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Examiners' Report
Principal Examiner Feedback

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4MA1 1HR January 2020 Principal Examiner's report

The majority of students were well prepared for this paper with all questions being given a good attempt. Familiar topics such as fractional arithmetic, sets, solving quadratic equations, reverse percentages were answered well and students showed a good understanding. It was pleasing to see students show more understanding of topics new to 4MA1 as they become more familiar from session to session, including density, mass, volume.

1. It was pleasing to see the majority of students make a positive start to the paper and score full marks. The first method (starting with 36 ÷ 8) and second method (starting with $36 \div \frac{8}{11}$) on the mark scheme were seen in equal measure and usually led to a correct answer. There were a small number of students who misinterpreted the information in the question and decided to split £36 between all three people e.g. starting their method with 36 ÷ 11.

2. This familiar 'show that' fractions question saw most of this cohort pick up 3 marks. Many were able to start with the correct improper fractions and then follow one of the routes guide-lined in the mark scheme. For those that did not gain full marks, a common error was to either not complete the method or skip straight from the improper fractions to $\frac{42}{5}$ without showing an unsimplified fraction (e.g. $\frac{336}{40}$) or correct simplification. Some students felt the need to scale their fractions up to a common denominator before multiplying but many of those still went on to show simplification down to the required answer.

3. This 4 part algebra question saw success for most students on all parts. In (a) most were able to correctly make *a* the subject; those that didn't normally started with $g - d$ resulting in 0 marks. In (b) a correct factorisation was usually seen; if not a partial factorisation gained 1 mark. Most were able to correctly expand and simplify the double brackets in (c) and part (d) saw almost all students gain 2 marks for a correct answer.

4. The first part of this sets question was answered very well with almost all students giving the correct list of letters. There were a small number who confused the union symbol with the intersection and gave an answer of 'e'. Part (ii) was also answered well with many giving the correct 4 letters. Again an answer of 'e' was seen, presumably from students ignoring the complement symbol on G and therefore giving the set $W \cap G$. In part (b) it was pleasing to see most students show a good understanding of the empty set notation and give a correct decision and reason, usually relating to e being in all three sets.

5. The majority of this cohort made a good start to this area question with a correct method to find the area of the semicircle. Those that did pick up the first method mark generally went onto gain full marks with the method to compare the area of the semicircle with the area covered by the 12 boxes being the most common seen. There were a small number

of students who showed a fully correct method with values but made the wrong decision and lost the final A mark. Some gave only 12 × 6 = 72 for their method which on its own did not gain a mark.

6. This quadratic equation question was answered well with almost all students gaining the two correct values for x. It was pleasing to see almost all follow the instructions of the question and show their clear algebraic working; correct answers with no workings scored 0 marks. Of those that did not gain full marks, some gained 2 marks for giving an answer of $(x - 9)(x + 4)$. Those that chose to use the quadratic formula usually did it well and showed enough workings to be credited.

7. The modal mark for this question was 3 as many students were able to interpret the question correctly and correctly find the original price of the hat. The next most common mark was 0 as some students increased the sale price by 15%.

8. This reverse mean question saw mixed results. There were a good number who were able find the total weight of the 3 remaining children on the trampoline (87). Some were then able to divide this by 3 to achieve the correct answer. Unfortunately, some stopped at 87; students should be advised to check if their answer is 'sensible' in context of the question. Others gained no marks for incorrect starts such as 28 ÷ 5 or 26.5 ÷ 2.

9. The first 5 mark question on this paper saw mixed results for this cohort. It is pleasing to see more and more students getting to grips with one of the new topics included in the 4MA1 specification. The first mark for finding the volume of the cuboid was gained by most students. It was also common to see the density formula used correctly to find the volume of the statue or the mass of one block of gold. Some students stopped at this point but many did go on to calculate the number of blocks needed (12.3576...) and interpret this as 13 full blocks. There were a small number who rounded 12.3576... down to 12 and therefore losing the final A mark.

10. This forming and solving a linear equation question was generally answered well with a good number of students able to gain the full 5 marks. The question required algebraic working to be shown and it is pleasing to report that this cohort did just that. A minority of those who had understood the question well stated the value of x instead of the required side length, and centres should advise students to re-read questions after completing each answer to check they have addressed it correctly. Basic errors were the main enemy for these students, with mistakes such as incorrect expansions (e.g. $6(x – 1) = 6x – 1$) and incorrect rearrangements of the linear equation often being seen. There were also a small number of students who multiplied lengths instead of finding the sum.

11. Parts (a) and (b) of this bounds question were answered very well. Occasionally an incorrect answer of 4.34 was seen in part (a). Fort part (c) students needed to interpret that they needed the upper bound for e and the lower bound for f. Some were able to choose the correct two values and find the difference to gain 2 marks. Of those that didn't, many picked up 1 mark for one correct bound, usually 17.5; many did the difference of both upper bounds.

12. In part (a) of this cumulative frequency question most students were able to read off the median correctly and give an answer in the range 22 – 24. Part (b) saw more varied success; a good number of students were able to read off at 45 and 15 correctly and find the difference to give a value in range. A common error seen was to use the total frequency as 50 rather than 60. In part (c) students were required to compare their medians and IQR's for both hospitals. It was pleasing to see a good number be able to produce two correct comparisons with at least one in context, usually using the medians to say Hospital A's waiting time was less. There was also a follow through available so even students who had gained 0 marks on (a) and (b) could have gained 2 marks on (c) so long as they correctly compared their values and this was occasionally seen.

13. Part (a) was a familiar question with many students able to give fully correct complete method and gain 2 marks. The main stumbling blocks were a lack of algebraic labels for the 2 recurring decimals and not enough significant figures given for the decimals if the recurring dots were missing; both mistakes led to 0 marks being awarded. In part (b) students were required to rationalise the denominator of a fraction but the lack of numbers within the roots meant that calculators were rendered useless. A good number recognised the need to multiply numerator and denominator by $(2+\sqrt{y})$ and therefore gain the method mark. Of those that did this some were able to go on to the correct answer but it was not uncommon to see students get into difficulty when attempting to expand and simplify the brackets.

14. It was rare to see the full 4 marks awarded in this circle theorems question. A good number of students picked up 2 marks for a correct method to reach 52 for the angle *OAC*. Students then struggled to gain the marks available for giving reasons for each stage of their working, without the correct circle theorem no further marks could be awarded. Some did manage to state that angle at the centre is twice the angle at the circumference or equivalent to gain B1 but then could not complete a full set of reasons. Some students assumed that *AB* and *BC* were equal in length; if used correctly this led to a correct value for *OAC* but the marks for reasons could not be awarded. Many students gave the isosceles triangle as a reason but omitted angles of a triangle sum to 180 therefore failing to gain full marks.

15. This trigonometry question was answered well with a good number of students gaining the full 4 marks. There were a variety of methods seen; some used only right-angled trig, some included Pythagoras' Theorem and some used the sin rule. There were a small number who misinterpreted the initial triangle and calculated *FD* as 12cos40 and this unfortunately led to 0 marks gained.

16. In this probability question the first two method marks were independent of each other. It was common to see either or both of these two marks gained for either working out the probability of winning chess (0.7) or the probability of not winning tennis (0.4). If these two marks were gained it was usually all or nothing after; some students got into difficulties and gained no further marks and some went onto gain the full 4 marks. A number of students found the use of tree diagrams helpful in successful responses, though these were not required.

17. Part (a) of this functions question was answered well with almost all students giving the correct answer. Part (b) was the opposite where a correct inequality for the range of f was rarely seen. Common incorrect answers were an attempt at the domain such as $x \neq 4$ and $x > 4$. Composite functions is certainly an area this cohort should work on. A good number of students were able pick up the first method mark, usually for a correct method to find g(2). Many of these failed to go onto gain the A mark, with common errors being calculating f(2) + g(2) or f(2) × g(2).

18. Part (ai) of this question required students to draw a tangent at *P* and find the gradient. Those that did not draw a tangent gained 0 marks in (ai). It was pleasing to see a good number draw a tangent and attempt to find the gradient. Some students misread the scale of the axes as 2 mm to 0.1, but could still gain the method mark for attempting to find the gradient. There were also some students who did not have the order of *x* and *y* coordinates correct in their division resulting in a positive gradient rather than a negative. It is essential that students draw the line of sufficient length as it was often very difficult to see if a tangent had been drawn at all. Some students did manage to have a complete correct method and an answer in range for 3 marks. In (aii), students then needed to use their gradient to find an equation of the tangent at *P*. This was done well with the most common method being to substitute a point from the tangent, usually (2, 2.4), into $y = mx + c$. Some instead used the *y* intercept from their drawn tangent. There was a follow through applied for their gradient but this was only acceptable if their value of *c* was greater than 3 (where the curve intersects the *y* axis). A good number of students were able to give both correct values for *k* in part (b).

19. It was pleasing to see this histograms question well attempted and a good number of this cohort gain the full 4 marks for a correct answer of 370. Of those that didn't, some gained 3 marks by finding frequency density correctly and then having a complete method to find the total frequency but made one error in readings, usually with the 185-190 bar. There were a number of students who struggled with the scale e.g. counted the 1cm^2 in the 155-160 and 160-170 bars as 15, or they misunderstood the question and thought that the frequency for the 155-160 bar was 160 and the 160-170 bar was 160.

20. This volume question proved to be a step too far for the majority of this cohort. It was rare to see anything more than 2 marks awarded. A good number were able to pick up the first 2 method marks for correct expressions for the two cones and subtracting to find the volume of the frustrum – at this stage missing brackets were condoned. From the third method mark onwards all expressions needed to be correct and this where the majority became unstuck.

21. A good number of students were able to pick up the first mark from a complete method to find *CB*. From here some were able to get as far as the acute version of *ACB*. After this point, very few gained any more marks due the fact that the obtuse version of *ACB* needed to be used and most did not recognise this.

22. In part (a) it was not common to see a fully correct answer although a good number of students were able to give one correct value, usually *a* as 2.5. A cosine curve was

occasionally seen drawn which gained M1. In part (bi) some success was seen; a common incorrect answer was (8, 5). In (bii) students scored well and the correct answer was seen on a regular basis.

23. The final question of this paper saw a good number of students gain the first and second mark for differentiating s and equating it to v. From there very little success was witnessed, with the most common incorrect mistake being to try to use the quadratic formula but with $a = 3$, $b = 8$ and $c = -5$. There were a small number of pupils who managed to arrive at the correct answer and the most common method used was the quadratic formula; completing the square was rarely seen.

Summary

Based on their performance in this paper, students should:

- Practise giving full reasons for each of stage of their working in angles and circle theorems questions.
- Practise drawing tangents to curves and finding the gradient.
- Work on functions as a topic, in particular finding the range of a function.
- Re-read the question after they think they have completed their answer.
- Consider whether answers are sensible for the context of the question.
- Show full workings clearly if this is an instruction in the question.

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