), all that was required was to read the graph at the numbers given. Many did this but then started to add the frequencies together. Part (c) was not answered well at all. A few candidates wrote down the groups using the table in part (b). Very few could work out the individual frequencies from the cumulative frequencies. After that the method to find the mean was the usual one of using the group midpoints.

In Question 13(a), many candidates had forgotten that the scale factor of volume is the cube of the length scale factor. In part (b), they did not use the product rule to find the number of different ways with many candidates attempting to name colours and write down all the possibilities.

Question 14 was the final problem solving question and only the higher achieving candidates were able to answer this using the rule for the gradients of perpendicular lines. Any other method always failed to produce the correct answer.

Question 15(b) was a two-stage sine rule question, in that they had to find angle ABC first and then subtract the two angles from 180 to find angle ACB. Some candidates attempted to use the cosine rule but this had been the target of part (a). This question tested when to use these rules as much as testing the use of these rules.

Question 16 required candidates to use $(x + 1)(x - 1) = x^2 - 1$ otherwise the expansion of brackets and subsequent factorisation becomes more difficult.

Question 17 tested candidates' knowledge of the shape of graphs and many did not know this one.

In Question 18, both parts (a) and (b) were answered well. In part (c), a decimal answer is not exact so a surd was required as the answer.

In Question 19, candidates were expected to draw a tangent at $x = 5$ and then find the gradient of that tangent. Good attempts at chords were also rewarded.

Paper 5 series overview

General Comments

This non-calculator paper is the second of the three papers taken by Higher candidates for the GCSE (9-1) Mathematics specification.

There was a small entry for the November resit paper with many more candidates entered for Foundation tier than Higher tier. There was a range of marks with all candidates able to access some parts of the paper. There were a few higher ability candidates aiming for the highest grade but most appeared to be aiming for the 'pass' grade 4 or grade 5.

Questions

Work was generally well presented but some candidates still chose very random approaches in their working to some of the problem solving questions like Question 10 where a more structured approach would have benefitted.

On questions involving diagrams, such as Question 8(b) and Question 15, those candidates that annotated the diagrams to support their working and answers had more success.

On questions involving written reasons, answer lines are provided and candidates should use this as a guide as to the amount of work needed. Four lines, as in Question 11, indicates that four points may be required in the complete answer. Candidates should use correct mathematical terminology when giving reasons and this is particularly important in geometry. When describing transformations, candidates should give a **single** transformation and be aware that extra transformations will result in no credit being given.

On this non-calculator paper, a number of candidates showed insight and saved time when processing. For example, on Question 4, some candidates having obtained the correct fraction $\frac{30}{250}$ realised that this was equivalent to $\frac{3}{25}$ and then converted to $\frac{12}{100} = 12\%$. Those that attempted a long division to convert $\frac{30}{250}$ to a decimal and then a percentage usually could not complete this correctly.

The questions that were answered well generally included those on fractions, estimation, describing errors in methodology with algebra and calculation, solving linear equations, solving quadratic equations by factorisation, and box plots.

The questions that were answered well by the higher ability candidates included LCM, angle calculations, construction, percentages, recurring decimals, surds, proportion, probability, regions and inequalities, completing the square and sketching the related function.

The questions that all candidates found challenging included problem solving with ratio, describing combined transformations, problem solving with trigonometry and exact trig values and the algebra of circles.

Paper 6 series overview

General Comments

This calculator paper is the third of the three papers taken by Higher candidates for the GCSE (9-1) Mathematics specification.

Almost all candidates were able to show positive achievement. The omission rates for whole questions and parts of questions were low except for the lower ability candidates.

Candidates made better use of their calculators than in previous series, and there were less instances of lengthy arithmetic processes being performed by hand. There was also improvement in maintaining accuracy within multi-step problems.

Many candidates did not understand or use correct notation and terminology. For example: completing a vector triangle with labels and arrows (Question 9(b)), suffix notation for sequences (Question 11), indices and roots (Question 14), using three letter notation for angles and stating circle theorems correctly (Question 16).

It appeared that candidates had enough time to complete the paper.

Questions

Advice

When solving an inequality, candidates should retain the inequality symbol and not replace it with "=" (Question 1).

When displaying an inequality, candidates should draw their solution above the printed number line rather than on top of it. If making a change to their answer, it is best to draw it again rather than amend the first attempt (Question 1).

For many models of calculator, negative numbers need to be entered in brackets i.e. as $(^-1)^2$, not $^-1^2$. Candidates might be encouraged to do these simple calculations in their head (Question 7a).

When a specific method is stated in the question, candidates should normally follow that instruction. In this instance, candidates should have been reading the answers from the graph, not rearranging the quadratic and then applying the formula. The marks allocated reflect the amount of work intended (Question 7(d)).

When asked to prove a statement, candidates need to do more than produce extra numerical examples (Question 10).

When asked to change the form of an expression in index and root form, it is unlikely that resorting to a calculator will help. Instead, candidates should note the number of marks available as this will give a reasonable indication of the number of steps involved, and maybe they could then perform one or two of these (Question 14).

Misconceptions

Whereas applying the compound interest formula finds the new balance at the end of the term, the simple interest formula produces the interest gained. Many candidates thought the simple interest formula also gave the new balance (Question 5).

Candidates continue to have difficulty with time conversions. For example, the working 2273 seconds = 37.87.. minutes = 38 minutes 27 seconds was very common (Question 12a).

$\sqrt[4]{8}$ was often interpreted as $4\times\sqrt{8}$ (Question 14).

Candidate performance overview

Candidates who did well on this paper generally did the following.

- Performed almost all standard techniques and processes accurately. Questions 1, 3, 7, 12, 13, 14.
- Usually interpreted and communicated mathematics accurately. In particular, information presented in words or diagrams was understood and correct notation was used when presenting a mathematical argument. Questions 9(b), 10(b), 11, 15, 16.
- Produced clear solutions to multi-step tasks. Questions 2, 4, 8.

Candidates who did less well on this paper generally did the following.

- Made errors in performing low-grade processes. Questions 1, 3, 7(a).
- Produced responses that lacked notation of an appropriate standard. Questions 9, 16.
- Showed poor setting out of multi-step tasks. Questions 2, 8.
- Misinterpreted questions and information or did not follow instructions. Questions 2, 4, 5, 6 10(b), 11, 17.

Question 1: Most candidates made some progress in solving the inequality but replacing the '≥' with '=' was common. The majority knew how to represent their solution on a number line.

Advice: When solving an inequality, candidates should retain the inequality symbol and not replace it with '='.

Advice: When displaying an inequality, candidates should draw their solution above the printed number line rather than on top of it. If making a change to their answer, it is best to draw it again rather than amend the first attempt.

Question 2: Although a common question with Foundation, this was found to be a particularly hard question. Only the more able candidates achieved more than 2 marks out of 5. Candidates often merely found 32% or 68% of £54 868 or they halved £54 868 and increased the answer by 32%, instead of recognising this as a reverse percentage situation requiring the step 54 868 ÷ 2.32 at some stage.

Question 3: A question requiring a similar process of cubing a probability was set on June 2019 Paper 6. There was little improvement here. Many candidates worked out $\frac{2}{6}+\frac{2}{6}+\frac{2}{6}$ and even obtained an incorrect answer of $\frac{6}{18}$ for that calculation.

Question 4: Overall, this was answered well. Some candidates used a width or height of rectangle B as being three times that of rectangle A, which was not the information given in the question and eases it considerably. The more able candidates set up and solved an equation, such as $3h^2 = 300$, to get the height of rectangle B as 10 cm and then the perimeter of 80 cm. Others lacked the algebraic formality but still found *h* through the correct arithmetic processing.

Question 5: Most candidates correctly found Kay's balance after 5 years of compound interest. However, few were able to finish the question correctly because they applied the simple interest formula to this balance rather than the interest accrued.

Misconception: Whereas applying the compound interest formula finds the new balance at the end of the term, the simple interest formula produces the interest gained. Many candidates thought the simple interest formula also gave the new balance.

Question 6: Listing and tree diagrams were used equally and with similar success. Lower ability candidates did not really grasp the two-step nature of the situation and scored 0 marks for $\frac{2}{8} = 25\%$.

Question 7: About half of the candidates were unable to evaluate $x^2 - 4x + 1$ correctly when $x = {}^-1$. The plotting of the points and drawing of the two graphs were very successful. The question was highly structured and ended with the instruction to "Use your graphs …". Candidates merely needed to write down the *x*-values of the two intersections which were marked as follow through from their graphs. However, many disregarded the instruction and wasted time in attempting, and failing, to solve by factorisation or using the quadratic formula.

Advice: If using a calculator, candidates need to put negative numbers in brackets i.e. as $({}^-1)^2$, not ${}^-1^2$. Candidates might be encouraged to do these simple calculations in their head.

Advice: When a specific method is stated in the question, candidates should normally follow that instruction.

Question 8: Many candidates scored full marks. The best responses set up and solved an algebraic equation, such as $\frac{1}{3} \times 5 \times 5 \times \frac{h}{2} = 30$, although many others found the correct answer through arithmetic processing. The incorrect answers of 3.6 and 14.4 were sometimes seen because candidates had confused themselves by redefining *h* as the height of one pyramid.

Question 9: Many candidates were able to solve the algebraic vectors problem in part (a). However, very few candidates had any idea of how to show the addition of two algebraic vectors on a diagram, complete with labels and direct arrows.

Question 10: When asked to prove a statement, candidates need to do more than produce a few numerical examples. The best responses showed consecutive algebraic terms correctly placed in a grid, the sums of the first two columns and a clear statement that the second column total was one more than the first column total.

Question 11: Suffix notation for terms of a sequence was not understood by many of the candidates. Those who could use the notation had little difficulty in answering parts (a)(i) and (a)(ii). In part (b), a conclusion, such as 'Since $u_1 = u_2$ all terms are equal', was required for full marks.

Question 12: In part (a), many candidates were unable to convert correctly between units of time.

Misconception: The working 2273 seconds = 37.87.. minutes = 38 minutes 27 seconds was very common.

In part (b), candidates often identified at least two correct bounds and divided their distance by their time. Those with the four correct bounds often made the error of dividing the upper bound of the distance by the upper bound of the time.

Question 13: Almost all candidates wrote down the probability of the first card being black, often as part of a tree diagram. Those that kept it in the form $\frac{30}{45}$ were more likely to be successful in applying the conditional aspect, obtaining $\frac{29}{44}$ for the second black card, as opposed to $\frac{2}{3}$ and then $\frac{1}{2}$. Most candidates knew to multiply their two probabilities.

Question 14: The more able candidates often achieved full marks. Otherwise, candidates merely obtained a decimal equivalent from their calculator and then made no further progress – this scored 0 marks.

Advice: When asked to change the form of an expression in index and root form, it is unlikely that resorting to a calculator will help. Instead, candidates should note the number of marks available as this will give a reasonable indication of the number of steps involved.

Misconception: $\sqrt[4]{8}$ was often interpreted as $4 \times \sqrt{8}$.

Question 15: Many candidates were successful in calculating frequencies and frequency density from a histogram. Very few candidates were able to explain that a calculation using part of a given interval is unreliable as the data may not be evenly distributed.

Question 16: Geometric reasons were not required for part (a). Although candidates often obtained the correct answer, the working was often unclear. The best responses started by adding line OB to the diagram and then stated, using correct notation, that angle OBA = 15° as well as marking it on the diagram.

In part (b), candidates had to show angle HDF was 82° and give reasons. Whether using angles in a triangle or on a straight line, the calculation 180 – (43 + 55) or equivalent needed to be seen to justify the answer of 82. The reasons were often incomplete. The 'alternate segment theorem' was often stated as 'the alternate angle theorem'.

Question 17: In part (a), candidates often joined A to (2, 9) and B to (6, 7), whereas the question stated that A mapped to (6, 7). There was opportunity for such candidates to gain some credit in part (b) and part (c). Candidates who did produce a correct diagram often gave the scale factor as 2 rather than $^-2$.

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