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Examiners' Report
Principal Examiner Feedback

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in Mathematics A (4MA1) Paper 2F

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4MA1 2F January 2020 Principal Examiner's report

Introduction

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

Handwriting was sometimes very difficult to judge, particularly within algebra where *x* terms very often looked like n's, m's or even u's. Benefit of doubt was given in most cases. Similarly, distinguishing between 4 and 9 was sometimes difficult.

Multi-step questions such as Q10 were a challenge to some and more practice is needed on such questions. Reading a question carefully and answering what is requested rather than what the student thinks is still something that needs work in many cases.

Question 1

Candidates were presented with a very familiar style of question on types of numbers at the start of the paper and they were almost all able to achieve full marks.

Question 2

Asked to put four decimal values in order of size in part (a), there was a sizeable minority who were unable to do so correctly. Writing 0.3 as a fraction in part (b) was far more successfully done; where there was an incorrect answer it was most likely to be 1/3 In part (c), many candidates could write a value with 5 decimal places correct to 2 decimal places but there was a large variety of incorrect answers with assorted numbers of decimal places.

Question 3

The majority of candidates did not read carefully enough the information, which told them that the perimeter of each square tile was 20 cm. For full marks they needed to work out that the length of a side of a tile was 5 cm and use this value to find the length and width of the rectangle and hence its area. Fully correct solutions were seen regularly. However, two misinterpretations also occurred frequently. One was that the area of each tile was 20 cm^2 which resulted in an answer of 240 cm^2 as there were 12 squares, but this gained no marks. Others took 20 cm to be the length of the side of a tile, used this to work out the width and length of the rectangle as 60 cm and 80 cm and an area of 4800 cm^2. This gained credit of one mark.

Question 4

The pictogram question, where candidates had to start by completing the key and then work out how many rickshaws were sold in February and draw the correct number of symbols for the 15

sold in May, was very well answered. The symbol used was a rectangle, sub-divided into 4, which represented 12 rickshaws. The most commonly seen error was where candidates thought they needed to give the number of rickshaws for each sub-division of the rectangle, hence answers of 3 were seen; however many of these then went on to gain full marks for the rest of the question.
It was encouraging to see most candidates able to deal with a 'problem solving' question in part (d) about whether or not Sandeep made a profit. It was good that most remembered to indicate that he did not make a profit, as well as showing their working to support their conclusion.

Question 5

Most candidates found little difficulty in simplifying $10a \times b$ in part (a) or solving $n + 3 = 7$ in part (b). Where a mistake was made in (b), it tended to be adding 3 to 7 giving an incorrect answer of 10.

Question 6

Candidates performed very well in parts (a) and (b). Those few who could not name the solid as a cuboid usually gave rectangle as their answer. Measuring the length of a line was mostly accurately done and where candidates did not gain the mark they were usually only a millimetre or two outside the limit for credit. The majority of candidates could pick out the two congruent shapes in part (c). Those who didn't often had no idea, regularly selecting a quadrilateral and a triangle.

Question 7

The large majority of candidates were able to score full marks on all parts of this number machine question, finding an output, an input and a missing function. Errors were few but in (a) this was mostly from candidates who gave 30 for the result of 15×4 In (b), a few candidates successfully did the inverse of $\div 6$ but forgot that they also needed the inverse of -2; if they showed 18 as the answer to the interim step, they gained one of the two marks. Some remembered to reverse the flow diagram but used the original functions rather than their inverse. In part (c), a handful of candidates penalised themselves by simply giving 3 as the missing function rather than the necessary +3

Question 8

By far the majority of candidates gained full marks for drawing the graph of $y = 3x - 1$, having first correctly completed the table of values in part (a). A few lost one mark for failing to join the points. The most common error in part (a) was for the y value for $x = -1$ to be calculated incorrectly. This often resulted in a line that was not fully correct but if at least 5 points from their table were accurately plotted candidates could gain one mark. Candidates should be encouraged to notice if one point is out of line with the rest and go back to check their working in part (a).

Question 9

Almost all candidates found the probability question in part (a) straightforward and gained both marks, giving their answers in accepted notation; it is now an exception for ratio notation to be seen, which does not gain full marks. For data given in a frequency table and asked to find the mode, some candidates were unsure as to whether it is the number of packets that is the mode or the number from the frequency table. More correctly gave 2 than otherwise but the frequency 17 was seen regularly, as were both 2 and 17, which could not gain the mark. In part (c), where the information in the table had to be used to find the total number of packets, it was pleasing how many candidates were successful; very few of these went on to find the mean, which would have denied them the accuracy mark. Where the table was not correctly interpreted, the most popular wrong response seen was simply the total of the frequency column.

Question 10

This multi-step problem produced many fully correct answers, enabling candidates to gain the full 4 marks. Where this was not the case, many could start successfully by finding the cost of one bottle of juice and one bar of chocolate but then multiplied these costs by the wrong numbers. Such candidates were credited with 2 marks. Very few were not able to gain at least the first mark for finding the cost of one bottle of juice, given the cost of three bottles.

Question 11

In part (a) (i) and (ii), almost all candidates recognised that both parts needed an inequality sign for the answers and the large majority were able to use them correctly. Most could pick out the element with the lowest boiling point for the mark in part (b) and the element with the greatest difference between its boiling and freezing points for another mark in part (c).

Part (d) was another ‘problem solving’ question. Responses showed that many candidates could count down from -35^{o}C to -101^{o}C and then make an attempt to work out how long this temperature drop would take if there was a 10^{o}C drop every 2 minutes. If they divided 66 by 10 or could arrive at a time of 13 or 14 minutes, they gained the method mark. Getting to exactly 13.2 minutes or 13 minutes 12 seconds proved much more of a challenge but some were able to achieve this.

Question 12

This question began with the need to increase 120 by 7.5% and while a high number of candidates found this straightforward, it is perhaps surprising how many could not produce the correct one or two-step calculation, even though their working showed that they knew this was what they were aiming for. Finding 7.5% of 120 was sufficient for the first method mark, but a noticeable number failed to add the amount on to 120 before progressing to the next step for the second mark. Asked for how much Salman saved in 2019, the accuracy mark was sometimes lost by giving the total saved in 2018 and 2019 or the difference in savings between the two years. However, full marks were frequently awarded.

Question 13

In part (a) candidates had to expand $x(5 - x)$ Correct and incorrect responses were seen in about equal measure, with the most common wrong answers not unexpectedly being $5x - x$ and $5x^2$ Factorising
$3y - 21$ in part (b) produced a similar proportion of right and wrong answers. Here the incorrect answers were usually ±7, ±7y, ±18 or ±18y. Changing the subject of a formula, which was tested in part (c), was poorly done by many, with quite random repositioning of the letters and the 3. Correct answers were regularly seen, as were responses that showed a correct first step. Of the incorrect attempts, simply swapping the p and the f appeared noticeably often. In part (d), it was encouraging how many fully correct answers of $T = 10m + 6n$ were seen. However, almost equally often, $T = m + n$ was given as an answer; this at least gained candidates one mark.

Question 14

The unambiguous statement that the given transformation showed a rotation was required for one mark. The second mark was for giving both the angle of rotation as 180^o and the centre as (0, 0), which had to be written as co-ordinates and not as a vector. This second mark could not be awarded where the inclusion of descriptors like scale factor, the equation of a line and other vectors implied more than one transformation. Fully and partially correct answers were seen in about the same proportion as wrong and muddled descriptions. Candidates should be encouraged to learn the only four words (reflection, rotation, translation and enlargement) that would potentially gain them a mark and be reminded that giving more than one of these words, in a question that asks about a single transformation, will negate the mark for a correct word.

Question 15

Some candidates could readily show two short steps of working to find the number of sides of a regular polygon, given the size of an interior angle of the polygon. However, for most candidates this question appeared beyond their knowledge of polygons, with many using 360^o in combination with 140^o, usually subtraction or division. From the regularity of 5 as an answer, it would seem that for some there is confusion between the words polygon and pentagon. There were also a number of trial and improvement attempts, which were mostly unsuccessful, and some muddled attempts at using a formula. The exception to this was from those who systematically worked through the angle sum and interior angle size for various polygons until they reached an interior angle of 140^o; if they correctly linked this with 9 sides, they gained all 3 marks. It was pleasing to see the occasional diagram of an interior and adjacent exterior angle, which often enabled the candidate to 'see' the first step and gain at least the first method mark. This is something to be encouraged. Blank responses were beginning to be noticed by this stage in the paper.

Question 16

Working with sets and Venn diagrams is a topic where candidates generally seem to have gained in confidence and many were able to allocate all the numbers in the universal set to the correct regions of the Venn diagram. Where this was not the case, most of the rest of the candidates were able to gain 2 of the 3 marks.

Question 17

In part (a), simplifying x^9/x^2 provided a high number of candidates the opportunity to gain the one mark for this question. However, almost equally, incorrect answers were seen. The most common errors were to divide or add the indices or to state the correct power as a number on the answer line without the base *x*. Many were also able to gain full marks in part (b), though almost as many were not. As in part (a), indices were sometimes incorrectly used. A surprising number of candidates simply used their calculators and gave a numerical answer, failing to understand what 'as a single power of 7' meant. Showing only one correct step, written as a power of 7, allowed some to gain one of the two marks.

Question 18

Changing 32.4 m^3 into cm^3 was the least well answered question on the paper. Only a very small number of candidates were able to gain any marks. Instead of the correct conversion factor of 1 000 000, most used 100 or other incorrect powers of 10, usually to multiply and occasionally to divide.

Question 19

Candidates are clearly becoming more familiar with the steps of working they are required to show when working with fractions and the full 3 marks were quite often awarded here. Omitting the final step lost some the accuracy mark but they were still rewarded with 2 marks. Those who could only get as far as showing the conversion of the mixed numbers to improper fractions gained one mark. There were also those whose attempts at manipulating the numbers made no sense, sometimes trying to incorporate methods from multiplication and division of fractions, for what was an addition question. Those who tried to work with decimals gained no credit.

Question 20

Candidates were presented with the diagram of a triangle, with the size of two of the angles given in terms of *x*, and were asked to find the value of *x* An encouraging number of candidates were able to gain full marks, subtracting the numerical components of the angle sizes from 180, to find that 5*x* had to equal 120. Those who progressed in this way almost invariably went on to the correct answer. Others likewise subtracted all the numerical components but stopped at that point with no reference to 5*x*. Other candidates were at least able to start correctly, by taking the 30^o from 180^o for one mark. Sometimes they went on to divide the answer by 2 assuming wrongly that the two other angles were equal but produced no further work worthy of credit. Others who assumed the two angles were equal tried to equate them and attempted to use algebra to solve their equation. Beyond these approaches, working was somewhat random, with some attempts at trial and improvement, and blank responses were noted.

Question 21

While a good number of candidates were able accurately to construct the required angle bisector for the 2 marks, much of what was seen were creative but irrelevant arcs and circles, which gained no marks. Occasionally, some candidates were awarded one mark for a correct bisector drawn but without any or sufficient arcs. Blank responses were seen but whether this was due to a lack of understanding or a lack of mathematical equipment it is not possible to say.

Question 22

Many candidates made a correct start on this probability problem by adding together the given probabilities for taking blue beads and yellow beads. If they went on, which a good number did, to subtract this from 1 to find the probability for taking red beads and green beads, they gained the first method mark. For the next mark, this value then needed to be divided by 3, as the probability of taking a green bead was twice that of taking a red bead. However, a majority divided by 2 and were unable to progress correctly beyond this. Others did not divide at all and their working either stopped or became increasingly muddled. Those who did divide by 3 and correctly allocated the two probabilities, were generally able to work to produce the correct answer. Asked for an estimate of the number of times a red bead would be taken, a few lost the accuracy mark by giving their answer as a probability.

Question 23

In part (a), candidates were asked to solve a simple linear inequality. A good number were able to show some correct algebraic working, leading to – 1.5, but often using = instead of > or ignoring those symbols completely. This was sufficient for the award of the method mark, as was showing the correct result for subtracting 7 from both sides. Less common was the award of the accuracy mark, which required the answer to be written correctly as an inequality. Much muddled working was also seen, sometimes as candidates simply tried to find a number that would fit.

To their credit, most candidates made an attempt at trying to solve the quadratic equation in part (b) but this often began with them adding the 40 to both sides and then trying to 'simplify' $x^2 - 3x$ in assorted ways before square rooting some resulting value. Only a handful realised that they needed to factorise the LHS and were able proceed from here to the two correct solutions. Of those who factorised, the + and – were sometimes not correctly placed but this at least gave them one mark. Trying out various values in the equation was quite a popular approach but at best this produced only one solution and in any case this question stated that candidates needed to show clear algebraic working so no marks were gained in this way.

Question 24

Given the cost of insurance for 3 consecutive years, candidates were asked to compare the percentage increase from 2016 to 2017 with that from 2017 to 2018. A high number of candidates simply compared the actual increases of 45 and 47, sometimes including a percentage sign, gaining the first method mark only. Of those who progressed further, finding 9% (or equivalent) for 2016 to 2017 proved more accessible than finding 8.6% for 2017 -2018. While

some kind of method could usually be deciphered for finding the 9% increase, often a rounded value, for example 8%, was then given for the subsequent increase but without working to show where this value had come from. Candidates still need to be encouraged not to round values too soon. Fully correct answers were seen, including the statement that Brigitte was not correct, which was required for full marks. Having got to 9% and then using this value to increase 545 by 9% and comparing this answer with the cost in 2018, was an acceptable method and, when used, it usually led to full marks being awarded.
Part (b) was a ‘reverse percentage’ question but this was not how the large majority of the candidates interpreted it. By far the most commonly seen, but incorrect, method was to find 15% of the new amount or to increase the new amount by 15% Where candidates understood the question, they were nearly always able to show the working required and give the correct answer for all 3 marks.

Question 25

There was a high number of fully correct responses to finding the mass of a gold bar, given its volume and density. Incorrect responses were also regularly seen, coming almost invariably from candidates who divided instead of multiplying.

Question 26

Converting from metres per second to kilometres per hour is a challenging concept for candidates at this tier and it was pleasing that a good number of correct answers were seen. The main difficulties arose from not knowing whether to multiply or divide, and also not knowing that 1000 is the conversion factor between metres and kilometres. So much muddled and wrong working was seen and there were blank responses. Those who could show a relevant first step using at least one correct conversion factor, gained the first method mark.

Question 27

An encouraging number of candidates were able to see that they needed to use Pythagoras’ theorem as the first stage of their working. Those who knew to subtract rather than add usually gained two marks, for the correct use of the theorem and finding the length of the diameter. The third method mark was awarded for using this value to find the perimeter of the semi-circle, which we did see. However, rather more common was the use of the area of a circle formula and so no further marks could be awarded. It is surprising just how many candidates do not know which formula to use in the context of circumference and area of circles. While there were candidates who went on to give the correct total length of the perimeter, some lost the fourth method mark by including the length of the diameter in their addition. Not unexpectedly, there were candidates who were unable to make a correct start, combining the given lengths, sometimes incorporating 90 and 180, in a variety of ways. Others made no attempt at this question. It was extremely rare to see a response where trigonometry had been used instead of Pythagoras’ theorem to find the length of the diameter but, if applied correctly, this approach obviously gained the appropriate method marks.

Summary

Based on their performance in this paper, students should:

• When solving inequalities students must realise an inequality will be the answer and not just a single term with no inequality symbol

• learn and be able to recall the formulae for the area and circumference of a circle and recognise when to use each

• read the question carefully and review their answer to ensure that the question set is the one that has been answered

• learn geometrical constructions and ensure correct equipment comes into the examination

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