Examiners' Report
Principal Examiner Feedback

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International GCSE Mathematics 4MA1 2H Principal Examiners' Report

Those who were well prepared for this paper made a good attempt at all questions. It was good to see several students having a go at the grade 8 and 9 questions and gaining a couple of marks for these, even if they could not see the question all the way through. The paper differentiated well.

Students tended to mainly show good working but some need to be reminded that when working is requested, they are unlikely to score marks without some working shown.

Students should read questions carefully and look at diagrams for hints, eg on question 2 it was not uncommon for students to think that rectangle *A* was twice the area of rectangle *B* and while our diagrams are not generally accurately drawn, they do not set out to confuse students; looking at the diagrams clearly showed *B* was bigger than *A*.

Students also need to ensure they learn appropriate terminology and know the difference between, for instance, area and perimeter, Students must also know the difference between calculations needed for right angled triangles and for non-right angled triangles.

Question 1

(a) We saw a good number of correct answers for this question involving multiplying powers of 3 and finding the index of 3 that the product gave. We saw several answers that gave 3^9 rather than just 9 but we gave this the mark.
(b) This was done almost as well as part (a). Some students gave the answer as 5^{21} rather than 21 and again we awarded the mark.
(c) This format of question has been asked before, so it was disappointing not to see more correct answers, or even correct methods. A fair number did give the correct answer but it was disappointing to see some show an embedded method such as 8 + 2 – 4 = 6 and give the answer as 6 rather than 4; these students were rewarded with the method mark.

Question 2

Many students could carry out the transference from the information to a correct equation and solve the equation to find the value of x. A common error was to multiply the expression for the area of rectangle *B* by 2 and equate to the expression for the area of rectangle *A*. Both those who did the question completely correct and this latter group were able to demonstrate they could expand over a single bracket correctly.

Less common errors included poor algebraic notation such as $5 \times 2x - 1$ and assuming that the rectangles were geometrically similar with a scale factor of 1.25.
A few students wrote down the correct algebraic equation and then used trial and improvement to find the value of x. If they used solely trial and improvement and clearly showed that $x = 2.5$ was the correct solution they were awarded full marks.

Question 3

(a) A good number of correct answers were seen for this part; however, we saw several cases of use of just 25 over 70 rather than 25 + 6 over 70 and some just giving a number, rather than a probability as the answer.
(b) There were a lot of fully correct answers to this standard question. Students, on the whole, knew they had to find ∑fx by using the midpoint of each interval and then divide by 70. Common incorrect methods used the upper bound multiplied by the frequency and these were able to gain a total of 2 marks if they divided their total by 70. We still get a small number dividing the total by 5, the number of class intervals, and getting a mean above any of the values in the table thus having no feel about the reasonableness of their answer. Generally, the rounding to get the required accuracy for the answer was good; students who wrote down all the figures on their calculator for the answer were not penalised provided it could have been rounded to the given answer of 21.26.

Question 4

This was answered well. However, there were some students with little understanding of proportionality and it was not uncommon to see 45 – 20 + 36 = 61 or 54 – 25 = 29 for part (a) and even the correct answer of 81 from using angles in a triangle (45 + 54 = 99 with 180 – 99 = 81), despite no angles being given in the diagram. This scored no marks. There were similar additions and subtractions for part (b). Others went down the route of incorrectly using Pythagoras despite it being a similarity question and no right angle present.

Question 5

This question was done well with students gaining the whole span of marks from 0 to 5 Most students were able to gain M2 for getting to 115 or maybe just M1 for getting 135. A lot of students knew and showed the rule of (n – 2) × 180 for the angle sum of an n sided polygon.
Common errors included, treating the pentagon as regular, using 360 degrees as the total interior angles of a pentagon, and using angles of a hexagon rather than a pentagon or octagon.

Question 6

Most students were able to find the total selling price (29.4) or the cost of 1 bottle (1.75) scoring the first mark. However, many were unable to continue correctly, often finding the difference of 29.4 – 21 but then dividing this by 29.4 rather than 21 before multiplying by 100 reaching the incorrect answer of 29%. Those students that found 29.4 ÷ 21 = 140 often did not go on to subtract 100 to get the correct answer of 40%, 2 marks were given for this value.

Question 7

Many students did this well, reaching the answer of 79 dollars in a clear and accurate way.
The most common successful approach involved using the multiplier 1.045^3 for the compound interest calculation for the investment in the Cyclone Bank to find the final amount. Then finding the final amount for the Tornado Bank and subtract. Far less

common were students who worked with the interest(s) received and they tended to make more errors especially in terms of accuracy.

Surprisingly there were nearly as many errors working with the Tornado bank as with the Cyclone Bank. Many students assumed that there was a single interest payment of 1150 dollars whilst others thought that the 1150 and the 25 000 they were given in the question meant that they had to turn this into a second compound interest calculation; they assumed they had to work out an interest rate by finding 1150 as a percentage of 25000 and then work subsequently with that.

Question 8

(a) The correct answer of 1 was rarely seen and there were all sorts of answers given, often involving x and y; 0 was also a common incorrect response.

(b) Responses were mostly correct for this question. Many got (i) correct but then started again in (ii) using the quadratic formula or completing the square, generally with poor success. There were also those who did not get (i) correct and then used their calculators to get the correct answers in (ii). This gained no marks in (ii) as the answers in (ii) **had** to come from their answer in (i). Candidates should be aware that when a questions says ‘hence’ they are required to use an answer they found in the previous part.

Question 9

Overall, this question was not done as well as expected. It seemed that the difficulty was interpreting the question and being able to work out what to do.

(a) In this part, students often did the wrong operation and added or subtracted or divided the wrong way round. A fair number managed to get to 0.073 or equivalent but then did not leave the answer in standard form, so losing the final accuracy mark.

(b) Few students got this part correct often forgetting or not realising the need to use 2.4×10^7 in their calculation and others multiplied by 3 rather than dividing by 3.

Question 10

This question was quite well attempted with most students able to gain M2 for finding *AB*. As often happens those who failed to find *AB* were those who could not rearrange their trig expression correctly and incorrectly gave 9.3cos38 or similar.
The odd student worked out the area rather than the perimeter of the triangle and some included *BN* in the perimeter as they had previously worked out this length and thought they should use it in the final answer.

Question 11

Many students got only as far as working out correctly angle *BOC* (or slightly further, finding angle *FOD*) , demonstrating knowledge of the tangent/radius property of a circle. Some students did go on and use the angle at the centre is twice the angle at the circumference property to find the correct size for angle *EFD.* A rare alternative method once angle *BOC* was found, saw students joining *D* to *B*, working out angle *OBD* and ten using angles in the same segment.

Although reasons were not asked for in this question, it is important that students make it clear which angles they are working out - this could be done in this case by using correct angle notation 'angle *BOD*' or by showing the angle measurements clearly on the diagram.

Question 12

(a) Although many students were able to reach p^6q^8, they often struggled to work with the coefficient with $64p^6q^8$ being a common incorrect answer. Many others wrote 42.6 p^6q^8 getting 42.6 from 64 ÷ 3 × 2
(b) Several students attempted to get a common denominator but made errors, especially if doing the calculation in 2 parts or multiplying the numerator by a multiple of *x*, but not always doing the same to the denominator.
Some students lost out because they did not fully simplify so only got M1.
(c) A lot of students didn't know how to handle this question and did 4*x* multiplied by each of the brackets separately.
A few students over-simplified their answers which was unfortunate as it lost them the accuracy mark.

Question 13

There were not many students who scored all 3 marks, but getting 2 marks was a common achievement, with most being able to convert the given equation $y = 2x + 2$ and the boundary along $y = -3$ into correct inequalities. The use of the 'greater than' and the 'greater than or equals to' symbols were both allowed, as were the 'less than' and the 'less than or equals to'.

The challenge for students was to identify the line on which the remaining boundary lay. A common error here was to assume the gradient was 1 and give the inequality as $y < x + 1$.
There was a substantial minority of students who though they had to have 'R' in their answer, either in combination with *y* or on its own. Such cases included 'R > −3' and 'R> *y* =−3'.
Such cases were not awarded a mark.

Question 14

The marks for part (a) were generally either 3 (full marks) or 0. Students familiar with histograms worked out the frequency densities of each interval next to the relevant row of the table and were almost always able to transfer their answers accurately to the grid. A small minority of students ignored the given scale and produced a histogram which was a vertical stretch of the required one. Such students scored 2 out of the 3 marks.

Responses to part(b) were more varied with students split between 0, 1 and 2 marks. Many could identify the number of flights which were late by 5 minutes or less but could not use this to write the correct conditional probability; they gave 4/70 as their answer instead of the correct 4/40.

Question 15

(a) This part was done very well with most students understanding the conditions for a value of *x* not to be included in the domain of g.
(b) Many students managed to gain M1 but lost out by incorrectly oversimplifying their answer.
(c) Students either seems to know what they were doing on this question and managed to get at least M1 or literally didn't know where to start. Several students literally inverted g(*x*). It was good to see so many realising they had to work with *x* and *y* then rearrange even if not done completely correctly.

Question 16

Those students who used a tree diagram to help them were often successful. There were many cases where the yellow counters were forgotten, usually when a tree diagram had not been drawn. There were also a few candidates who added the fractions along the branches and then found the product of their answers! Others calculated the probability thinking the counters were not replaced. Some of these candidates were able to score 1 or 2 marks from the special case in the mark scheme. However, it was not uncommon to find the denominator reduced by 1 in the second fraction but the numerator staying the same. These candidates clearly were confused about how to deal with the situation.

Question 17

Many students knew the correct process to use to rationalise the denominator and sensibly showed how to do this and then showed an unsimplified answer of $\frac{8\sqrt{5}+8}{4}$ followed by the answer of $2\sqrt{5}+2$. However, many students left their answer as this - failing to appreciate there was one more step to do to get an answer of the required form of $\sqrt{a}+b$.
Some did realise this but simply divided through by 2.
Errors seen from students in this question included using an incorrect multiplier to rationalise the denominator (typically using $\sqrt{5}-1$) or simply entering the given fraction as a calculation into their calculator and copying the screen display - this approach scored no marks as working was requested.

Question 18

Quite a few students were able to find the area of triangle *ABC* using the sine formula for area, scoring 1 mark. Fewer candidates realised that they first had to work out the length of *AC* using the cosine rule before they could work out the area of triangle *ACD*. Some candidates incorrectly assumed triangle *ABC* was right angled and therefore used incorrect methods to find *AC*. Candidates need to realise that over-rounding earlier in a question could lead to the loss accuracy for the final accuracy mark.

Question 19

It was surprising to see that some students were unable to do a rearrangement of their linear equation but were then able to substitute this correctly and then show more complex algebraic working later in the question.

The most common errors, once they had substituted correctly, were caused by an inability to cope with the algebra required to simplify this to a correct quadratic equation.
A substitution of $x = y + 3$ was always much more successful than $y = x - 3$ due to the difficulties that arose from expanding and collecting negative terms in the latter method. A very common error was to substitute for $x = y + 3$ into C to get $3y^2 + 21y + 18 = 0$ or $y^2 + 7y + 6 = 0$ and then write $x = -1$ and $x = -6$ rather than $y = -1$ and $y = -6$. This meant they could not access the final two accuracy marks.

Question 20

We saw a lot of blank responses or students giving formulas but not knowing where to start.
Some students knew '*d*' was something to do with -1/4 but did not include the '*k*' and since they didn't not show working could not gain the first M1
It was quite a difficult question having a fractional '*d*' to start with and then a negative '*k*' which led to errors made by pupils.
Some students did attempt to find k but used the formula for the sum of 15 terms = $90+2k$ rather than using $a + (n - 1)d$.
Of those who did gain full marks, we saw a wide variety of correct methods being used including simultaneous equations. We will mark any correct method we see, even if not on the mark scheme.

Question 21

To do this challenging question well students had to have a secure knowledge of quadratic functions and of transformations and their effect on algebraic equations of curves.

For part (a), not many were aware how to find the coordinates of the maximum point by using the completed square form for a quadratic. A few expanded the function f and used calculus to find the maximum point. This was a correct method but required a lot more work.

For part (b), many students simply added 4 to the equation $y = \mathrm{f}(x)$ to give $y = \mathrm{f}(x) + 4$. Of those who recognised that this was a translation parallel to the x-axis many replaced x in $\mathrm{f}(x)$ by by $x + 4$ instead of the correct $x - 4$

Part (c) proved a challenge because some students who were correct in parts(a) and (b) could not describe the correct transformation. Sometimes they gave a combination of transformations or used incorrect language such as 'flipped'. Of those that did recognise that reflection was involved only a few stated the correct line. Some even wrote 'reflection in the origin'

Fully correct answers to part (d) were rare, although many students scored at least one mark (usually for identifying b with 90). Many of the more successful students started by drawing the graph of $y = \cos x$ on the grid as an aid to working out the values of a, b and c they were required to find.

Question 22:

Students generally found this the most challenging question. Many were able to score the first mark by equating the formula for the volume of a sphere to 288π although some candidates incorrectly used x (the diameter of the sphere) in this formula, rather than $x/2$ or r. Those who used the formula correctly, then wrote $x = 6$ rather than $x = 12$. A common error was to equate the formula for the volume of a sphere to 288 rather than 288π which meant they could access the method marks for the question but lost both accuracy marks. Other difficulties were caused from needing to divide both sides by 4/3 and take the cube root. Students who went further and calculated the lengths of sides often only worked out the length of *AB* and not the perpendicular height required. Some students found the area of one triangular face and then multiplied this by 4, not realising that the four triangular faces did not all have the same area. It was encouraging to see that the few that got the question completely correct tended to show their working clearly.

Summary
Based on their performance on this paper, students should:

- when using decimals instead of fractions in probability calculations, they must be made aware they should round all answers to at least 2 decimal places.

- put the size of any angles calculated on the given diagram. For example, in question 11, students used a calculation to find 42° but because they didn't identify the angle, no marks could be awarded. Had 42 been seen in the correct place on the diagram, even without calculations shown, the mark could have been awarded.

- be aware of the word 'hence' in questions (such as in 8(ii)) and understand that this means they must use their answer to the part before.

- be encouraged to look at the reality of their answers. For example, one student wrote that after investing 25 000 dollars for 3 years at 4.5% compound interest they would receive $2 293 346.28 interest

- know when to use trigonometry in right angled triangles and when to use the sine rule and cosine rule.

- know when to cancel in algebra and when not to divide throughout by a variable

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