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Examiners' Report/ Principal Examiner Feedback

Summer 2012

International GCSE Mathematics
(4MA0) Paper 4H

Level 1 / Level 2 Certificate in Mathematics
(KMA0) Paper 4H

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General Introduction to 4MA0

There was an entry of almost 42,000 candidates, 10,000 more than a year ago. This comprised over 28,000 from the UK, including over 6,000 for the new Edexcel Certificate and about 13,000 from overseas. The Foundation tier entry exceeded 5,000, an increase of almost 4,000, mainly Certificate candidates, while the Higher tier entry increased by over 20%, the increase, just over 7,000, coming in approximately equal numbers from the two qualifications.

On the Higher tier papers, there were a few questions which challenged even the ablest candidates but, overall, the papers proved to be generally accessible, giving appropriately entered candidates the opportunity to show what they knew.

Introduction to Paper 4H

Generally paper 4H performed as expected. There were two challenging questions at the end but the most able candidates performed well on both of these. Most topics appearing on the paper, (with the exception of Q17b - external case of the intersecting chord theorem) were familiar and expected. The commonly tested topics did sometimes introduce extra factors. The average speed calculation (Q3d) required a reading from a graph, the cosine rule triangle (Q17a) had an overlap with a circle and the tree diagram (Q18) was "truncated" according to various outcomes. All questions were accessible and those with a lower success rate were designed in that way to discriminate between abilities. Overall most candidates produced well structured, legible working which was easily to follow. Those who did not ran the usual risk of losing method marks.

Report on individual questions

Question 1

A relatively straightforward starter question that required a numerical process, completing in the correct order of operations, meant most candidates obtained full marks on the first question. Some played safe and wrote out the numerator and denominator separately, either of these gained the method mark. In a minority of cases 24/5 was stated as an answer, as a result of Casio calculators being in a particular mode. This was not penalised as 24/5 was viewed as an improper fraction rather than a division of two integers.

Question 2

Better candidates spotted the most common correct method involved calculating the total score of the boys and girls before dividing by 20. Weaker candidates simply found the mean average of 18 and 16.5 and by following this incorrect method gained no marks. Almost no candidates used a ratio or proportion method but the mark scheme catered for these rare occurrences.

Question 3

Most candidates coped easily with the demands of the first three parts. In part (d) only a numerator of 39 was accepted as a starting point to gaining full marks although some leeway was given in the values chosen for the denominator. Failure to convert 1 hour 15 minutes to 1.25 hours was a source of lost marks. Candidates who incorrectly converted this to 1.15 hours picked up one method mark from the two available. Some candidates, in failing to read the question carefully, attempted to work out the average speed of the whole journey. Weaker candidates used a time of day (typically 1715) as their denominator value.

Question 4

Shapes P and Q were meant to represent a triangle and a stem to form a flag. Full marks were awarded in both parts if the stem was overlooked and the flag was taken to be a triangle. Therefore in part (a) a rotation of 90 about (1, 1) gained full marks (treating P and Q as triangles) as an alternative to the more popular transformation of a reflection in the line x = 1, (treating P and Q as flags). It should be noted that the most common cause of lost marks was either to use the incorrect terminology in describing transformations ("shape P was *flipped* about the line *x* =1") or to provide a multiple transform ("shape P was reflected and then moved 4 squares to the left").

Flags and triangles were dealt with in a similar way in part (b). A triangle or a flag in the correct position gained full marks. A correct triangle or flag in the wrong position but facing the correct way gained one mark.

Question 5

Both parts of this question were answered well by the more able candidates. In part (a) most chose to invert the second fraction and change from division to multiplication. Cancelling then had to be shown to have taken place, or multiplying numerators and denominators to reach an improper fraction, equivalent to 1 5/7 was then required to secure the accuracy mark. In part (b) the more able candidates usually chose the conventional route of changing the original mixed fractions to improper fractions before proceeding onto subtraction. Again an improper fraction had to be reached by this method, this time equivalent to 3 7/12, to secure the accuracy mark. Less common routes were catered for in the mark scheme such as ignoring the integer parts and processing 3/12 – 8/12 separately.
The essence of both parts of these types of "show that" question was to make the left hand side of the expression equal to, or equivalent to, the right hand side.

Question 6

With weaker candidates the orientation of the triangle caused difficulties with some opting to use sine rather than tangent. In a minority of cases multiplying by 34 caused some candidates to end up calculating tan (72 x 34). A surprising number of able candidates chose to use the sine rule to reach the correct answer and this method gained full credit, and was catered for in the mark scheme. Incorrect rounding was not penalised provided a decimal number rounding to 105 was seen in the body of the script.

Question 7

At higher level most candidates spotted that the easiest method to eliminate one variable was to subtract the two original equations to produce $2a = -4$. In some cases this was incorrectly stated as $2a = 4$ and all marks were lost as a result. An algebraic treatment was required to gain any marks. In very rare cases the correct answers were obtained either by inspection or trial and error and this gained no credit. Overall this question was well answered and provided a good source of marks.

Question 8

Finding the prime factors of a number is a topic commonly tested and this was well answered by the majority. The factors either as a final answer, or implied from a factor tree or division ladder had to multiply to 300 to gain credit. A few candidates lost the final accuracy mark by not giving the correct prime factors as a product (adding or listing them), or including 1's in their final answer.

Question 9

Extra numerical processes, following on from the correct answer of 67 cm were not penalised. This was to take into account the numerous attempts to find the mean average. 67 calculated by a correct method, therefore gained full marks and subsequent working was ignored. Multiplying incorrectly by zero in the fourth interval (eg 7 x 0 = 7) resulted in one method mark and the accuracy mark being withheld. A minority of candidates multiplied each frequency by two (the class width).

Question 10

In part (a)(i) a significant number failed to spot the double negative in multiplying out the second bracket (– 3 x – 1), and hence $x + 2$ instead of $x + 8$ was a common incorrect response gaining one mark providing working had been shown. Part (a)(ii) had a higher success rate. Untidy algebra was not penalised in part (b) provided it was equivalent to $r = \sqrt{(v/\pi h)}$. Candidates should make it clear in their final answer, or in their working, that the square root symbol is to cover the whole fraction. In ambiguous cases credit will not be given.

Question 11

Weaker candidates often attempted the unnecessary step of converting from standard form into ordinary numbers before attempting addition. This sometimes resulted in all marks lost through incorrect conversions. It is disappointing to record that a significant number threw away half of their marks by not stating their final answer in standard form.

Question 12

Both parts of this question provided challenges for many candidates, particularly the shading required in the second part of the question. A full follow through was allowed provided C was a clearly identified separate set. The rare cases where sets A and B overlapped, and the intersection was labelled as either the empty set, and/or set C, was not given any credit.

Question 13

Follow through method marks were allowed in several parts of this question. In part (b) joining plotted points with straight line segments and not a curve, particularly around the turning points was penalised. Part (c) was the source of most lost marks. A method of y = 5 stated or drawn (or implied from $x^2 - 3x - 1 = 5$) was required before the accuracy mark could be awarded. This was to negate the advantage some candidates might have had with equation solving facilities on certain models of calculators. A translation of the curve by 5 units downwards was not accepted, as the question specifically asked for a suitable straight line to be drawn on the grid.

A relatively straight forward calculus component at the end of this question ensured that good candidates scored well overall on this question. A a significant minority either substituted $x=4$ into the original cubic or set their derivative expression to equal 4. Both cases show that whilst many can go through the processes of differentiation, their understanding of what it represents is sometimes patchy.

Question 14

The wording of the question directed candidates to consider a Venn diagram approach and most candidates took this lead. The key to success was identifying the 7 students who studied both languages. Some candidates lost their final mark by including this value in their total for students studying French or Spanish. Weaker candidates were usually able to pick up one mark by starting with 2 intersecting sets and 6 non-linguists outside these sets.

Question 15

In part (a) candidates usually scored two or zero. Weaker candidates in part (b) mistakenly thought BD bisected the angle ADC and/or triangle BCD was isosceles. A 'formal' statement was required in part (b)(ii) which included the words "opposite", "angle" and "cyclic quadrilateral".

Question 16

More able candidates in part (a) were not put off by the presence of the circle and recognised that to find the opposite side in a triangle given 2 sides and an enclosed angle, the cosine rule provided the most economical method. A disappointing number, having substituted correct values into the cosine formula chose to reduce 180 – 144cos 28° to 36cos 28°.

Part (b) was intended to be solved by the intersecting chord theorem, and this did not occur to most candidates. The accuracy mark was dependent on a method mark to prevent random guessing being rewarded by 3 marks. In a minority of cases, elaborate trigonometry methods were employed which usually meant sides BC and AD drawn and numerous sides and angles calculated. If these methods led to an answer of 4 (rounded if necessary) full credit was given. A very elegant solution was accepted based on the fact that triangles ACX and DBX were similar, (as angle CAX = angle BDX sharing a common chord BC).

Question 17

Part (a) was essentially finding the area of the blocks covering 25 to 40 minutes, dividing this by the total area of the histogram and converting to a percentage. Sometimes elaborate ways were employed to achieving this, including counting small squares etc. Because the blocks were of equal width a consequence was the heights were proportional to the frequencies and this helped some candidates. The most economical method in part (b) was to calculate the frequency density for the 10 to 15 minute block (3.2). Determining the frequency density scale then led to the frequencies in all other blocks. In practice there was more opportunity to award partial credit in part (b) than part (a). In some cases correctly working out the frequencies for part (b) led to some reach the correct answer for part (a).

Question 18

The consequences of the outcomes of each game defeated some candidates and led to incorrect values on the probability branches for the second and third game. Weaker candidates failed to take into account that pairs of probability values had to sum to one on their tree diagram. In part (b) a follow through was allowed to gain the method marks using their values from the branches. Most gained at least one mark by identifying the combination Bill wins, Bill wins from the top branches. Some stopped at this point and considered no other combinations. A disappointing number of candidates are still happy to present a final probability answer as greater than one.

Question 19

The tariff for each part of the question was two marks. Taking this into account, and the relative ease of the question for able candidates, the normal rules of requiring a method mark before the accuracy mark could be awarded were relaxed here. Some candidates in part (a) thought $f^{-1}(x)$ meant the reciprocal of $f(x)$ and some thought in part (b) $gf(x)$ meant $g(x)$ x $f(x)$. Incorrect simplification, of a correct initial expression, was the cause of most marks lost in part (b) though good candidates, familiar with the topic of functions, scored well in both parts.

Question 20

Candidates answering 'show that' questions involving fractions (earlier in the paper), or surds (here) should always show detailed steps. Assuming known facts or skipping steps often leads to marks being withheld. The basic breakdown of the marks was to reward the correct expansion of the brackets with two marks. Partially correct expansion gained one mark. The third mark was for a demonstration on how $\sqrt{8}$ could be manipulated into incorporating $\sqrt{2}$.

Question 21

This question was probably the most challenging on the paper in terms of its length and complexity. Various trigger points had to be reached before method or accuracy marks could be awarded. Once a correct quadratic had been established to gain the first three marks, a correct method had to be shown, leading to the correct answers before the final two marks could be awarded. Overall a significant number gained the first two method marks but did not have enough precision in their working to reach a correct 3 term quadratic.

Question 22

More able candidates understood the principle behind the question (ie. two spheres + space = cylinder) but their algebra manipulation often let them down. Common mistakes were to only have one sphere or to multiply out 2 x $4/3\pi r^3$ as 8/3 x 2 x πr^3 or 8/3 x 2 x π x 2 x r^3. Again, as with other selected A* questions, gaining full marks for the correct answer was dependent on a correct method seen. This was to prevent the award of a considerable number of marks (5 in this case), for a correct answer obtained either by trial and error, or by a lucky guess. Candidates had to reach a stage of one occurrence of r^3 in a correct equation, (typically $r^3 = 125/8$) to qualify for full marks. The phrase "*show your working clearly*" should be taken as a statement that a demonstrated correct method is a requirement to gain full marks.

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