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Examiners’ Report/
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Summer 2012

International GCSE Mathematics
(4MA0) Paper 3H

Level 1 / Level 2 Certificate in Mathematics
(KMA0) Paper 3H

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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 3H

The demands of this paper proved to be appropriate; the vast majority of the 36,700 candidates were able to demonstrate positive achievement and many scored high marks. The majority of candidates gave sufficient explanation and showed their working clearly.

Most questions had high success rates but there were exceptions. Question 1 (Ratio) was less well answered than anticipated and only a minority scored full marks on Question 18 (Geometry and equations). Other questions tended to polarise candidates, which made them useful discriminators, chief amongst these being Question 16 (Repeated percentage increase) and Question 20 (Bounds).

Report on individual questions

Question 1

Although well answered, part (a) did not prove to be the straightforward starter it was intended to be. There were many wrong methods, most of them involving 11 (6 + 5), notably 24.54 $\left(\frac{54\times 5}{11}\right)$, which appeared frequently. Methods such as this, which included in the working either 54×5 or $54\div 6$, even if accompanied by incorrect operations, scored 1 mark out of 2. Regular wrong answers which received no credit included 29.45 $\left(\frac{54\times 6}{11}\right)$, 4.9 $\left(\frac{54}{11}\right)$ and 19.8 $\left(\frac{54}{6}+\frac{54}{5}\right)$.

A substantial proportion of candidates correctly expressed the given lengths in the same units and gained full marks on part (b). Of those who ignored units but demonstrated some knowledge, many scored 1 mark out of 3 either for 36 : 54 (or an equivalent ratio, often 1 : 1.5) or for $\frac{54}{36}$ (or 1.5). The numbers were occasionally reversed but such attempts received no credit. Another common error was incorrect conversions, leading to answers such as 15 and 0.15, which also scored 1 mark out of 3.

Question 2

Many candidates answered the first part correctly and, of those who did not, few failed to score 1 mark, which could be gained in two ways. These were an acceptable substitution, such as $2 \times -3^2 + 4 \times -3$, or the accurate evaluation of one of the terms, usually the second term as −12. The first term was frequently incorrectly evaluated as −18, as a consequence of which −30 was by far the most popular wrong answer.

In the second part, the majority started by substituting the values of *A* and *x* in the equation. Apart from a small minority who evaluated the first term as 64 $[(2 \times 4)^2]$, most obtained a correct equation and solved it to find the value of *k*. A variety of methods was used. Many used formal algebra, while others used arithmetic, inspection or trial approaches, all of which were acceptable. Occasionally, the formula was initially rearranged with *k* as the subject and the values of *A* and *x* then substituted.

Question 3

The vast majority of candidates used the laws of indices correctly in the first two parts.

In part (c), many candidates found the correct value of *n*, either by constructing an equation or by inspection. A large number scored 1 mark out of 2 for showing $5^n = 5^{13}$ in their working or for giving 5^{13} as the answer. A correct first step of $\frac{5^n}{5^{10}} = 5^3$ could lead to a range of wrong answers, the most popular ones being 7 (10 − 3) and 30 (10 × 3), with some support also for −7 (3 − 10). The first step of a small minority was to rearrange the given equation as $5^n = 5^3(5^4 \times 5^6)$ and then 'multiply out' the brackets in a variety of ways.

Question 4

Errors of any sort were rare in the use of Pythagoras' theorem to find the length of a hypotenuse. Some candidates, though, lost the final accuracy mark where they prematurely rounded the answer to 6.7 or 7 without showing the more accurate answer of 6.712… in their working.

Question 5

The majority of candidates found the three correct positive whole numbers 1, 3, 8. Of the rest, many scored 1 mark out of 2 for three positive whole numbers which had either a mean of 4, notably 1, 4, 7, or a range of 7, more often the former. 1 mark was also awarded for 0, 5, 7. A substantial number of candidates, though, were unable to attempt this question.

Question 6

A high proportion of candidates showed the correct region. 2 marks out of 3 were awarded for three correct lines with the wrong region shaded, which was relatively unusual. Many candidates scored one mark for either the lines $x = 5$ and $y = 3$ or the line $y = x$. The examiners' interpretation of 'line' was generous, two of the boundary lines of a rectangle, for example, being accepted, the other boundary lines being ignored. One common error was confusion between the lines $x = 5$ and $y = 5$ and between the lines $y = 3$ and $x = 3$. Another was drawing the line $y = x$ as a diagonal of the grid, that is, from the origin to the point (8, 6).

Question 7

This question proved straightforward for the majority of candidates. A few found only the area of the triangle, failing to add it to the area of the rectangle, but hardly any were unable to find the height of the shape. Occasionally, angle B was treated as 45°, leading to $CN = 5$ and an area of either $9 \times 5 + 12.5$ or $36 + 12.5$.

Question 8

In the first part, the vast majority of candidates scored full marks. Even those giving a wrongly rounded answer, such as 48, 47.8 or 47.65, were not penalised, if a value which rounded to 47.6 appeared in their working. A few started incorrectly with $\frac{3440}{1639}$.

The second part (reverse percentages) had a reasonable success rate, the correct answer, 2500, resulting from either $\frac{3440}{1.376}$ or $3440 \times \frac{100}{137.6}$. The errors which invariably arise when this topic is tested were, however, very much in evidence. Some candidates just found 37.6% of 3440 (1293.44), while others subtracted this value from 3440 to obtain 2146.56, the most common wrong answer, which was also found by calculating 62.4% of 3440. Another regular but less frequent wrong answer was 4733.44, the result of increasing 3440 by 37.6%. Keying in 3400 instead of 3440 also occurred often enough to be noticed.

Question 9

Apart from occasional errors with expanding the brackets or rearranging the terms, solving $3(2x - 1) = 6$ posed very few problems.

$\frac{2y+1}{3} = \frac{y-2}{4}$ offered more scope for mistakes and so the success rate for this was lower but still commendable. A minority were unable to make a meaningful start, with faulty first steps, such as $3(2y + 1) = 4(y - 2)$ and $\frac{4(2y+1)}{12} = y - 2$. Most, though, made either a recognisable attempt to remove the fractions or worked with a denominator of 12 throughout. There was no particular pattern to the errors made by candidates; some were in algebraic technique, $8y + 4 = 3y - 6$ for example sometimes leading to $5y = -20$. Other errors, though, were conceptual.

Question 10

The majority of candidates calculated the mean accurately in part (a), although there were some wrong answers which appeared regularly. One of these was 13, obtained by summing the products correctly (78) but then dividing by 6, instead of by 25. This scored 1 mark out of 3, if working were shown. Another was 3.5 $\left(\frac{1+2+3+4+5+6}{6}\right)$ and 0.84 $\left(\frac{1+2+3+4+5+6}{25}\right)$ also appeared occasionally.

Part (b) was very well answered, most candidates appreciating the need to add $\frac{5}{25}$ and $\frac{8}{25}$, although a few found the product and even, on rare occasions, the quotient. Less predictable answers were $\frac{7}{25}$ $\left(\frac{3+4}{25}\right)$ and $\frac{47}{78}$, which used products from part (a).

The quality of answers to part (c) varied widely. Many demonstrated a clear understanding of probability and scored full marks but a significant number either could not make a start or, if they did, had insufficient knowledge to gain any credit. In between these two extremes, there were numerous candidates who, usually after success on part (i), either omitted a product or included an extra one, when summing the products in part (ii). The product omitted was usually $\frac{3}{25} \times \frac{5}{24}$ or $\frac{5}{25} \times \frac{3}{24}$, while the extra product was almost always $\frac{6}{25} \times \frac{5}{24}$. As usual, a minority answered the question as if it were 'with replacement'. Those who did this could score a maximum of 2 of the 5 marks available. The product $\frac{8}{25} \times \frac{7}{24}$ appeared occasionally, 8 being the number of pods containing 4 peas.

Question 11

Most candidates scored full marks on part (a). The other two parts, although answered correctly by many candidates, were considerably more demanding. In part (b), a common error was to use a scale factor of 4, often implied by an answer of 4.75 cm. Although penalised in part (b), full marks could still be scored, and often were, in part (c) for the correct use of this scale factor in finding the area of triangle *ABC*. A substantial number of candidates did not appreciate the need to square the scale factor in part (c). Inevitably, Pythagoras' theorem made occasional appearances.

Question 12

The majority gained full marks in the first part. Those who did not usually failed to subtract from 80 their cumulative frequency reading when $l = 15$ and there were also a few scale reading errors.

Full marks were less common in the second part, although it was still well answered. Understanding of interquartile range was variable and marks were also often lost through misreading the horizontal scale. This was penalised even if incorrect readings for the quartiles gave an answer in the acceptable range. An indication that 20 and 60, the cumulative frequencies corresponding to the quartiles, were involved scored 1 mark, even if these values were then used incorrectly. Some candidates found their difference and gave 40 as the answer. Others went on to use a cumulative frequency of 40 to find the median, a result found in one unrewarded step by a significant number of candidates. Occasionally, 30 on the time axis was divided into 4 parts.

In both parts, candidates could score 1 mark out of 2 for a clear indication of their method on the graph, usually appropriate lines. On questions like this, candidates will never be penalised for lines which are too dark or thick and it is safer to err on this side.

Question 13

Many candidates obtained the answer $n = 10$ by a correct method, usually finding the interior or exterior angle of the pentagon first and then doing the same for the n-sided polygon. The final step was either to use the sum of the exterior angles or to construct and solve an equation for n, such as $\frac{180(n-2)}{n} = 144$, where 144° is the size of the interior angle of the n-sided polygon. It was not unusual for candidates to confuse the interior and exterior angles of a pentagon but still go on to obtain $n = 10$. Such responses received no credit, as did all who obtained the correct answer with spurious working or with no working at all. The solution "$2 \times 5 = 10$" certainly had the merit of conciseness but, sadly, had no mathematical basis. Some candidates reduced their prospects of reward on this question, because their working was so difficult to follow.

Question 14

Most candidates had some knowledge of $y = mx + c$ and many had a thorough understanding which enabled them to score full marks. Candidates who made some progress lost marks in a variety of ways. Making y the subject of $2x - 3y = 6$ was the most popular method of finding the gradient in the first part but algebraic errors in this rearranging were not unusual. For weaker candidates, the use of a graphical approach was, perhaps, safer but the coordinates used were sometimes wrong. Many candidates realised that the gradients of the lines in the two parts had to be equal and a candidate whose gradient was wrong in the first part but used correctly in the second part was still awarded full marks for the second part. The y-coordinate of the point (6, 9) was sometimes taken directly as the value of 'c' and so equations such as $y = \frac{2}{3}x + 9$ sometimes appeared as the answer to the second part. Some candidates used $y = mx - c$ in part (b), possibly because c was negative in part (a).

Question 15

Many candidates obtained the correct answer using
$OB = 8\sin 30° = 4$
$BD = 2 \times 4 = 8$
$BC = 8\cos 63° = 3.63$
which is probably the most direct method.
A wide variety of other approaches was used, often successfully, including Pythagoras' Theorem, the Sine Rule and the Cosine Rule. The length of *AB* and the size of angle *BCD* were sometimes found and used. As always, any mathematically correct method was acceptable.

With so many different methods being employed, there was a wide range of errors, which had few common threads. One regular wrong answer was 7.13, the consequence of using $8\sin 63°$ for *BC*.

Question 16

The majority of candidates scored either full marks or no marks. Many of those who scored full marks used the product of multipliers 1.2 × 1.17 or an equivalent expression, while others nominated and used an initial population such as 10 or 100. Those who used this approach sometimes lost the final mark by failing to subtract the initial population from the answer. Most of those who scored no marks gave an answer of 37 (20 + 17) and a significant number could not make a start. Between these extremes, candidates gained 2 marks for 1.404 or 140.4 or 1 mark for stating one of the multipliers. A few candidates thought that the increases were per year and so calculated 1.2^{10} .

Question 17

In part (a), the majority gained some credit, either full marks for $81a^8b^4$ or 1 mark for answers such as $3a^8b^4$, $12a^8b^4$ and $81a^6b^4$ where either the number or the letters had been correctly dealt with. There was also a wide range of answers which scored no marks, for example, $3a^8b$, $3a^6b^4$ and $12a^6b^4$.

It was a similar story in part (b); most scored either full marks for $3c^4$ or 1 mark for answers like $4.5c^4$, $9c^4$ and $3c^6$. No credit was given for $\sqrt{9c^8}$; either 3 or c^4 had to be explicitly stated for the award of 1 mark out of 2.

Question 18

This question was challenging for even the best candidates but some of them, using a variety of strategies, constructed and solved an equation to score full marks. Their working was often elegant and always interesting. There are too many distinct methods, at least eight or nine, to discuss them here but details of most of them appear in the published mark scheme.
Of the substantial majority who did not score full marks, a significant number scored 1 mark for giving the size of angle *COD* as *x*, usually by marking it on the diagram and a few scored 2 or 3 marks for finding the sizes of other relevant angles. Some of the candidates who scored no marks could not make a start but most made an attempt, often obtaining an answer of 34.5, which was unfortunately usually based on the mistaken belief that, as a result of the alternate segment theorem, the size of angle *OCD* was 69°. A wide variety of other unsuccessful numerical approaches was tried.

Question 19

This question produced a good spread of responses with a high proportion of completely correct solutions. A minority of candidates were unable to make a start but the majority made some headway. Some scored 4 marks out of 5, often as a result of premature approximation at some stage. Occasionally, the area of only one of the two shapes was found, usually the sector. Some candidates thought that the segment was a semicircle and used the cosine rule to work out its 'diameter'.

Question 20

There was great variation in the understanding of bounds. At one extreme, many candidates produced concise, completely correct solutions, while, at the other, many had no appreciation of the concepts involved. An explicit statement of the lower bound of the volume (42.875) was a pre-requisite to gaining any credit. Those who only stated this number scored 1 mark. Finding the lower bound of the length of a side ($\sqrt[3]{42.875}$ or 3.5) was the second step and, finally, 6×3.5^2 gave $73.5\ cm^2$, the lower bound for the surface area of the cube. It was surprising how many candidates completed the first two steps successfully but then failed to multiply 3.5^2 by 6.

Question 21

This question produced a wide range of responses. The general standard of algebraic skills was high and there were many completely correct solutions. Candidates gained 1 mark for $2x^2 = 20 - 3x$ and a further mark if they rearranged it as $2x^2 + 3x - 20 = 0$. For solving this quadratic equation, factorisation was a more popular method than use of the quadratic formula and the minority who stated the solutions with no working scored only 2 marks out of 5. Two regular causes of mark loss were slips in algebra and failure to find the *y* values, after the *x* values had been obtained successfully. A small minority substituted for *x* in terms of *y*, obtaining $y = 2\left(\frac{20-y}{3}\right)^2$ and some overcame the many perils which awaited candidates going down this dangerous road.

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