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Examiners' Report
Principal Examiner Feedback

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International GCSE Mathematics
4MA1 2HR Principal Examiner's Report

This was an unusual examination series, and we had a very varied group of responses with some of an excellent standard but others leaving out vast quantities of the questions on the examination paper.

This paper gave students, who were well prepared, ample opportunity to demonstrate positive achievement. Some challenging questions towards the end of the paper discriminated well and stretched the most able students.

Some students still need to heed the wording 'showing clear working' as on questions where this is requested no marks are awarded for merely seeing a correct answer.

Question 1
All parts of this question were answered well and many candidates scored full marks. Algebraic errors to avoid include (a) omitting brackets when squaring negative numbers, (b) not factorising fully, (c) failing to identify $4t \times 3t$ as $12t^2$ and (d) making sign errors when expanding brackets.

Question 2
Most candidates were able to answer this question efficiently, using a variety of methods to find the area of the semicircle. Some responses, however, used perimeter of shapes and as such could not gain any credit.

Question 3
The first part of this question was generally answered well, with correct answers of 24 and 30, although some candidates gave only one of the values. Most other candidates who were not awarded the mark for this question had left it completely blank. Similarly in part (ii) the majority of candidates gave a fully correct answer, and those who did not, often included extra values, especially 22 or 30.

In part (b), most candidates failed to secure the mark for this question. Common incorrect answers included $(A \cap B)'$ and $A' \cup B'$ and many included extra incorrect notation such as $n(A \cup B)'$ or $C \cap A \cap B$.

Question 4
Most candidates managed to score both marks for part (a), and otherwise usually scored one mark for either 81 or for k^8. The most common incorrect answers included incomplete simplification, such as 3^4k^8 or gave answers such as $81k^6$ and $27k^8$.
In part (b), the responses to this question highlighted the need for candidates to work on the laws of indices, particularly in relation to negative indices. An answer that included $7m^4$ gained one mark in a fairly high number of cases, but the other mark for n^6 was not commonly given.

Question 5
There were mixed fortunes on these responses. In part (a) many could rotate the shape through 180 degrees but did not always use the centre of rotation about the point (−3, 2), thus gaining just one mark. Two marks were awarded for the correct rotation in the correct location, which was seen much less frequently. Part (b) was generally answered

with better accuracy, although some candidates mixed up the horizontal and vertical translations.

Part (c) required the description of "enlargement, scale factor 2 from centre (−3, 3)" or equivalent, and as such only a minority of responses gained full marks. A good number of candidates gained one or two marks by providing a partially complete answer.

Question 6

Many students did not realise that the Wednesday price of £1.26 was in fact 105% of the price on Monday. Hence 1.26 ÷ 1.05 =1.2 and 1.2 × 30 = £36 gave the cost of 30 litres of petrol on the Monday. However, a good number of candidates were able to gain just one mark for a partially correct calculation that typically included multiplying 1.26 by 30, even if a percentage multiplier of 0.95 was used.

Question 7

This question was not well answered in many cases and a large number candidates struggled with this question. It was apparent that many candidates were not familiar with this topic at all and were unable to even identify the straight lines of $x = 3$ and $y = 1$ which would have gained one mark following the special case. Although some candidates were able to identify all the correct inequalities to define the region. Incorrect responses were frequently blank, or were seen simply listing co-ordinate points of intersection and hence gained no credit.

Question 8

Part (a) was an excellent source of marks, with a very high proportion of candidates correctly identifying the Pacific ocean. In part (b), many candidates secured both marks, and otherwise it was common to see the M1 awarded. Those that did not gain any marks either found the sum of the numbers rather than the difference, chose the wrong values from the table or incorrectly converted the values in the table from standard form before finding the difference. A large number of candidates gave 93930 as final solution, therefore not obtaining the accuracy mark. Some lost the accuracy mark as they incorrectly rounded their final answer to 9.3×10^4.

Question 9

The majority of candidates opted to factorise and then successfully obtained the correct answer, however some students factorised correctly but did not go on to solve for x. Use of the quadratic formula and completing the square were other valid methods seen. Accuracy was less good when candidates chose to use the formula, with sign errors occasionally occurring at the –(–21) stage or when squaring –21. Candidates occasionally left their answer as –441 due to omitting brackets in their working out. Where students scored 0, they had attempted to rearrange the equation, or to factorise with a single bracket.

Question 10

A good understanding of how to calculate the estimate the mean was shown, invariably those who got to $160 + x$ went on to write a correct equation followed by a well worked solution. Occasionally, responses were seen containing errors such as use of end points instead of midpoints, or using 5 as the denominator in their expression for the mean.

Question 11
Calculation of the major arc was well attempted, using 320 as the required angle. Also commonly seen was the entire circumference subtract the minor arc, using 40 as given in the question. Some candidates incorrectly calculated the area of the sector, leading to 0 marks. After scoring the first two marks, many candidates did not add the lengths of the radii to obtain a value for perimeter, and astonishingly, some candidates even subtracted these radii.

Question 12
This question was very well answered and responses without showing working were rare. This is a common type of question and candidates were well prepared for it. Candidates who employed the substitution method made very few errors and tended to score full marks. Elimination was seen more often and, again, very successfully. There were some arithmetic errors, the most common involved subtracting negatives, but generally, the correct operation was used to eliminate one variable and substitution of their value was universally well done.

Question 13
Most candidates successfully scored 3 marks on this trigonometry question, showing a good understanding of the topic and knowledge of angles of depression. Where candidates failed to score any marks they either incorrectly identified the location of the angle of depression, used the incorrect trigonometric ratio or had calculated the horizontal distance rather than the vertical. For these candidates this meant they could not score the first method mark, unless attempting to use Pythagoras to work out the required height.

Question 14
This question proved to be challenging for many candidates. Some students had problems in decoding the question and deciding how to approach the question. These sorts of questions have been around for many years and students should have a 'go to' approach, using multipliers, with diagrams to indicate time direction, showing when to multiply and when to divide.

Many responses did earn a mark by showing a decimal (0.85 more often than 1.0285) but too many candidates left their working in the form (1 − 15%, or 1 + 2.85%). Only a small proportion then wrote a correct equation to score any further marks. The minority who did use the correct equation tended to obtain a correct answer, although several used $2x$ rather than x^2 thus scoring 3 marks only.

It was common to see the use of expressions written as (1 + 2.85%) which should be discouraged, instead, candidates should use decimal multipliers, or at least immediately turn their percentage expression into a decimal multiplier, eg. 1.0285 in this case.

Question 15
This question was the most poorly answered on the paper. Many responses gained no marks as they were left blank, or to multiply two odd numbers, eg. 7 × 11 as attempt to justify the statement. Of those responses that took note of the instruction to use an algebraic proof, candidates most commonly scored 2 marks by correctly expanding a product of odd numbers, but unfortunately using the same variable twice. Some

candidates were not familiar with the word ‘product’ and tried to add their expressions, hence gaining no marks.

The key point in this question is to appreciate that for *any* two odd numbers, there must be a use of different variables, and only a small minority of responses showed this by using eg. $(2m + 1)(2n + 1)$ as their algebraic expression. A number of candidates with fully correct algebra, and a factorisation did not gain the final mark, due to a lack of conclusion. “Hence odd” would be sufficient following suitable algebra.

Question 16
Many candidates did complete the Venn diagram correctly in part (a) but too many merely copied the four numbers given in the question and randomly entered them into the four empty areas. In part (b), many identified the number in the set $A \cap B$ but relatively few gave their answer as a probability. Correct answers in part (c) were rare, although some candidates picked up a mark for 62 + ’12’ or 80 − ‘6’ with a few starting from scratch with 38 + 24 + 12. The calculation often missed out the 24 giving 50/80 as an answer or the 12, giving 62/80 as an answer. From an incorrect Venn diagram, some gained follow through marks for using probabilities from their diagram, especially in part (i).

Question 17
For a question at this stage of the paper, a good number of candidates were able to complete this to a high standard and obtain full marks, or close to full marks in all sections.

a) Most candidates achieved at least 1 mark from $g(3) = -7$. Where candidates did not go on to gain the second mark for 55 they had often incorrectly squared −7 to get −49 or they were trying to multiply function g by function f.
b) Candidates frequently scored M1 for expanding $(x - 10)^2$ even when the first method mark had not been scored. Some candidates omitted the +6 on the left hand side of their equation, incorrectly obtaining $x^2 - 20x + 100 = x^2 + 6$. This appeared to occur when candidates were expanding the brackets separately, rather than creating the equation first hence leading to an incorrect value of x.
c) A majority of candidates realised that $x = 0$ was the value that had to be excluded from the domain of h, thus gaining the mark.
d) A good number of responses showed the first correct step of removing the fraction, multiplying by x to obtain a correct expression. After this first mark, however, quite a few rearranged incorrectly and did not recognise that factorising was needed to make x or y the subject. Candidates who were able to do this generally went on the score 3 marks, providing an answer in terms of x.

Question 18
Most candidates did make a start on this question. Those who factorised early within the question gained more success as the quadratic found was easier to solve and led to the correct two solutions. However, a significant number did not factorise initially and then often made errors in reaching a correct cubic equation. Candidates that followed the alternative scheme frequently came to a stop at the cubic, as solving a cubic should not have been necessary on this question. Responses that gave all three roots of the cubic (two correct solutions and the asymptote) were not fully correct and hence could not achieve the final accuracy mark.

Question 19
Part (a) was answered well, with powers of 2 or 4 being the most common first step. Only a handful of responses went straight to 1024 from their calculator, hence not achieving the first mark. The instruction to show each stage of working clearly was used to highlight to candidates that they should be using laws of indices to manipulate the terms, which many candidates did with confidence.

Part (b) was similarly well answered, when attempted, and a majority of candidates were able to get at least the first mark for $\frac{1}{16}$ or 0.0625 seen. From there, a variety of methods were employed, some long-winded and others very efficient in obtaining the answer, such as $\left(\frac{1}{16}\right)^{-\frac{5}{4}}$ and the very unconventional $\sqrt[-\frac{4}{5}]{16}$. Although many students produced very elegant solutions, manipulating powers with accuracy, there were some that produced unclear working, and candidates should cross out working that they do not wish to be marked (two different approaches or contradictory working).

Question 20
This question was a good differentiator. To make substantive progress, students needed to identify the angle *AOC* as 150 degrees. Most did and went on to find the area of sector AOC. The correct area of triangle AOC was less common, and this is another question where drawing on the diagram would help students focus on what is required. Those who did find this tended to go on to the correct answer and earn full marks. Some assumed that the shaded area must be a semicircle and others tried a variety of trigonometrical ratios to try to solve. Candidates did not seem particularly familiar with the formula for the area of a triangle as $\frac{1}{2}ab\sin C$, and often took the longer approach of working out base and height.

Question 21
This question elicited many correct responses, even though it was a challenging question, set towards the very end of the paper. As this question has been seen a few times in previous papers, candidates have clearly learnt what is expected of them and how to tackle such a question.

Of those candidates who provided an attempt to this question, many of those starting with the correct fractions for RR and BB went on to correctly gain 3 marks for a fully correct equation. Some candidates assumed replacements and used n^2 in the denominator rather than n(n-1) which was not given any credit. The alternative approach of using RB and BR with the complement probability was not commonly seen, although it would be a perfectly valid method.

From a correct equation, some responses contained arithmetic errors in simplification but most candidates went on to give the correct answer of 18. Those who obtained a correct quadratic usually managed full marks, and those who didn't were those who failed to realise that you can't have half a bead and gave the non-integer solution in addition to the integer solution.

Question 22

The last question on the paper, this 3D trigonometry question was set in a different context, although many students did not recognise it as such. The word 'plane' is in the specification, but a large proportion of candidates failed to understand the significance of this, with the diagram, and attempted to solve using the sine and cosine rule.

To make progress, candidates needed to work toward finding length MB and then use this within triangle MBT to find the required angle. A large proportion of candidates failed to add MB to the diagram, therefore not aware that angle BMT was to be found. Those students who found MB by a one-step method were generally successful, but those who tried to find AC, followed by MC and hence MB were less successful, often stopping at AC which gained no credit. Some candidates introduced a new point where the lines AB and MT crossed on the diagram (although these were non-intersecting lines). Such responses generally earned no marks, unless other valid work was seen elsewhere.

Summary

Based on their performance in this paper, students should:

- Practice writing set notation
- Focus on knowledge of topics that are also set out Foundation tier, found towards the earlier part of the examination paper. Transformations is a topic that is frequently neglected.
- Use the simplest approach where possible – factorising instead of using the formula or completing the square when solving quadratics, and trigonometric ratios, rather than cosine and sine rule when dealing with right angled triangles.
- Use percentage multipliers for reverse percentage problems, or for repeated percentage problems.
- Develop knowledge of proof, and suitable expressions for odd and even numbers.
- Take heed of the instruction "show each stage of your working clearly".

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