Examiners' Report
Principal Examiner Feedback

Summer 2023

Pearson Edexcel GCSE (9 – 1)
In Mathematics (1MA1)
Foundation (Calculator) Paper 2F

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GCSE (9 – 1) Mathematics – 1MA1
Principal Examiner Feedback – Foundation Paper 2

Introduction

This paper was accessible to all students with a good amount of clear working shown over most of the paper. Some questions, mainly towards the end of the paper, were not as well answered by students but this was due to the differentiation and ramping of the level of demand of the questions. It was pleasing to see students making improvements in their approaches to questions that required a written response, and in longer multi-step questions. In particular, written responses in questions 12b, and 22 showed improvements.

This paper requires the use of a calculator and students are expected to have access to and a reasonable working knowledge of how to use a calculator. There is evidence that some students continue to try to use written methods even when they have a calculator. This often means that calculations take longer and increases the chance of inaccurate answers. One example of this is when break-down or build-up methods were used in attempts to work out percentages. This approach is often far less successful than a more direct approach using a calculator.

A ruler and protractor were also required for this paper, but evidence suggests that some students did not have access to one or both of these items. It is essential that students have a full set of the required equipment when sitting a GCSE mathematics paper.

Students should carefully read the question fully and ensure they read both the numbers given in the question and their own handwriting carefully. Inaccurate reading leads to inaccurate answers and means students lose marks unnecessarily. Similarly, poor handwriting and layout of work remains a big problem. The inclusion of working out to support answers is essential to gain full credit but remains an issue for many. Working out not only needs to be shown, it also needs to be shown in a clear and logical way, demonstrating the processes of calculation used. This is most important in longer questions, and in “show that” questions. Contradictory work also remains a common cause of lost marks and was most notably seen in question 18b in which a range of approaches were attempted and the method intended to be marked was not always clearly identified.

REPORT ON INDIVIDUAL QUESTONS

Question 1

A good accessible start to the paper with this question being well answered most students scoring the mark.

Question 2

Another accessible question with a majority of students correctly writing the decimal as a fraction.

Question 3

Most students could change between metres and centimetres but converting between metric units remains challenging for some students with many forgetting the conversion factor to use.

Question 4

Simplifying a simple algebraic expression seemed to cause very few problems for most students. Common incorrect responses included 82*t* or 7*t* from not applying the correct operator.

Question 5

This question was answered correctly by almost all students.

Question 6

Whilst most of the cohort could answer both parts correctly, students were slightly more successful in part (b).

Question 7

Part (a) was well answered with many students being able to accurately measure the length of the line. However, performance in part (b) was not as good, with far fewer being able to accurately measure the angle. A number of blank responses were seen which suggests not having a protractor was an issue.

In part (c) the wrong name was often stated for the type of triangle, with equilateral being the most common incorrect answer. Symmetrical was also often seen but as it is only a property of an isosceles triangle and not a mathematical name, credit could not be given.

Question 8

It was pleasing to see the majority of students attempt this first mini problem-solving question. Whilst there was mixed level of success, many students were able to gain full marks by reaching an answer of 96, either using the scale before or after adding the distances. When a correct answer was not given, many gained partial credit for either using the scale for one of the shorter distances or for adding both lengths to find the total distance. A significant minority of students ignored the labelling on the diagram, and attempted to work with their own measurements, typically using 12cm. Centres should encourage students to refer to diagrams, particularly noting any labels or measurements given.

Question 9

Almost all students could continue the sequence correctly to gain the mark in part (a).

Part (b) performed less successfully. Whilst many were generally able to write the correct values using ratio notation, not all continued to write their ratio in the simplest form and although many achieved the correct simplified ratio, some went on to do further incorrect simplification such as 4:9 leading to 2:3 which lost the accuracy mark. However correct simplification to 1:2.25 (1: *n*) did not lose the accuracy mark and was occasionally seen. When no marks were awarded, it was often due to not understanding how to write the appropriate values using ratio notation, such as simply writing as a fraction instead. Other commonly seen responses that gained no credit included choosing the incorrect terms from the sequence or selecting three terms e.g. 8:23 or 8:13:18 and a small minority attempted to find the *n*th term.

Question 10

Part (a) was usually correct. Rare mistakes arose from misreading the scale or reading off from the incorrect axes.

Part (b) required the use of the conversion graph combined with working with time and was attempted by nearly all students. Very few students drew lines on the graph from £9 to 6 hours and this sometimes led to the graph not being read correctly. However, very many responses gained full or partial marks even if the graph showed no indication of use.
The most common error occurred in the use of correct time notation when writing the final answer, with a significant number of students losing the final accuracy mark. Occasionally a correct answer in 24-hour notation was given on the answer line along with an incorrectly converted 12-hour time.
There was some confusion when adding on 6 hours, with students counting 08:00 as 1, 09:00 as 2 etc and arriving at a final answer of 1:00. Where a list of times appeared in the working, they were able to gain the method marks for a correct reading from the graph and attempting to add to 8 am. Less commonly seen errors were: misreading the Cost axis and mistaking £9 for £8.50 resulting in a time in hours and minutes that they did not know how to deal with, and inaccurate lines drawn by hand on the graph giving wrong 'hour' values.

Question 11

Using a frequency table to find the total weight was generally well answered, with most students understanding that they needed to multiply the weights by the number of people, before adding together to get the total weight. Some just added the weights in the weight column, ignoring the frequencies thus gaining no credit. Arithmetic errors cost a minority of students the accuracy mark (disappointing on a calculator paper) and some students only included 5 products, usually omitting a weight with frequency of one. Adding an extra column to the table proved very helpful for many students.
It is important for students to have experience of working with data in tables and to understand how to extract the relevant information. Centres should also encourage students to make full use of a calculator to check their answers when in a calculator exam.

Question 12

Students seemed to find drawing the mirror line in part (a) challenging and accuracy was not always acceptable even when they had 'the right idea'. Where students had drawn lines connecting the matching vertices to aid them, often no reflection line was drawn possibly indication a lack of understanding of what was needed. Many answers showed little or no use of a ruler with lots of free hand lines or dashed lines. Frequent incorrect responses included simply to draw a line in the diagonal of the grid, drawing a vertical line, or a vertical and a horizontal line, or a diagonal that was clearly nearer one shape than the other. Many drew the

line slightly incorrectly, having not realised the need to draw across the diagonals of the grid, often due to trying to link their mirror line to a corner of the squared grid.
It was very pleasing to note the success of the first explanation response question, particularly so early in this paper. Most students correctly identified the mistake made and were able to explain this clearly. However, a correct description was occasionally contradicted by giving a combination of different transformations. Other common responses that didn't gain credit included ambiguous or incomplete descriptions of where the shape should appear such as it should go down not across, or it is facing the wrong way.

Question 13

Success in this question was mixed, with understanding of the information provided being vital in the level of success. Whilst most of the cohort gained both the marks available, many scored no marks at all, often due to not identifying that 50 represented one sixteenth and subsequently dividing 50 by 16 rather than multiplying by 16. Of those who correctly interpreted the information given, some incorrectly thought they still needed to add or subtract the 50 teachers to their answer.

Question 14

This multi-step problem proved challenging for many students. Whilst many were able to start this question sensibly, very few were able to complete the processes required to find the correct answer. Partial marks were often awarded with many students successfully gaining marks for correctly calculating the volume of one or both shapes. This was usually done before any unit conversion. Fewer students worked accurately with one dimension between the shapes to find the number of packets that could fit along one edge of the box. Students who found the number of packets along each edge (9, 8 and 12), often misunderstood what to do with these values, with addition of 9, 8 and 12 being a commonly seen next step rather than multiplying. Students choosing to work this way often marked their values on the diagram and this approach is to be encouraged.
Students who gained the unconditional accuracy mark for conversion between units usually converted units before working out the volume. Some students attempted to convert after calculating the volume and were often confused with volume conversion from mm^3 to cm^3 and vice versa and so were unable to go on and achieve full marks.
Quite a few students calculated the surface area rather than the volume or simply added all the three lengths together for each shape.

Question 15

This question required students to compare the likelihood of two outcomes, showing all working, and performance was disappointing. Whilst many students could express at least one probability, very few could show one outcome was more likely than the other and chose to state a conclusion that was unsupported. Comparing the probabilities as equivalent fractions with a common denominator, decimals, percentages or even a ratio was acceptable.
A lot of students listed all the numbers on a dice, and highlighted the ones which were less than three, or listed all the numbers on the spinner and highlighted those which were more than five, but did not write this as a probability and therefore gained no marks. These students then went on to conclude that the spinner giving a number greater than 5 was more likely because there were more available options. Some who did write it as a probability often

included 3 on the dice and/or 5 on the spinner, suggesting that there was a misunderstanding of ‘less than 3’ and ‘more than 5’.
Of those who attempted to convert to a common format, many made the error of writing $\frac{2}{6}$ or $\frac{1}{3}$ as 0.3 or 30%

Question 16

A single mark was often awarded in this question. Whilst a mark was often awarded for multiplying speed by time, frequently using minutes or an unconventionally written time, many students struggled to efficiently work with decimal time. Converting to minutes and calculating 56 ×105 was a popular start to the question, but this was often left as 5880 or divided by 100 rather than being divided by 60. Errors with decimal time were common with conversion to 145 min or 1.45 hours seen regularly. There were successful attempts by students who chose to use a partitioning approach by adding 56, 28 and 14 after splitting 56 in half and then in half again. However, a small number choosing this method then didn’t add the correct quantities together to show a complete method and gained only 1 method mark.
A substantial number did not know the formula for speed, distance and time and some who drew the correct formula triangle for speed were still unable to rearrange or apply this successfully.

Question 17

Most students managed to score the first mark for a start to the process, typically for a correct starting process of adding the number of seats in cinemas **A** and **B** (250+350). However, many failed to know how to progress from there with many dividing 600 by 2 or 3 and very few knowing they needed to calculate 3 × 380 to find the total number of seats in all three cinemas, which was also a valid start.
A lot of students worked with an embedded correct answer, showing their understanding of calculating the mean as adding then dividing, but the value 540 remained embedded with another number (e.g. 1140 or 380) given as the final answer. This scored 3 marks. A significant number of students attempted to try various values added and divided by 3 to give the desired mean but then gave up. Some had success with this approach, but students need to be reminded that where a trial and improvement method is used, all or no marks can be awarded.
Another common incorrect approach was to see the numbers as a sequence leading to an answer of 150 or even 450. Use of algebra was very rarely seen.
Often it could be seen that students understood what the mean is but do not know how to work in reverse in this question. Therefore, it would be useful for centres to ensure more exposure and practice of worded reverse mean problems.

Question 18

It was very pleasing to see that the majority of students could gain full marks in part (a). When full marks were not awarded, the most likely score was zero and was often due to a range of approaches being attempted. Most students chose to divide 180 by 12 and then multiply by 3. Occasionally a student would try a build-up method of 12 cans cost £3, 24 cans cost £6 etc. Unless completely correct, this approach rarely scored partial marks.
The addition of an extra measure alongside money when using proportion appeared to cause great difficulty for many students in part (b). Fully correct solutions were rare in comparison

with part (a) and many more students demonstrated a choice of approaches, often simply trying to make use of the values in the question using a range of operators. Of the students who correctly showed that each can cost 29p, many then struggled to know how to use this to calculate the cost of a proportion of the can, with many simply dividing by 3 as they thought 100 was a third of 330 ml. Whilst some students got as far as 0.088... or 0.09, unfortunately the accuracy mark was often lost for leaving their answer in pounds when it was requested in pence. Centres should encourage students to read the question again at the end of their calculations to ensure the final answer is given in the correct units or to the required level of accuracy.

Question 19

The majority of students gained marks on this familiar frequency tree question, with part (a) being well attempted and many gaining at least one mark. Of those who were not awarded full marks, the vast majority were able to correctly place at least one of the given values, generally for placing 150 correctly, and then could calculate at least 1 or 2 of the missing values. However, many students placed 110 incorrectly as the number of students who have a bicycle and a car, simply reading this value from the question and not realising this was the total number of people with a bicycle and making use of the final piece of information given. Careful reading should be encouraged for this type of question and it was pleasing to see students checking that the values they had placed totalled 240 and correcting as necessary if 240 was not reached.
Part (b) required students to use their frequency tree to find a percentage, with a large proportion of students who were successful with the frequency tree, correctly working out the required percentage. Whilst many identified the correct value to use as a numerator, a small number of students calculated this as a percentage of the total people rather than the number of people who had a car and therefore gained no marks. The most common errors from incorrect frequency trees led to 110 and 150 being used in part (b) but could be followed through for both marks if used correctly. Other students simply stated the values from their frequency tree or as a fraction rather than converting them to a percentage or gave a subtraction e.g. 150 – 45 or even 100 – 45.

Question 20

It was pleasing to see that the majority of students gave a fully correct answer to this question. Many of the students who gained the 2 marks for the question simply gave the full answer, which was acceptable for the award of the marks, but many showed no intermediate calculations for the numerator or denominator and gained no marks for an incorrect final answer. A method mark was often awarded for correctly evaluating either the denominator or the numerator but the values were then added or multiplied rather than divided. Most students wrote down all the figures from their calculator as advised in the question without rounding unnecessarily which was also pleasing to see.
A common error was to get a final answer of 28.306.... that resulted from entering the calculation into the calculator in one go without brackets or proper use of fraction function. This led to BIDMAS being applied incorrectly on the calculator and often led to no marks being awarded. Students should be encouraged to work out and write down the value of the numerator and denominator separately to ensure they are awarded for their working out and to avoid order of operation errors.

Working out the value of the reciprocal in part (b) appeared demanding, with very few students gaining the mark available. Many wrote the reciprocal of 0.625 as $\frac{1}{0.625}$ but did not evaluate to give the answer as an acceptable value such as 1.6.

Question 21

Around half of the cohort were successful in writing the value correctly as a product of prime factors and gaining the two marks available in this standard and familiar question.
As with previous series, the most common reason for the loss of marks was due to writing factor pairs instead of finding prime factors, gaining no credit, or finding the prime factors but not writing these as a product. Listing the correct prime factors using commas or as an addition gained the method mark only.
A number of students made careless arithmetic errors when writing their factor tree such as $6 = 3 \times 3$ or $10 = 5 \times 5$ and quite a few left 15 at the end of a branch, resulting in an incomplete factor tree which scored no marks. Some students included 1s in their factor trees, which was acceptable for the method mark, but not for the accuracy mark. However, this was less frequently seen than in previous series which is encouraging.

Question 22

As with previous series and explanation questions, a variety of responses were seen. Approximately half of the cohort provided a suitable explanation with a decision of “No” that was accompanied by appropriate figures to support and justify the reasoning. The common correct approach was to correctly calculate the number of red and blue counters there actually were or reason that if the statement were correct then there would be 72 counters in the bag. Centres should discourage students from writing answers that simply restate the facts given in the question such as there is 1 red for every 2 blue, as these are unlikely to gain credit. Occasionally a decision was not provided, incorrect figures were stated or a contradiction was given which led to the mark being withheld but this was less frequent than with previous similar explanation style questions.

Question 23

Mixed responses were seen in part (a). Some students understood the concept but didn't write down an integer and gave responses such as 4.9.
In part (b), most students were able to demonstrate some knowledge of inequalities, but the accuracy mark was often lost due to not knowing how to interpret the inequality symbols correctly by use of open and closed circles. Just giving a line was the most common response by those students who attempted this part of the question. However, some students drew a line from −4 to 0 or −4 to −1, indicating that the inequalities were not being interpreted correctly. If only one circle was correct it was more often the closed circle at −4. Of the students scoring no marks, common answers included: a cross at −1½, lines from −3 to 0 or from −4 to 0, lines that start correctly at one end but end with an arrow at the other, and lines which extend beyond one of the endpoints.
A common misconception noted was the students treating it as two separate inequalities by drawing two circles and two lines with direction. Some students tended to use two arrows to help with the direction of each part of the inequality, again not realising that it was one inequality.

To improve performance of this familiar skill, centres should emphasise the need for a single line connecting both circles rather than two separate lines. Centres could also focus on stating integer values represented by the inequality as this would help students appreciate that the number lies between these two values and should not be represented by two inequalities.
The final part of this question was not answered well, with most scoring no marks. The fraction part of the inequality seemed to confuse many students. Those who started trying to reverse this part of the process were usually unsuccessful due to either changing the fraction to 10 from multiplying the numerator and denominator or multiplying by 5 but omitting the 2 from the next stage of their calculations. However, converting to 0.4 was seen often and being a calculator paper, by following algebraic processes and using the calculator for calculations, students should have been able to reach 25, but a surprising number who used 0.4 did not. The intention to use a correct first step was often carried out incorrectly, contradicted or carried out on one side only. For those who chose to begin by correctly adding 4 to both sides, many were then unable to continue correctly and deal with the fractional element. Finally, for those who had replaced the '<' with an '=' in the working, most remembered to return it for the answer. However 25 alone was seen on the answer line more often than the correct answer when marks were awarded.

Question 24

This question proved to be challenging to most students and was not answered as well as expected. Some students were able to begin to write an expression for the area of the triangle, but many did not divide by 2. Of those who attempted to write an expression for the area of the rectangle, many gained the mark by writing $5 \times 4x - 1$ but this was often without using brackets which then caused difficulty in simplifying the expression later. Often $4x - 1$ was simplified as $3x$ or the area as $19x$. This demonstrated a weak understanding of creating expressions to represent the areas and collecting like terms.
Whilst a small number of students were able to write a correct expression for both shapes, it was rare for any of them to include the additional 10 cm^2 correctly in either of their expressions or in an equation. Multiplying or dividing by 10 or 100 was often seen instead. Some students omitted algebra altogether and wrote either '48' or '24' for the area of the triangle. Trial and improvement methods were often seen and, when used, were quite often unsuccessful. Another common mistake was to calculate the perimeter of the shapes and attempts to use Pythagoras' theorem by some students were seen.
Centres are encouraged to remind students that if only a method of trial and improvement is seen then they will score no marks unless a fully correct answer is given. This approach should not be encouraged.

Question 25

Combining the skills of applying percentages and ratio in this small problem appeared to be demanding for many students, with many often only being able to work with one or the other but not both together. Calculating 57% of 800 was by far the most common first step shown but, after finding 456, it was common either to multiply or divide by 7 or 12 without using 19 in their calculations. Of those who chose to work with percentage first, this was not always done correctly by those using a build-up method rather than the calculator. When doing this, very few showed a method for the individual percentages and just stated what they thought the percentage was, so any error lost the method mark.
Almost all responses that gained full marks worked through each part as an individual calculation such as dividing by 19 and then separately multiplying by 7, very few used

fractions in their working. This approach proved to be the most successful and should be encouraged.

Question 26

The majority attempted the question and but very few fully correct answers were seen. Of the students who gained partial marks for finding one correct value, usually 12.65, it was common to provide the incorrect upper bound of 12.74. In addition to blank responses, whole number answers of 12 and 13 or 12.6 and 12.8 were often seen as incorrect values that gained no credit. The most successful answers were often those where a number line was drawn showing 12.6 to 12.8 and subsequently identifying where the bounds would be. Therefore, to improve student outcomes, centres should encourage students to use a number line method where the number to add or subtract is half the degree of accuracy asked for. Students would also benefit from having a better understanding of inequality notation.

Question 27

Most students scored at least one mark in this question for working out the value of either 4% of £150 000 or 1.5% of 160 000. Many continued working to gain a second mark for either using compound interest for one value or, more commonly, working with percentage increase for one year for both values. It was common for 8% and 3% to be used due to only considering simple interest. Students are reminded to read the questions carefully as the third mark could not be achieved unless compound interest was used. A very few students used the approach of using decimal multipliers, a few students used the formula from the exam aid, and those that did tended to get it correct, others listed values for each year separately. Students should be encouraged to write down all their processes when using a calculator to make their intention clear. A build-up method was commonly used and often led to an incorrect answer, and without any working out, marks could not be awarded. Unfortunately, some students used 1.4 for 4% or 1.15 for 1.5% or attempted to use the % button on their calculator which often led to only adding 0.04 or 0.015.

One approach to this question was to use compound interest for only Tamsin and add one year of interest for Rachel to find valid comparable figures. This approach was seen rarely, with many that used compound interest rather than simple interest, often calculating 2 years for both Tamsin and Rachel. When compound interest was used, correct figures and a correct decision often followed. A very small number of students did not make a final decision though.

Question 28

Student’s responses to this last question were very mixed, with some not attempting it at all. Very few students successfully matched all the graphs to a correct equation, although a few scored 1 mark for two graphs correctly assigned.

Summary

Based on their performance on this paper, students should:

- read questions carefully, including after reaching a final answer to check whether the magnitude is sensible, units are appropriate, and the level of accuracy required is shown
- practice questions involving proportion and algebraic expressions
- practice using measuring equipment such as rulers and, more particularly, protractors
- give clear and succinct explanations when a written answer is required
- use a calculator rather than relying on paper methods, particularly when working with percentages
- avoid using inconsistent units or rounded or truncated figures in calculations so that their final answer is inaccurate

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