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Examiners' Report
Principal Examiner Feedback

Summer 2019

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In Mathematics A (4MA1) Paper 1HR

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The majority of students were well prepared for this paper with all questions being given a good attempt. Familiar topics such as angles in polygons, prime factors, percentages and Pythagoras' Theorem were answered well and students showed a good understanding. Students are showing more understanding of topics new to 4MA1 as they become more familiar from session to session. Converting units of speed, pressure and expanding three linear brackets were all well attempted; arithmetic series is certainly an area for improvement.

There are still some students who do not show their complete method and centres would benefit from spending time with future cohorts practising showing all the steps to their solutions.

Question 1

The first question on this paper saw students tackle a problem involving volume and capacity. Many were able to gain the first method mark for finding the volume of the entire cylinder or the area of the cross section. Many students stopped at this point. Among those who continued, a range of incorrect methods were seen, including many students becoming mixed up with incorrect unit conversions. There were some students who were able to complete the method correctly and pick up 3 marks; some gained 2 marks for finding the vertical distance from the surface of the water to the top of the cylinder. Some struggled to convert between litres and cm^3.

Question 2

This familiar geometry question was generally answered well by the majority of this cohort. The most common method seen was to calculate the size of the exterior angle and then divide this into 360 to reach a correct answer of 20. For those students who decided to work with the sum of the interior angles formula, some picked up the first method mark for a correct equation, although many forgot to divide the sum by the number of sides (n). This method produced less success as students made a mess of the equation when trying to solve for n. Other incorrect methods occasionally seen included attempts to construct a scale drawing.

Question 3

Students from this cohort have a good understanding of the meaning of the intersection symbol and many were able to gain the mark in part (i). Part (ii) also saw plenty of success with many able to list the values for $A \cup B$; those that didn't generally failed to include 15 in their list. Sometimes the answers to (i) and (ii) were seen transposed, indicating confusion over the meaning of the symbols. The final part saw mixed results with many students failing to get to grips with the complement notation; the most common incorrect answer was 12, 14, 16, 18, 20.

Question 4

This 2 mark linear equations question was answered well with the majority of students picking up both marks with a correct answer. Of those that didn't, some did manage to gain M1 for collecting terms in x and numbers terms on either side of a correct equation. Common mistakes were getting mixed up with the signs of the rearranged values and ending up with $4x = 30$ or having $-4x = 30$ but ending up with $x = 7.5$

Question 5

Part (a) was done very well with most students able to give a full method and correct answer for writing 720 as a product of its prime factors; both product of powers and individual values e.g. $2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5$ were seen regularly. These questions require a full method to be seen and there were a small number of students who gave a correct answer with no workings, presumably from the prime factors function on their calculator; this gained 0 marks. Other common errors seen were incomplete factor trees e.g. ending a branch at 9 and incorrect products at the bottom of branches e.g. 3 and 3 below 6. There were very few students who spotted the connection between part (b) and the answer to part (a); of those who did get a correct answer of 5 the most common method was to simply write $720 \times 5 = 3600$ and realise the answer is 5.

Question 6

Part (a) of this familiar percentages question was answer very well with the majority of students able to gain 3 marks with a correct answer. Those that didn't seemed unable to work with the percentage and added 0.08 to 4.25. Part (b) was not answered quite as well although a good proportion of the cohort were able to work with reverse percentages and gain the correct answer. The most common incorrect method was to reduce 9.45 by 8%, which gained no marks.

Question 7

This problem solving Pythagoras question proved to be a good discriminator for this cohort as the full range of marks were seen. Many students were able to pick up the first two marks for a correct complete Pythagoras method to find half the base of the triangle. It was then common to see many different methods from here, the most common being to work with half the area of the large triangle and do 0.5 × base × height and then multiply by 2. It was also common to see trigonometry methods, both right-angled and non right-angled. Some students did not attribute their angles either on the diagram or using correct three letter notation, which cost them marks. Some students correctly finding the value 4.5 failed to relate it to the correct length on the diagram, which resulted in them calculating the area of an incorrect triangle.

Question 8

In this reverse mean problem is was common to see students pick up the first method mark for finding the total weight of the 10 people or the 3 people. Many were able to then go on and reach a correct answer. There were plenty of incorrect methods seen, the most common being to subtract 79.2 and 68 and then divide by 7; this gained 0 marks.

Question 9

Parts (a) and (b) on this algebraic simplification question were answered very well with almost all students gaining 1 mark on each. Part (c) was also answered well but there were more students who didn't gain full marks; common errors were a failure to evaluate 5^3 correctly and an inability to evaluate the algebraic terms correctly. Students were able to gain 1 mark for two correct terms in a product and many did so.

Question 10

It was pleasing to see students showing some good methods to pick up full marks in this topic new to the specification for 4MA1. Workings were required so those students who gave only their answer gained no marks. There were a large number of students who gained 1 mark by working with × 60 × 60 or ÷ 1000, but could not go any further. Two of the most common problems was confusion in the conversion between m and km and to divide by 3600 instead of multiply.

Question 11

This ratio problem threw up some issues for this cohort as many struggled to make a correct start to the process; sharing 15 into the ratio 2 : 7 was commonly seen as an incorrect start. For those that did pick up marks, a variety of methods were seen. The most common was for students to work with the ratios 2 : 7 and 12 : x – 3 to work out that x – 3 = 42 and therefore x = 45. Some students stopped one step from the end and gave 42 as their answer. Some students considered that 12 was $\frac{2}{9}$ of the total age 3 years ago, going on to find the total age as 54 and that x is $\frac{7}{9}$ of 54. Frequently, students ignored the crucial -3 element using ratios 2 : 7 and 15 : x. This incorrect method gained no marks.

Question 12

Another topic new to the specification saw mixed results. A large proportion of the cohort were unable to consider the area of the 3 different faces of the cuboid and divided 105 by the volume instead. Others thought this was a bounds question and proceeded to find the upper and lower bound for each of the edges and work with those. It was pleasing to see some students consider the pressure for at least one of the faces. Of those that did all three possibilities, most were able to select the greatest and the least and find the difference.

Question 13

This sets question was answered well with a good proportion with students able to shade the correct area for part (a). It was common to see 'double shading' as well which proved to be a successful method. Part (b) also saw plenty of students gain one mark, although many could not grasp the concept of set notation and gave incorrect answers.

Question 14

This familiar tree diagrams question was answered well with most students able to pick up 6 marks. There were a few who made errors in part (a) and only gained 1 mark. Some students in part (b) failed to deal with the fact there were 200 days and gave 0.13 as their answer. It was possible to gain full marks in (b) even if mistakes were made in (a); or 3 follow through method marks if the correct answer was not achieved. 0.1 + 0.2 was occasionally seen as a first step in (b), leading to 0 marks.

Question 15

This question proved a challenge for many students with a fully correct solution gained by around half of the cohort. Of those that did gain full marks, a variety of equivalent equations were seen. Some students gave their answer in the form $y = -\frac{1}{3}x + 2$ which was enough to gain 3 marks. A common stumbling block was finding the gradient of the perpendicular line; many were able to rearrange $\mathbf{L}_1$ but then could not find the negative reciprocal for the gradient of $\mathbf{L}_2$. A number of students here thought that the perpendicular line had a negative gradient rather than a negative reciprocal gradient. Other incorrect methods included substituting (9, −1) into $\mathbf{L}_1$.

Question 16

This two-part calculus question proved to be all or nothing for the majority these students. For those that made a correct start and differentiating correctly for 2 marks in (a), almost all went on to complete part (b) correctly and pick up 5 marks in total. Common incorrect methods seen were failing to multiply by the powers when differentiating and setting the quadratic from (a) equal to 6 in part (b) and attempting to solve. Many did not recognise the need to differentiate at all; a number of students treated the question as a constant velocity problem and just divided displacement by time. Those students who could differentiate but not relate it to the problem, often failed to get the marks in (a).

Question 17

In part (a) of this histograms question fully correct solutions were uncommon. Many students failed to work with frequency density or any sort of scale and relied on a quirk of the question, the fact that the last two bars had the same width, to pick up a solitary mark for a correct frequency. In part (b) there were follow through marks available and it was common to see students work with 16 correctly from (a) to pick up one or two marks. In part (b) many students used half the class width from 40 to 60 instead of a quarter of it.

Question 18

Part (a) saw another of the topics new to 4MA1. Students are becoming more familiar with the style and most knew to expand and simplify a pair of brackets and then multiply their quadratic expression by the remaining linear bracket. Students found it difficult to keep their algebra accurate and many lost the accuracy mark after making mistakes in their expansion, the most common error being to write $-14x$ instead of $-49x$. Students should be aware that if they are multiplying a two term expression by a three term expression then they should get six terms; often they only had five terms and lost marks. Part (b) saw less success although a good number of students were able to gain the first method mark for multiplying by the denominator and expanding the bracket. It was often then all or nothing for the last two marks: those students who realised they should collect terms in m and factorise were generally then able to go on to gain the correct solution.

Question 19

Students are still getting to grips with this topic new to the specification. Some were able to pick up a method mark for the correct substitution into the sum of a series formula (given at the front of the paper) but were unable to progress further. For those that could recall and work with the nth term formula generally went on to gain at least 2 or 3 marks; it was common to see incorrect algebra which let some students down. Often, despite having the correct pair of simultaneous equations the students were unable to solve these correctly. Of those that managed to gain a correct value for a and d, almost all went on to gain the full 5 marks.

Question 20

This algebraic simplification saw mixed responses from this cohort. There were a decent proportion who managed to pick up 2 marks for reaching as far as 125×10^{21n}. The majority of these students were not able to go on to the correct answer and struggled to deal with converting this expression into standard form, 1.25×10^{23n} being a common incorrect answer. There were a large number of students who were not aware of how to begin the problem and gained 0 marks. Common incorrect answers seen were

Question 21

It was pleasing to see a good number of this cohort gain 1 or 2 marks on part (a) for one or two correct coordinates. Part (b) proved to be a challenge for most with very few picking up 2 marks; there were a good number who gained 1 mark for one correct value, with $a = 2$ and $b = 3$ being a common incorrect answer.

Question 22

Simultaneous equations at this level are always a challenge and that certainly proved the case for these students. Most were able to pick up the first method mark for substituting the linear equation into the quadratic equation. It was common to see errors in algebra lead to an incorrect quadratic equation in *x* or *y*; this lost the first accuracy mark but students could still gain the next method mark for correctly substituting into the formula or factorising their quadratic. Of those that did arrive at a correct quadratic, many were able to go onto gain the full 5 marks for a correct pair of *x*, *y* values.

Question 23

This challenging circle theorems question rarely saw students gaining full marks. A good number were able to access to first method mark for an expression for *ABF* or *CDF*. From then on it was rare to see method marks gained; the next mark required students to arrive at expressions for two other angles and this was a stumbling block. For those that did manage this, many were then able to work with their algebra to arrive at the correct answer, some setting up an equation in *x*, others using simultaneous equations in *x* and *y* where *y* = *AFB* = *DFE*. Often, students labelled various angles as being right angles, leading to 0 marks. It is important that centres stress that students cannot make assumptions about angles in diagrams.

Question 24

It was pleasing to see most students pick up 1 or 2 marks on this grade 9 vectors question. The first 2 method marks were accessible to most and many were able to give vectors for $\overrightarrow{AP}$ and $\overrightarrow{AC}$ or $\overrightarrow{CA}$. The third mark was much more difficult to access and as the A mark was dependent on M3, this was the end of the line for most students on this question. For those who were able to set up a vector for $\overrightarrow{OQ}$ or $\overrightarrow{QP}$, many were able to go on find the correct answer of 3 : 2. Common incorrect methods included using similar triangles; this method was given no credit as the question specifically asked for a vector method.

Question 25

To be able to make a start on this question students had to find a method for angle *XYZ*. Most were not able to do this due to the fact a diagram had not been given and as result gained 0 marks. It was pleasing to see a small number of students make a correct start and go on to give a fully correct method and answer in range. Common incorrect methods seen were attempted scale drawings or attempting the bearing of *X* from *Z*.

Summary

Based on their performance in this paper, students should:

Show all steps of their methods and workings, especially in those questions that specifically ask for it.

Read the wording in the question to ensure that their answer reflects what has been asked for.

In calculus, recognise that $v = \frac{ds}{dt}$ and $a = \frac{dv}{dt}$

Ensure basic skills such as conversion of units do not impede their success at higher grade questions.

Practise problems involving arithmetic series and ensure they learn the nth term formula which is not given on the formula page.

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