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Examiners' Report
Principal Examiner Feedback

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International GCSE Mathematics
4MA1 1HR Principal Examiner's Report

It felt rather unusual for a 4MA1 exam session to be sat in November and this did not feel like the usual cohort sitting this paper. All questions were attempted well and right through to the last question there were a good proportion of students gaining full marks; it is often the case that the final few questions see many blank or incorrect responses but this was not the case.

Topics new to 4MA1 are now well answered, question 9 being an example of this. It is pleasing to see students have a good go at longer mark questions; even if the correct answer was not gained partial solutions were picking up marks. Some topics continue to cause problems with incorrect methods seen, examples being arithmetic series (question 18) and indices and prime factors (question 21).

1 This familiar opening question saw many students pick up 3 marks and get off to a good start. Many were able to convert $3\frac{3}{4}$ successfully to $\frac{15}{4}$, and from there two main methods were seen; the first multiplied to $\frac{105}{36}$ and then cancelled and converted to a mixed number or vice versa, the second method was to cancel first to $\frac{5}{4}\times\frac{7}{3}$ and then obtain $\frac{35}{12}$ and go on from there. Some students 'met in the middle', meaning they started working with both the left hand and right hand sides and showed they were equal to each other, usually at $\frac{35}{12}$. There were some students who were not able to get beyond the first method mark as they jumped from $\frac{15}{4}\times\frac{7}{9}$ to $\frac{35}{12}$ without showing correct cancelling or $\frac{105}{36}$.

2 If question 1 saw mostly correct answers, the second question on this paper provided more mixed results. Some students were able to provide correct arcs and a bisector in tolerance – a bisector unsupported by correct arcs could only gain 1 mark. It was rare to see correct arcs not followed by a correct bisector. There were a good number of students who were clearly not familiar with the concept of an angle bisector and failed to produce anything credit worthy.

3 Part (a) was answered well with almost all students able to give a correct answer of h^9. In part (b) many students were caught out by a lack of brackets around the −5 when squaring and this generally led to an incorrect answer and 0 marks. For those that were able to calculate $(-5)^2$, most went on to gain 2 marks. In part (c) it was pleasing to see all students show their clear algebraic working as instructed in the demand of the question. Many were able to go on to gain the correct answer and 3 marks. There were several who failed to multiply the right hand side by 4 correctly, usually ending up

with either $8x + 3$ or $2x + 12$; if they followed through the rest of their method correctly they could still gain 2 marks.

4 Part (a) saw most students pick up one mark for correctly identifying the modal class. In part (b) students were required to estimate the mean from the frequency table and most did this successfully to gain 4 marks. Of those that didn't, many were able to gain 2 marks for consistently using another value within the intervals, usually the upper bound. Some students attempted completely incorrect methods, such as summing the frequencies and dividing by 5.

5 This two part percentages question was generally answered well by this cohort. In part (a) many were able to gain 3 marks for an answer of 10.2, either by doing $\frac{8265-7500}{7500}\times 100$ or $\frac{8265}{7500}\times 100 - 100$. For those who did not gain 3 marks, many picked up 1 mark for either 8265 – 7500 (= 765) or for 8265 ÷ 7500 (= 1.102) but were unable to take their method further. In part (b) it was rare to see any other marks awarded apart from 0 or 3. The most common incorrect method was to find 130% of 31.50.

6 This was the first question that caused real issues on this paper. Around half of this cohort were able to interpret the information correctly and find two correct values for 2 marks. Of those that did not gain 2 marks, some gained one mark for finding one correct value, usually $a = 22$. The most common error seen was to assume b was the midpoint of 11 and −19. Another common error seen was subtracting -3 from 47 and b from 11 then dividing by 2.

7 The first step of this speed, distance, time problem required students to convert a time from hours and minutes into only hours or only minutes. Some were not able to do this successfully but could still go onto gain the two method marks if they used their time correctly – 2.42 was a regularly seen incorrect time. There were still many who were able to convert correctly, usually to 2.7 hours, and then follow through their method correctly to gain an answer of 81. Some misinterpreted the speed, distance, time formula and in this case were generally only able to pick up one mark for a correct conversion.

8 The majority of students answered this compound interest question well with many picking up 3 marks for an answer in the range 1511 – 1512. It was pleasing to see many using the most efficient method e.g. $1200 \times (1.08)^3$. For those that did not gain 3 marks, many were able to pick up one mark for a correct first step, e.g. 1200 × 1.08 (= 1296). Some students interpreted the multiplier incorrectly and used, for example, 1.8 or 1.008, gaining 0 marks.

9 Pressure, force, area was one of the new topics introduced into the specification for 4MA1. It is pleasing to see it has now become a familiar topic and this cohort on the whole dealt with it well. Many were able to find the area of the square and then use this correctly in the formula to gain an answer of 78.3. The most common error seen was to not find the area of the

square but instead use 1.5 as area in the formula, gaining 0 marks. Some students did gain one mark for finding the area correctly, but then used this incorrectly in the formula e.g. by doing pressure ÷ area.

10 This 5 mark question saw the whole range of marks awarded. There was a good proportion of students who dealt with the ratio correctly, then the fractions for lemon and fruit and go on to correctly calculate the total profit for all 3 cakes. Some got as far as working out the number of chocolate or lemon or fruit cakes but could go no further, usually because they did not work with the fractions. Without using the ratio to find the number of chocolate or lemon or fruit cakes, no marks could be gained and this was the case for a small number of this cohort, the most common incorrect method being to do 80 ÷ 3, 80 ÷ 2, 80 ÷ 5 respectively.

11 Part (a) of this question was answered well with almost all students gaining 1 mark for a correct cumulative frequency table. Many were then able to go on to correctly plot their points at the upper limit of the intervals and join with a curve or line segments. There were some who did not use the upper limits of the intervals but could still gain one mark if they used a value consistent within the intervals such at the mid-interval values for either the frequency or cumulative frequency table. In part (c) many were able to give an answer in range and those that did not have a fully correct answer in (b) could still gain 2 marks in (c) for a correct median following through their cumulative graph in (b).

12 This 4 mark simultaneous equations question was answered well by most of this cohort. Almost all followed the demand in the question and showed their clear algebraic working, although some did just write down the correct answer with no workings, presumably from an equation solver on their calculator – this gained 0 marks. For those who were able to use a correct method to gain one correct value for x or y, most generally went on to gain full marks. Some were unable to make a correct start to their method, for example making the coefficients of x or y the same but then using the incorrect operator to try and eliminate one, gaining 0 marks.

13 In part (a) of this calculus question many were able to pick up 2 marks for a correct derivative. Some left +4 in as part of their dy/dx whilst others simply left the question blank. Part (b) required students to set their dy/dx to 2 and solve this quadratic equation for x. Many did this well, showing their working as requested in the question, to gain 4 marks. For those that did not get part (a) fully correct, 3 marks could still be gained for using their three-term quadratic correctly from (a). A common incorrect method was to set $15x^2 - 2x - 6$ equal to 0 instead of 2 and solve this equation; this could still gain the third method mark provided their method was shown, most often seen in the form of the quadratic formula.

14 This algebraic expansion question saw the range of marks awarded. A good proportion of this cohort were able to expand and simplify correctly to gain 3 marks. The most common method seen was to expand the first two brackets and then multiply the result of this by $(5x + 6)$. If 3 marks were not gained,

many were able to pick up 1 or 2, by first expanding 2 brackets for the first mark, and then if they had at least 3 out of 6 or 4 out of 8 terms correct for their second expansion they picked up the second mark. A small number of students attempted the ‘all in one’ method where all 3 brackets are expanded in one go; this usually contained errors with a maximum of a possible 2 marks being awarded.

15 There were many ways to start this proof but the most common method was to begin by recognising that angle *BDF* was 70°. This picked up 1 mark and if the correct reason was given (alternate segment theorem) a second mark was gained; a good number of students made it to this stage. The next step was a method to find the angle *EFB* using opposite angles in a cyclic quadrilateral and if this was done correctly and the reason given the third mark was gained. The fourth mark was to conclude the proof by stating that angle *CBF* = angle *EFB* and therefore they are alternate angles so *EF* and *ABC* are parallel. Some students took different approaches such as adding extra lines such as *EB* or *OB* and *OF*, where *O* was the centre of the circle; these methods saw varying degree of success. There were a good number of students who could gain no more than 1 mark on this question as they failed to give any correct reasons for their working. Some began with what they were trying to prove, that *EF* and *ABC* are parallel and therefore angle *EFB* = 70°; this approach gained 0 marks.

16 Part (a) of this functions question saw mixed results with around half of this cohort gaining B1 for an answer of −4. Part (b) also caused issues with 0, 1 and 2 mark solutions all seen regularly. Of those that gained 2 marks, both methods from the mark scheme were seen ie finding $f(x) = 6$ and substituting into $g(x)$ along with finding the function $gf(x)$ and substituting $x = 2.6$. Some students were able to gain 1 mark for a correct first step but were unable to go any further. In part (c) composite functions were again assessed but this time an equation needed to be solved. Many were able to do this correctly and go on to gain 3 marks. Of those that didn’t, some gained 1 mark by finding the function $fg(x)$ and setting it equal to 2. The most common incorrect method seen was to substitute $x = 2$ into $fg(x)$ or similar. Part (d) also saw many gain 1 mark for a correct start to the process, students needed to reach
$y(x + 4) = 5x$ or $x(y + 4) = 5y$ to pick up this mark. Many then failed to reach the second mark as they could not expand, rearrange and factorise correctly. Some still went on to gain 3 marks and both $\frac{4x}{5-x}$ and $\frac{-4x}{x-5}$ were seen regularly.

17 Part (a) of this 3D Pythagoras / trigonometry question saw a variety of different methods used. All successful methods began with a method to find *FH*, which many students were able to do. From there the most efficient method was to use $\tan CFH = \frac{10}{FH}$ to rearrange to find the angle *CFH*. Other methods seen were to find *CF* using Pythagoras on triangle *CFH* and from there many different trigonometry methods could be used to find angle *CFH*. A few students appeared not to be sure what was meant by the angle between

the line and the plane. Part (b) was less well done with many students failing to realise that the length of *BG* was required. For those that did, many were able to go on to gain the second mark for a method to find *BE*; some lost the third mark as they failed to use brackets around $12\sqrt{2}$ when squaring in their calculator leading to an incorrect answer. In both parts (a) and (b) there were completely incorrect solutions seen, usually when the incorrect triangles were used from the prism.

18 To make progress on the first stage of this solution the values given in the question needed to be interpreted correctly. The first method mark could be gained through a correct equation such as $a + 5d = 39$ or $a + 18d = 7.8$ or $13d = -31.2$. If this led to a correct value for a or d then 2 marks were gained. The third mark was for substituting their found values for a and d into the sum formula, this could be achieved even if the values for a and d were incorrect, as long as they been clearly previously stated. A good number of students completely their method correctly and gained 4 marks for an answer of 555. The most common incorrect method seen was to interpret the initial information incorrectly or use an incorrect formula for the nth term when trying to set up equations for a and d.

19 The first of the three marks for this bounds question was an unconditional accuracy B mark for a correct upper bound for *AD* or *DC* or lower bound for *EH* or *HG*. The second mark was a method mark for a complete method to find the upper bound of the area of the shaded region – students did not need to use the correct bounds so long as their lengths fell in the inequalities in the mark scheme – 8.34 and 7.24 were often seen for the upper bounds of *AD* and *DC* respectively. Many were able to follow through the whole method correctly for an answer of 28.25 and 3 marks. The most common incorrect method seen was to ignore bounds for the lengths and find the shaded area without using bounds e.g. $8.3 \times 7.2 - 6.2 \times 5.3$ and then try to find the upper bound for this value; this gained 0 marks.

20 This two part question saw few correct answers. Many students were unable to get to grips with the transformations and common incorrect answers were $(-9, 4)$ and $(-6, 4)$ for (i) and (ii) respectively.

21 The first of the grade 9 questions provided a challenge for this cohort. The first two method marks were for working with prime factors, and the third mark was for a correct quadratic equation in n. Even if none of the first 3 marks were gained, students could gain the fourth mark for a method to solve their 3 term quadratic and this was often seen. There were a good number of students who were able to go on and find both values for n. Some gave only one value for n, usually 5, unsupported by any correct working, and this gained 0 marks with the assumption being that the student had used trial and improvement.

22 This 6 mark problem solving question provided many different methods. The full range of marks were awarded and it was pleasing to see a good number of students gain 6 marks for a correct answer. Both methods in the mark scheme began with finding the size of an exterior or interior angle for a

regular octagon and there were various paths students could take from there. Many split the shaded area into triangle *ACD* and rectangle *ADEH*; others considered the area of the whole octagon and subtracted the areas of triangle *ABC* and trapezium *EFGH*. Some students avoided calculating any angles and worked entirely with Pythagoras; this was not on the mark scheme but effectively bypassed the need to work out an exterior or interior angle of the octagon.

23 It was pleasing to see a good number of correct responses to the final question on the paper. The question required students to set up a quadratic equation using the products for the probabilities of picking blue, blue or white, white or orange, orange. There were two methods in the mark scheme and the most commonly seen method was the top one where students considered the denominator to be $(x + 7)(x + 6)$. A good number were able to gain 2 marks for 3 correct products and the intention to add. From there gaining the third mark was a challenge, the initial equation needed to be manipulated to reach a 3 term quadratic ready for solving. The most common incorrect methods seen were considering the problem to be 'with replacement' or simply trying substituting values in for x, the latter sometimes resulted in the correct answer but gained 0 marks as clear algebraic working was required. A few students correctly got as far as working out that there were 9 orange beads and stated this as their final answer. Centres should advise students to re-read questions after they have completed their answers to ensure that they have answered the question that was put.

Summary

Based on their performance in this paper, students should:

- learn how to convert between hours and minutes and only hours or only minutes
- be familiar with methods for calculating mid-points of two given points.
- have plenty of opportunity to develop skills in manipulation of powers of integers.
- re-read questions after they think they have found the answer to check they answered properly.
- show cancelling of fractions
- understand the link between differentiating and gradient
- learn and remember correct reasons for angle calculations

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