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Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/04 Autumn 2020 series

Version 1

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

	Reports for the Autumn 2020 series will provide a broad commentary about candidate performance, with the aim for them to be useful future teaching tools. As an exception for this series they will not contain any questions from the exam paper nor examples of candidate responses.

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 that caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

A full copy of the exam paper and the mark scheme can be downloaded from OCR at https://www.ocr.org.uk/qualifications/gcse/mathematics-j560-from-2015/assessment/#gcse-question-papers-mark-schemes-and-reports.

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Paper 4 series overview

There were more candidates for this paper then previous November series, with more aiming for the higher grades. There was however a wide spread of marks from candidates.

Questions that were answered well were on standard form (Question 1), the problem-solving question involving percentages (Question 2), seasonal graph (Question 9, despite more than one-fifth of all candidates not plotting the point in (a)) and expanding three brackets (Question 17).

Questions that received poorer responses than expected were mainly early questions involving some problem-solving, plus most of the questions from 14 onwards due to the nature of the topics tested. Question 3 was a multi-proportionality problem set in context and this was rarely recognised as inverse proportionality; many candidates assumed that the more people making the delivery, the longer the delivery would take. In Question 4, many left out the x outside both sets and despite obtaining a non-integer value for x (which represented several students), still carried on with the question. In Question 6, often candidates could not find the length of a cube from its volume. Responses to Question 7 often demonstrated that candidates were unable to find the gradient and equation of a straight line, which was surprising at Higher tier. Question 10 was another problem-solving question and required a compound area to be found, which many struggled with; most did not use the fertiliser rate as direct proportionality here, but did at least realise the need for the number of bags of fertiliser to be an integer. The later questions were aimed at the higher grades. The topics tested (such as sine rule, quadratic expression factorisation, circles and tangents, area in speed-time graphs and finding points of intersection of a line and a circle) are those that have often been found challenging by candidates previously.

Many did not successfully answer the construction question (Question 5), which does appear to be a weakness for a lot of candidates.

In this paper many problem-solving questions were of relatively low demand and hence in the first half of the paper, but still most candidates struggled to answer them correctly. There are several issues here. Candidates do not always use all the information given to them, their working is not logical and is difficult to follow, while some tend to 'over-think' the problem and make them more difficult than they should be.

In answering the problem-solving questions, there are often several stages to be answered in a particular order, which rely on students' working being clear, labelled and in order so that they themselves can follow it. The evidence from this paper suggests that for most candidates it is not. An example of this here was in Question 10 in finding a compound area. Few candidates labelled the areas they were finding and working showed little structure at all, which sometimes caused issues when they tried to bring their calculations together to reach a final response.

Proportionality is a topic that is often well answered without a context, but when placed in an unfamiliar context, appears to cause problems and misconceptions.

There is still too much premature rounding and truncating of decimals during a series of calculations or steps, which results in a large error in the final response that places it outside of tolerance. Candidates should note any requirements for the answer and use that as a guide for working. Wherever possible, candidates would be expected to use the accuracy of their calculator as much as possible, i.e. by saving part results in a memory to be used later.

Candidates who did well on this paper generally did the following:	*Candidates who did less well on this paper generally did the following:*
• used all the given information, often highlighting the text in the question • set their work out in a logical manner, so that they could follow it easily • showed each step in their working • stated any formulae used before substituting values in • gave the response in the form required • clearly checked their responses to see if it was reasonable • used diagrams to record information.	• provided working that lacked structure and did not flow • left out steps in their working • would cross out working, often changing their strategy • would round/truncate numbers in intermediary calculations, then use these in subsequent calculations meaning that the final response was of insufficient accuracy • did not give the responses in the form required.

Comments on individual questions

Question 1

Many candidates answered this standard form question very well and three correct responses were usually given. The common error was to write the power of ten as a negative when it was actually positive and similar for the positive powers.

Question 2

Most candidates answered this question very well. Some candidates did not use the information that the marks of the three papers are added together, so made the question more challenging than it should have been.

Question 3

Candidates often had difficulty finding a clear strategy to solve this problem. Many seemed to not understand inverse proportionality, treating it similar to direct proportionality and calculating the time for 5 people to deliver to 270 house as 150 (minutes) ÷ 3 (= 50 minutes for 1 person) × 5 = 250 minutes. Another common problem was converting the time in either minutes or hours into hours and minutes.

	**Misconception**	Too many candidates treat the decimal figures in hours as the minutes.

Question 4

Candidates would often write down an equation, but frequently omitted the x outside both sets; this gave $8x - 3 = 60$, which leads to a non-integer response. When finding the probability that a bank account is chosen, many used the $2x$ only and not the $x - 1$ part, presumably as they did not see that it was part of the set B.

Question 5

Some candidates did not attempt this question, possibly through not having the appropriate equipment. Among those who did respond, it was not answered as well as expected. Many appeared to have forgotten the constructions, while some bisected a different angle in (a) and/or a different side in (b) to the ones asked for. Despite the instruction to 'show all your construction lines' some candidates responded with a bisector line only, although if this was accurate it would have gained some credit .

Question 6

Almost all candidates were able to work out the volume of the cuboid, but many did not then cube root this to find the side length of the cube.

Question 7

There are two precise points on this line, at (−2, −6) and (2, 4). The intention was for candidates to select these points to work with and make their calculations simpler. Many however used other points instead that could not be read so clearly, leading to approximate values and so some did not give an accurate gradient. In (b) it was hoped that most candidates would use the information given to reach $y = 2.5x + c$ and receive a mark, but this did not happen frequently.

Question 8

In this question candidates needed to consider their strategy carefully to avoid making the question more demanding. Many chose to calculate the total profit, which was difficult because there were two different profits and some microwaves had a loss. They needed to work out the total income and total costs and use these to work out the profit, as suggested by the boxes on the page. The percentage profit should have been calculated by dividing by the costs, but many divided by the income.

Question 9

Many did not accurately plot the point needed in (a) nor join it with any sort of line. In (b) and (c) what was needed was knowledge of the difference between variation within a year (e.g. the most umbrellas are sold in Question 1) and variation between the years (e.g. sales are increasing year to year). Candidates seemed to over-think these parts and long responses were not needed. In (d), amounts were not required to be calculated, but just to say that she is assuming that the sales trends continue.

Question 10

This was another problem that candidates needed to use a clear layout and strategy to solve. Many worked out the fertiliser needed for the square and semicircles separately, which caused more problems. Most found the semicircles' radius correctly, but then proceeded to work as if there were three whole circles in the question rather than three semicircles. Sometimes candidates calculated the fertiliser needed for the square using its perimeter rather than its area. In calculating the fertiliser required, rather than multiplying the area by the rate many instead divided. However, once a value for the amount of fertiliser needed was reached, finding the number of bags needed was usually done well.

Question 11

Many answered part (a) correctly. In (b), most candidates chose the smallest value for both distance and speed before dividing, whereas for the shortest time they should have chosen the highest possible speed. As in Question 3 (and elsewhere), candidates demonstrated misconceptions in changing decimal hours to hours and minutes.

Question 12

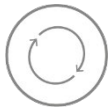
In (a), many did the translation correctly, however some transposed the two movements. In (b), candidates were recommended to use the large grid and draw the two transformations before attempting to work out the single one, but not all did.

Question 13

Many answered part (a) correctly, although some did not work out the lowest score, which was required for full marks. A few did not draw the box, which is important to show the quartiles. In (b) some gave the range or the lowest score. In (c) many correctly recognised that it is range or interquartile range that describes consistency.

Question 14

The successful attempts almost always used the sine rule to find the unknown angles and then the side. Although the cosine rule could be used, it is a long and complicated formula that should be used in the last resort when other rules cannot be applied. Good solutions had at least four figures in all numbers in the intermediary stages.

	**AfL**	Rounding or truncate numbers in intermediary calculations can lead to accuracy errors. In their working, candidates should use a greater degree of accuracy than required in the final response and when using a calculator ideally use the complete accurate values throughout.

Question 15

While higher scoring candidates often answered this question correctly and completely, many other candidates found it difficult to express where the errors were. Candidates responded best in part (a), usually with the correct factors often given. Some just gave the correct factors however; the question asked for the 'complete correct solution', so both the correct factors and the correct answers as well were required. In part (b), many found it difficult to evaluate the solutions from the formula, especially with a negative value of b. Many seemed to focus on the negative 8 in either place, which were not incorrect. The short fraction line is a common error from candidates that we see frequently in examination series and many did not spot it here either. Again, we required the corrected formula as well as the two correct answers (given correct to 3 significant figures), which many did not do.

Question 16

Few responses to this question were seen from lower scoring candidates. Those who attempted it usually answered correctly. The crucial step for many seemed to be writing down the correct initial equation of $y = \frac{k}{x^2}$.

Question 17

Successful candidates usually multiplied out the first pair of brackets to get $x^2 - 1$, before attempting to multiply by the third bracket.

Question 18

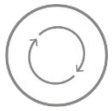
Most candidates did not attempt part (a). The important thing to know is that a tangent is perpendicular to the radius at that point, so finding the gradient of the radius is the correct first step. Most candidates struggled with part (b), although as it was a straight line and the gradient was given in (a), it should have been within reach of more candidates.

Question 19

In part (a) many candidates did attempt to find an area under the graph and often correctly separated the area into a triangle and a rectangle, however only the higher scoring ones achieved the correct response. A common error was to omit the half in finding the area of the triangle, so they calculated 30 × 15. In the rectangle they used the height of 30 correctly, but often they calculated 40 – 15 incorrectly; few showed any working so we assumed that this was done mentally. In (b)(i), candidates should have subtracted the distance readings before dividing by 2. In (b)(ii) they needed to have attempted to draw a tangent to gain any credit. When finding gradients in both (b)(i) and (b)(ii), many candidates just divided the *y*-ordinate of a point by the *x*-ordinate of the same point.

Question 20

The successful candidates demonstrated clear structure in solving these equations. The common approach was to substitute the expression $x + 2$ for y in the quadratic equation. The final quadratic equation could be factorised and those candidates that used the formula often made errors. The demand in the question does not specify accuracy, which usually suggests that the expression will factorise. Two sets of answer lines were given, to indicate to candidates that two pairs of values were expected.

	**AfL**	Reading the question properly, using all the information and giving the response in the form required can lead to big improvements in performance.

Other

Candidates did struggle with the AO3 (problem-solving) questions. Most of these were in the first half of the paper. Some did not take note or use all the information given in the question. Candidates need to choose an efficient strategy to answer the question (for example in a compound area they need to determine which areas to find and then combine them together before proceeding to the next stage). Some were unable to link all the parts to a question together. Working is often difficult to follow for examiners and seemingly for candidates themselves too. Few go back after reaching a clearly incorrect figure and check their working. Candidates almost never make an estimate to see what the answer should roughly be. While this cohort was quite small, they did appear to struggle more than usual with these questions as many of these questions were targeting the lower grades this series.

Common misconceptions

Candidates will often treat inverse proportionality as direct proportionality, i.e. saying that if it takes 3 people 150 minutes to do something, it will take 1 person 50 minutes to do the same thing.

Key teaching and learning points – comments on improving performance

A strong recommendation that would likely lead to many improvements would be to highlight all the given information in the question and to highlight the required form of the response. Candidates should then check that their response satisfies all these.

Guidance on using this paper as a mock

This paper can be used as a good mock assessment with Higher tier students, particularly when used to highlight the performance issues raised here. For best assessment practice, it should be used under exam conditions and alongside the November 2020 J560/05 and J560/06. A calculator should be used with J560/04.

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