Examiners' Report
Principal Examiner Feedback

Summer 2024

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 appears to have been accessible to the majority of students with evidence of clear working shown throughout the paper. Due to the differentiation and ramping of the level of demand, some questions, mainly towards the end of the paper, were not as well answered by students.

This paper requires the use of a calculator, and students are expected to have access to and have a reasonable working knowledge of how to use a calculator. Similarly to previous exam series, 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 there is an increased chance of final answers being inaccurate, often due to premature rounding as seen in Q23. Break-down or build-up methods were used in attempts to work with percentages and as with previous exam series, this approach is often far less successful than the more direct approach of using a calculator method.

Additionally, a ruler, protractor and compasses were required for this paper, with evidence suggesting that some students did not have access to all 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 will mean that 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 manner, demonstrating the processes of calculation that are used. This is most important in longer questions, and in "show that" questions. Contradictory work also remains a common cause of lost marks due to a range of approaches being attempted and the method intended to be marked was not always clearly identified but this was less apparent in this series, which was pleasing to note.

Report on individual questions

Question 1

The opening question was accessible to all students and was well answered with very few students not being awarded the mark.

Question 2

It was pleasing to see that many more students could successfully convert between litres and millilitres compared to previous sessions. The most common error was to divide by 100 rather than 1000.

Question 3

Writing a fraction as a decimal seemed to be answered by the majority of the cohort but a large number did not write in the correct format, writing their answer as a percentage instead or writing it as a decimal with the wrong magnitude.

Question 4

This question requiring the identification of a multiple between two given values was answered correctly by most of the cohort. When the mark wasn't awarded, it was often due to including more than one value, some of which were not multiples of 7.

Question 5

Students generally completed the statement for a simple algebraic expression correctly and were awarded the mark.

Question 6

This question contained three parts and required students to use knowledge of pictograms. Part (a) was answered very well, with a very large number of students showing they could use the key to state the number of houses for a given month.

Similarly, part (b) was also often answered well with most students being able to draw symbols to represent 11 houses for April to gain the mark. A variety of representations totalling 11 houses were seen, with students often using two full squares and predominantly an 'L' shape and, although the 'L' shapes were drawn freehand, the intention of the candidate to represent a value of 3 was almost always clear. Some drew internal lines to show the 'L' shape representing three smaller squares each of value 1 and some even added numbers indicating the value of the symbols (i.e. full squares labelled with 4). Some drew a rectangle to represent half of a large square and a separate smaller square representing one quarter of the large square. Whilst a variety of sizes in diagrams were shown, the intention was clear in the majority of responses.

Full marks were most commonly awarded on the final part of this. Some students wrote 18 on the answer line without any working, while many showed working in a variety of ways. Where working was shown but a correct answer not given, this enabled them to pick up partial marks for a valid method. It was common to see the totals for each month adjacent to each row on the diagram followed by a total or an addition for the number of houses sold in the first four months and/or a subtraction from 60. Where working was shown, errors were few and far between suggesting writing down the stages of calculations was helpful. When full marks were not awarded, it was usually due to a mistake in interpreting the key and using an incorrect value for one of the months. March tended to be read as 16 and not 12 on occasion and this led to an answer of 14, but a lack of working often led to the mark for 60 – ([Jan + Feb + Mar] + 11) not being awarded and as such, centres should impress on students the value of showing their working. Some gave 42 on the answer line as they forgot to subtract this from 60. However, these types of errors were uncommon.

Question 7

Part (a) was well answered with many students being able to accurately measure the length of the line. An answer outside of the acceptable range suggests students place their rulers incorrectly either at the start of the ruler or at 1 cm rather than at 0.
In part (b) only a small proportion of the cohort being was able to accurately measure the angle. Commonly seen incorrect answers were between 110° and 115° suggest that students were reading backwards from 180° and so should be encouraged to check they are using the correct scale. A number of blank responses were seen which suggests not having a protractor was an issue.

In part (c) most students knew that a hexagon was a 6-sided shape and were able to draw it confidently, with the majority of attempts resembling regular hexagons. In some instances, students were very helpful by numbering the sides or vertices. Where a ruler was used there were clearer shapes drawn. Freehand drawings often resulted in the mark being lost because there was doubt as to whether there was an extra vertex along their lines. The most commonly drawn incorrect shapes were octagons and pentagons. It was however pleasing to note that where multiple attempts had been made, an indication of the final answer was given and this reduced the mark being lost due to a choice of answer.

Question 8

Many students were able to write down the required coordinates in part (a) and a similar level of success was seen when plotting the point in part (c). When the mark wasn't awarded in part (a), it was often due to writing the x and y coordinates round the wrong way and often led to the answer to part (c) being plotted incorrectly at $(2, -4)$ instead.

Success in part (b) was not as frequent however, still a majority gained the mark nonetheless. The most successful approaches to finding the midpoint of AB often appeared to be when the two points were joined and often led to either full marks or 1 mark being awarded. When only the method mark was awarded it was often for either transposing the x and y coordinates or for marking the midpoint on the grid. Other common errors included the exclusion of the negative sign for the y coordinate, stating $x = 0$ and $y = -2$ or giving the coordinates of point B due to not reading the question carefully.

Question 9

This first multi-step problem proved challenging for many, with less students than expected gaining all 4 marks available. Students often struggled to interpret the distance readings from the car given in the question as two five-digit mileages, often treating them as single digit distances and simply adding the digits together rather than subtracting. With working shown supporting the method used, these students were frequently awarded two marks, a mark for [mileage] × 47 and a conversion from pounds to pence, pleasingly often seen as a single step of [mileage] × 0.47.
For those who found the real mileage, by subtracting 47241 from 47879, and reached the figure £299.86, the final step of adding the £80 expenses was not always understood, with it either being ignored; being subtracted; or using incorrect magnitude.
When partial marks were not awarded, it was often due to not showing the multiplication. For example, 188 or 1.88 without also showing 4 × 47 gained no credit for [mileage] × 47.

Problem solving activities in lessons with real-life context such as this would be beneficial for students to understand what process is required. Students should also be encouraged to check if their answer makes sense in real life.

Question 10

Listing outcomes for events is frequently assessed on this tier and is often answered very well. However, it noted that success in this question was poor in comparison to previous series, often due to only two events rather than three being written as a combination. The most successful responses used a systematic listing approach to avoid repeated combinations and ensuring all possible outcomes were given. Those using T and H also appeared to be more successful to those writing heads and tails in full, but both were acceptable. Layout of the combinations also appeared to be a common cause of lost marks as the combinations were not always clearly defined in a standalone way making it difficult to see whether letters had been "grouped" together or not. For example, using brackets to define a group was clearer than using commas alone.

Question 11

Providing a valid reason with a decision was required in this written response question, with most students being awarded the mark for giving very clear and concise responses. A very wide range of explanations were seen and accepted, as shown in the mark scheme, and it was pleasing to see very few instances of contradictory reasons also being given compared to similar past questions. Where the mark was not given, the student had often argued that the statement was correct. Other responses that scored 0 involved statements that did not clearly indicate a decision, or statements that included incomplete statements such as 2 had a 90° angle without relating the angle to probability.

Question 12

This question was answered well with the majority of students using correct processes to arrive at 8 × 35 and giving a fully correct answer of 280g. Some students achieved only two marks for an answer of 560g (using white chocolate bars rather than milk) and even fewer achieved only one mark for an answer of 840g (the total weight). For those students who achieved no marks this was either due to them not attempting the question, although this was rare, or not being able to make a correct start to find $\frac{2}{3}$ of 24 due to simply writing $\frac{2}{3}$ of 24 which is insufficient as a process. A common incorrect answer of 12 from just dividing by 2 was also seen. The other common misconception in this question was the use of 0.6 as equivalent of $\frac{2}{3}$**.** Students should be encouraged to show processes at all times, (e.g. 24 ÷ 3 × 2 or 2 ÷ 3 = …) rather than just writing "$\frac{2}{3}$ = …" as this will enable them to achieve the process marks even when they make mistakes.

Question 13

The expression in part (a) was often simplified correctly, with over half of the cohort being awarded the mark. The most commonly seen error was to add the coefficients rather than multiply or still including multiplication signs.

Success in part (b) was very pleasing with a significant proportion of students demonstrating they understood substitution of negative numbers and could also evaluate correctly to score full marks. The most common incorrect answers stemmed either from doing $3 + 2 – 4$ instead of $3 + 2 \times (-4)$, or from evaluating incorrectly as -20 due to failing to apply the correct order of operations. The use of brackets $3 + 2(-4)$ was sufficient for students to achieve the method mark for a correct substitution and students should be encouraged to include brackets around negative values in every topic as this would mean incorrect evaluation from poor calculator use could be avoided.

Question 14

Both parts of this question required students to use knowledge of the relationship between speed, distance and time, with many students making good use of a formula triangle and many obtaining correct answers in part (a) and partially correct answers in part (b) as a result.

The majority gained both marks in part (a) and very few only gaining one mark. Students gaining no marks often multiplied instead of dividing, with many not considering the large magnitude and not realising that 108km/hr is fast for a bike ride. Only some students felt the need to work in minutes and not hours, despite no need for converting units of time.

Part (b) was answered less well, with only a small proportion giving a fully correct answer. Partial marks were often awarded, with students often gaining one mark for 2.25 and most then continuing to find 5.25 to gain the second mark. The third mark was often lost for an inability to correctly convert the decimal to minutes, with 5 hours and 25 minutes along with the wrong decision being made due to this. Some successfully converted fully to minutes and then compared but this approach was rarely seen.

Converting time from decimal form to hours and minutes continues to be an area of weakness for students on this tier. Ensuring students are confident with converting to and from time base 60 to decimal base 10 and developing understanding of compound measure skills involving speed distance and time with a calculator would be beneficial at all grades.

Question 15

Whilst there were very few blank responses seen, many failed to score both marks. It was common to see incorrect use of decimal multipliers, frequently forgetting to divide by 100 and 8750 being a commonly seen incorrect answer. It was also noted that a larger than expected number of students used compound interest instead of simple interest and this may have been more commonly attempted due to a lack of understanding of the differences and using the formulae sheet provided.
Where responses included 6×2.5 in an attempt to find the total percentage interest, the method mark was rarely awarded, as there was often no mention of percentage or an expression in the form 6×0.025 and there was often confusion over what the 2.5 really was, so was not uncommon to see an answer of $2.5 \times 6 = £15$. Multiple examples of 3500×6, 3500×2.5 or attempts to subtract interest amounts once found were also seen. Given students had access to a calculator, a significant number chose to use a build-up method with no clear process shown. This often led to no marks being scored due to an arithmetic error. Centres should emphasise the need to show a valid process even when using a build-up approach and that ‘of’ is not an acceptable process.

To improve on this skill, students need to be secure in their understanding of what a percentage is as a fraction or part of 100. Centres should also ensure students can confidently use their calculator to find basic percentages. Students would benefit with being more familiar with the difference between simple and compound interest applied in real life contexts to make it more memorable to candidates.

Question 16

Part (a) required an accurate reading from the conversion graph provided, and many students were able to give an answer within the acceptable range of 167 to 173 and those not gaining the mark often demonstrated they knew how to use the graph correctly but made an error when interpreting the grams scale.

Part (b) however, was often poorly attempted in comparison. Successful students were those who used the graph wisely to extrapolate data and clearly showed what reading they were using and how this multiplied to make 1000g. Many students were either competent in using readings from the graph as a factor of 1000 or applied a build-up method of various readings.

Of the students identifying the need to use a factor of 1000 and reading from the graph, most go on to get full marks. Some students only gained one of the two marks available as they were unable to interpret the scale for ounces, e.g. reading 100g = 3.5 ounces as 100g = 2.8 ounces, but could follow through and scale up correctly.

Another common error that students made was to use 300 grams as part of a build-up, usually equating this to 10 ounces or more before multiplying by 3 and adding a reading for 100g. This approach gained no credit due to 300g being outside of the range of the graph.

Extrapolation has always proved to be a challenging topic for students and in this series, although improvements can be seen, many of the students show insufficient working when the answer is outside of the specified range as incorrect readings need to be supported to gain credit.

Question 17

In line with similar questions requiring constructions to be performed, full marks were rarely awarded for this loci question. Many students were seemingly unsure how to start and many simply shaded an unbounded area that they thought made sense. When a mark was awarded, it was more often for being able to draw the 4cm arc than the perpendicular bisector. Arcs were often drawn freehand (which was condoned if within guidelines) and suggests many candidates lacked a pair of compasses despite these being listed in the required equipment. Bisectors were mainly drawn without construction lines (acceptable in this question) with students often citing "9.4cm" or "4.7cm", showing that they had just measured the line and attempted to draw a perpendicular line from the midpoint. When the arc and bisector were drawn within guidelines, the region was almost always identified correctly.

Question 18

Whilst many students gained all 3 marks available in this small problem, many students struggled to find 56% of 1800 using a valid method as the first step. Calculations attempted unsuccessfully were often a non-calculator method such as a build-up or partitioning method,

with the working shown often being insufficient for students to be given credit. Students should be encouraged to use a calculator appropriately and be confident in using decimal multipliers. Of the students who could calculate 56%, many of those then misunderstood the question and did not subtract this from 1800 and some also did not divide by 66. The vast majority of students did, however, realise and therefore gained credit for using [44%] ÷ 66. As with the majority of questions requiring the use of percentages, many students still believe writing 56% of a number or 56% = … is sufficient evidence of a correct process but such statements gain no credit unless a correct value is given. Use of the percentage button on the calculator may account for this but there is evidence to support the conclusion that many students do not know how to use this function correctly.

Question 19

It was pleasing to see that the majority of students gave a fully correct answer to part (a) of this standard use of a calculator question. Many of the students who gained the 2 marks for the question gave the full answer, which was acceptable for the award of the marks, but many showed no intermediary 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 this was less frequently seen compared to similar questions on previous series. 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 1.809.... that resulted from evaluating the numerator and then typing ÷ 4.6^2 – 8.91 rather than calculating the denominator separately or making use of the fraction function in the calculator. This led to BIDMAS being applied incorrectly and often led to no marks being awarded due to not always showing the value of the numerator and providing only an answer. Other common incorrect answers suggested students were either not using the fraction button but using ÷ instead (−8.6106….), square-rooting the entire calculation (5.1499….) and only square rooting the 35.2 in the numerator (0.885….).

Part (b) required the answer to part (a) to be rounded to 2 significant figures and whilst a follow through from part (a) was acceptable, the majority of students rounded to 2 decimal places instead.

To improve success on this type of question, students need to be rigorous in showing their working through part calculations and should be encouraged to work out and write down the value of the numerator and denominator separately to ensure they are awarded for partial evaluation and to avoid order of operation errors. They also need to improve their ability to confidently use functions such as the fraction button when entering complex calculations into a calculator.

Question 20

A great number of students were seemingly unable to successfully engage with this question despite Pythagoras' theorem being on the formulae sheet provided, with many trying to find a solution using angles in a triangle or area formulae. Of those attempting to work with Pythagoras' theorem, many incorrectly thought the unknown side was the hypotenuse, finding 192 + 102 instead of 192 – 102 or not squaring the lengths before subtracting.

Some attempted to use trigonometry rather than Pythagoras and this was often unsuccessful.

Question 21

Writing a number as a product of prime factors in part (a) is a familiar and standard question that was answered perfectly by a significant number of students. The most commonly seen method was to use a factor tree, with many showing a complete tree, some including 1 on their tree which still allowed for at least the method mark to be awarded but some not completing the factorisation for 9. When all of the prime factors had been found, some went on to correctly write as a product, some wrote as a product but included 1 which was not condoned for the accuracy mark and some either wrote their answer as a list or as an addition calculation. When a mark was not awarded, it was often due to listing single factors or factor pairs of 90. It was rare to see more than one error in factor trees compared to previous series which was pleasing.

There was less success in part (b) with the majority of students being unable to find the LCM of two values written as prime factor products. The most successful approach came from listing multiples of 12 and 18. When the mark was not awarded it was often due to candidates not knowing what to do with 12 and 18 or finding the HCF instead of the LCM. The use of Venn diagrams was rare but when used often led to a correct answer.

Question 22

This 2-mark question, on the whole, was answered very well with most students being able to substitute both of the values correctly and being able to find the difference to gain both marks. A common mistake was to substitute the incorrect values or not using the formula at all and dividing the number of bottles, redundant information, by the number of machines. It is therefore important for centres to ensure that students read the questions carefully and not assume that every number is to be used in the question.

Question 23

This question was a good discriminator for this cohort, with the full range of different possible scores seen. Almost all students attempted the question and very few blank responses were seen. Many were able to gain the first mark, usually by working out $1 - 0.16$ and thereby showing some understanding of probability and some gained the first mark for working correctly with ratio to find the total number of discs in the bag, but this was seen less frequently. A score of 2 marks was also often seen, usually where students got as far as a probability of 0.46 but then did not know how to go further, or for working with probability and ratio separately but not knowing how to combine both skills correctly to make further progress through the problem.

Of the students who understood how to approach the problem and showed a complete process, many rounded their numbers prematurely, often reaching answers like 69, 70.5 or 71 and scored all but the accuracy mark. Centres should remind students to work with accurate values fully until the end of the question and avoid premature rounding or truncating.

Question 24

A standard and familiar question split into 3 parts and assessing knowledge of quadratic graphs.
In part (a) many students achieved the full 2 marks for finding all three values correctly. However, equally as many achieved 1 mark for finding one or two correct values, with the corresponding *y* value for when *x* was negative being incorrect. Students should be encouraged to use their calculator to find the values, using brackets when substituting negative values.

The majority of students achieved one mark for plotting at least 5 of their coordinates correctly, with many of these being for following through their incorrect points provided a mark in part (a) had already been awarded. Some of the students who got full marks in (a) only achieved one mark in (b) as they did not join their points, joined them using line segments or their parabola did not have a clear vertex below the *x*-axis.
The final part of the question was not answered very well at all and was often left blank. Very few students achieved the full two marks for two solutions in range. The method mark was occasionally awarded for an answer of 2.5 to 2.7 but many students often disregarded the negative value of *x* and very few attempted to draw the line $y = 4$ or marked the solutions on the graph which would have also led to the method mark being awarded. Another common mistake leading to lost marks was writing the answer(s) embedded in coordinates.

Question 25

Combining the skills of applying fractions, percentages and ratio in this small problem appeared to be demanding for many students, with many often only being able to work with one of the three skills but not all in a correct way. Calculating $\frac{3}{7}$ of 14 was by far the most common first step shown, earning 1 mark with these students either failing to advance further in the problem-solving process but many then using a correct process to find the number of sweets for Andy and Tina after the first exchange to gain 2 of the 4 marks.
Of the students gaining 2 marks, a large number either stopped or were not able to work with 12.5% using a valid method.

Very few students showed working for every step which often led to marks being unachievable if arithmetic errors occurred. Selecting a specific value to begin working with was more commonly seen than expected, with many multiplying each part of the ratio by 21 from adding the parts of the ratio together or using 100. Of these students, very few were successful due to increased arithmetic errors or decimal values when working with a starting value of 100. Unfortunately, the majority of the cohort gained no marks and this was often due to using 21 rather than 14 when working with $\frac{3}{7}$.

Centres should give more opportunities to students on practicing the best way to approach multi-step problems involving multiple skills, particularly involving ratio, and how to logically organise their calculations.

Question 26

The majority of students were not able to form a suitable equation involving at least two angles. When marks were awarded, students were often able to secure 3 marks. However, they missed out on the final mark due to not providing a suitable conclusion to show that *ABCD* was in fact a trapezium. When marks were awarded, only a small minority were awarded 1 or 2 marks and this was often due to being able to form an equation but either not recognising the need to solve; simplifying incorrectly; using an incorrect method to isolate; or isolating correctly with arithmetic errors.

The main error when beginning the problem occurred when students did not recognise that a trapezium has one pair of parallel sides, and consequently, the co-interior angles on the same side of the transversal sum up to 180 degrees. Instead, they approached the problem as if dealing with a general quadrilateral, which often affected the final communication mark. Additionally, some students correctly added the four interior angles or a suitable pair of angles but did not equate the sum to 360° or 180° degrees to allow them to solve for the variable *x*. This oversight prevented them from securing any marks in this section.
Lots of responses tried to use the formula for area of a trapezium which again scored no credit.

Question 27

This penultimate question required students to use knowledge of similarity and, of the students who knew how to calculate the scale factor, most then went on to calculate the correct length and got the answer correct so it was pleasing to see that many of the cohort were successful. The method mark was often awarded for making an attempt to find the relationship between the corresponding sides but often showed the scale factor as the final answer. A few students demonstrated the common misconception of adding or subtracting to find the missing sides, rather than realising a multiplicative relationship was needed, indicating they didn't understand the relationship between the triangles. Another common error was to compare 6 to 8 as adding 2, so adding 2 to the 1.5 to get 3.5, or subtracting 1.5 from 6 to get a scale factor of 4.5 instead of 6/1.5 to get 4. A surprisingly larger than expected number of students seemed to measure the side of the smaller triangle with a ruler, despite the question saying similar shapes, leading to answers around 2.5.

Question 28

Finding the class interval containing the median in part (a) was not answered well. The most common incorrect answer was the interval in the middle of the table, giving evidence that frequencies were not considered. The working and answer for part (b) was also seen in this part which was surprising to see.

Performance in part (b) when calculating an estimate for the mean was in line with previous series with a range of incorrect methods seen and blank responses being frequent as well. Students who knew what they were doing tended to score full marks or at least one mark for finding 5 products but dividing by the wrong value, often 5 (groups) or the sum of the midpoints. A small number of students correctly found products but then rounded before adding and dividing and this approach leading to the second mark not being awarded. Some students rounded the frequencies to the nearest 10 before multiplying by the midpoint, no doubt attempting to 'estimate' but this was given no credit. Various other approaches that

scored no marks were seen such as totalling the minimum or maximum values of the intervals and dividing by five.

As with previous series, choice of method was a common issue. Whilst many students correctly found products within the interval, a large number were ultimately not awarded the first mark due to using an alternative incorrect method as noted in the additional guidance on the mark scheme.

Summary

Based on their performance on this paper, students should:

- read questions carefully, including checking whether the magnitude of an answer is sensible, units are appropriate, and the level of accuracy required is shown;
- practise questions involving ratio and forming algebraic expressions;
- practise using equipment such as rulers, protractors and compasses;
- practise using calculator functions and negative numbers;
- use formal methods when working with fractions or percentages.

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