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Examiners Report June 2009

GCSE

GCSE Mathematics (1380)

Higher Non-Calculator Paper (3H)

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1. PRINCIPAL EXAMINER'S REPORT – HIGHER PAPER 3

1.1. GENERAL COMMENTS

1.1.1. This was an accessible paper that gave candidates ample opportunity to demonstrate their understanding. Candidates seemed to have had enough time to attempt all the questions and many made very good attempts at the paper.

1.1.2. There were many candidates who did not appear to have studied some of the more difficult topics. In some cases the paper proved far too challenging for candidates and entry at the Foundation tier might have been more appropriate. It is difficult to believe that candidates who substitute 2 and 5 into $4n - 3d$ and write down 42 – 35 are best suited to the Higher tier.

1.1.3. There were several questions in which basic arithmetic let many candidates down. In question 10, for example, dividing 40 000 by 125 proved to be beyond many and some struggled with 1000 ÷ 125. Simple arithmetic errors were common in questions 4, 8(b) and 21.

1.1.4. It was pleasing to see that most candidates had written in ink and in the appropriate spaces in the paper. Candidates should, however, be reminded to take care when setting out their answers. In questions 10, 24 and 25, in particular, working out was frequently poorly presented and difficult for examiners to follow.

1.2. REPORT ON INDIVIDUAL QUESTIONS

1.2.1. Question 1

This question was answered well by the vast majority of candidates. The most common errors in part (a) were due to the failure to carry out simple additions and subtractions accurately with incorrect entries seen most often in the 'Car' column. Some candidates failed to notice the empty space in the 'Total' column and left this blank. In these cases it was apparent that candidates had not carried out a horizontal check as well as a vertical one. The probability in part (b) was usually correct.

1.2.2. Question 2

Part (a) was answered very well by most candidates. For some, the signs caused a problem with $2x - 8y$ being the most common incorrect answer. Most candidates were also successful in part (b). Some, though, wrote down $2c + 4r$ in their working and then made this equal to $6cr$, or even $8cr$, and lost a mark. A few candidates gave the answer as $c^2 + r^4$. Many candidates did not know the difference between an expression and an equation but they were not penalised for this.

1.2.3. Question 3

This question was answered well with the majority of candidates completing the table accurately and drawing the correct straight line. In part (a) the most common error was an incorrect *y*-value for $x = -1$. Candidates with an error in the table frequently went on to draw the correct line but unfortunately did not return to (a) to correct the table. A significant number of candidates found it difficult to plot negative coordinates, often plotting negative values of *y* as positive values. A few plotted the points correctly but failed to join them up.

1.2.4. Question 4

Although part (a) was well attempted the correct answer of 15 was perhaps not as common as might have been expected. Many of those who did not work out the correct answer gained one mark for substituting the value of *P* to get $50 = 4k - 10$ but then incorrectly manipulated the terms to get $4k = 50 - 10$. Thus 10 was the most common incorrect answer. Many candidates who gave an answer of 10 were unable to gain the first mark because they did not show the substitution. Some of those with a correct method failed to divide 60 by 4 correctly. In part (b) most candidates correctly substituted the given values. The majority went on to give the correct answer but some who wrote 8 – 15 gave the answer as 7 rather than –7.

1.2.5. Question 5

Part (a) was answered extremely well with most candidates rotating the shape 90^o clockwise, usually using *O* as the centre of rotation. Most errors resulted from rotating the shape 90^o clockwise about the wrong centre although some candidates rotated it 90^o anticlockwise about *O*. Full marks were surprisingly rare in part (b). Many failed to identify the transformation as a translation. Some candidates used words such as 'transformed' or 'moved' but many did not attempt to name the transformation and simply described the movement by using words or a vector. Vectors were often correct although sometimes the signs were incorrect. Other common errors included writing coordinates instead of a vector and describing the movement as 'across 3 and down 1'.

1.2.6. Question 6

In part (a) the majority of candidates were able to give a correct explanation although some gave parallel sides rather than equal sides as the reason. Another common error was for candidates to substitute $x = 5.5$ into both expressions instead of using the properties of a rectangle. Only the weakest candidates failed to gain any marks in part (b). The most common errors resulted from incorrect manipulation and often led to $2x = 13$ (instead of $2x = 11$). Some candidates failed to divide 11 by 2 correctly. Those who resorted to trial and improvement were rarely successful. Although there were many fully correct answers in part (c) some candidates struggled to substitute correctly into each of the four expressions. Many made calculation errors. Only a small number of candidates stated that the total perimeter was $8x + 13$ and then made just the one substitution.

1.2.7. Question 7

Part (a) was answered correctly by about 90% of the candidates and almost 70% were successful in part (b). Many of those who answered (b) incorrectly did not appreciate that the answer had to be less than 1. Part (c) proved to be the most difficult with about half of the candidates giving the correct answer. The most common incorrect answer in this part was 32.20.

1.2.8. Question 8

In part (a) the majority of candidates divided 72 by 2 and then found the square root, usually just giving the positive solution which was sufficient for full marks. The common error was for candidates to try to find the square root of 72 and then divide by 2. A few divided by 2 twice and gave an answer of 18. Part (b) was generally answered well with the most common method being the use of a factor tree. Many fully correct answers were seen and most candidates were comfortable with index notation. Some made errors in their factor tree (often $6 = 3 \times 3$) and some who found the correct prime factors listed them on the answer line or wrote $2^3 + 3^2$.

1.2.9. Question 9

The correct answer of a 2 by 2 square was drawn by about half of the candidates. A very common error was to draw a rectangle with either the correct width or the correct height. Some candidates reproduced the given plan whilst others reproduced the given front elevation. Part (b) was answered quite successfully. Most candidates seemed to have a good understanding of what was required and appreciated that the shape should look like a prism. Some of the sketches were not too well drawn but the majority at least showed a trapezoidal face.

1.2.10. Question 10

There were two main methods used for answering this question. The first, converting 40 litres to millitres and then dividing by 125 posed problems for candidates in the evaluation. Often, the number of millitres was incorrect with 40×1000 frequently being evaluated as 4000. The subsequent division by 125 was very poorly attempted or, in some cases, not attempted. Too often the answer found by using this method was incorrect. The second method, finding the number of seconds for one litre, i.e. dividing 1000 by 125, and then multiplying by 40, usually led to the correct answer. There were frequent attempts at repeated addition rather than division and these often resulted in incorrect answers. Sometimes a mixture of the two methods was seen in this question.

1.2.11. Question 11

Part (a) was answered correctly by about 80% of the candidates. About half of the candidates were successful in part (b), giving an answer of 63.5 or 63.49 recurring. The most common incorrect answer was 63.4. Often candidates did not give enough decimal places for a recurring decimal and wrote 63.49.

1.2.12. Question 12

Candidates were very successful at using compasses to draw an arc with centre *B* and radius 4 cm and shading the correct side of the arc. About a quarter of the candidates were able to draw the angle bisector from *A* to *BC* and those who did usually went on to get full marks. Many candidates drew the perpendicular bisector of *BC* and some drew a vertical line from *A* to *BC.* Some bisected the wrong angle (usually *B*) and some drew more than one arc but no straight lines. One third of the candidates, though, gained no marks at all in this question.

1.2.13. Question 13

Part (a) caused little difficulty, with most candidates gaining full marks for a suitable question with response boxes. When marks were lost it was usually because candidates omitted response boxes or produced a tally chart instead. In part (b) many candidates failed to realise that there were two ways in which the question could be improved. Firstly, many did not give a time period in their question, although some did include this in their responses. Secondly, the response boxes were sometimes too vague or, more commonly, the options were not mutually exclusive.

1.2.14. Question 14

The majority of candidates gained one mark for rounding at least two of the numbers correctly to one significant figure and a further mark for the correct processing of two of the numbers, most usually 7 × 200 = 1400. Most candidates, though, were unable to divide correctly by 0.05 with only a few realising that dividing by 0.05 is the same as multiplying by 20. Far too many candidates lacked the understanding that dividing by a number less than 1 makes the final answer larger than the original number. Another common error was for the denominator, 0.051, to be rounded to 0.1 or, less commonly, to 0.5, 1 or 0.

1.2.15. Question 15

In part (a) almost 70% of the candidates were able to write 64 000 in standard form. The success rate in part (b) was much lower with just over 30% able to write 156×10^{-7} in standard form. Here, 1.56×10^{-9} was a common incorrect answer. Many candidates, though, wrote the answer as an ordinary number.

1.2.16. Question 16

It is encouraging that many candidates were able to recognise different types of factorisation and distinguish between the type involving common factors and the type which needs two brackets. The majority of candidates demonstrated knowledge of factorisation in part (a) although a number did not fully factorise the expression. Partial factorisations such as $2(2x^2 - 3xy)$ and $x(4x - 6y)$ were quite common. Some candidates identified $2x$ as the common factor but made a mistake inside the brackets, e.g. writing $2x(x - 3y)$. In part (b) many candidates attempted to factorise into two brackets, although a large proportion did not find two numbers which both multiplied to give –6 and added to give +5. Many found numbers which satisfied one condition or the other, but not both, e.g. 2 and 3.

1.2.17. Question 17

In part (a) most candidates were able to plot the points correctly and produce an accurate cumulative frequency graph. Some candidates plotted the points correctly but drew a line of best fit and some plotted at the midpoints of the amounts spent. Part (b) was also answered well with most candidates able to find the median. Few, though, drew a horizontal line from cf = 60 so were unable to be awarded a method mark if their answer was incorrect. Some candidates believed the median to be 64 (the frequency in the middle of the table) and some wrote 0-250. Good comparisons were made in part (c) between the spending of men and women although there were some confused statements made by candidates who did not appreciate that the different numbers of men and women was not relevant when comparing the medians.

1.2.18. Question 18

Many candidates answered part (a) correctly, recognising the right angle between radius and tangent and using the angle sum of a triangle to work out the size of angle *AOD*. There was, though, some evidence of poor arithmetic with some candidates unable to subtract 126 from 180 correctly. Correct answers to (b)(i) were much rarer. Many candidates had remembered that angles in the same segment are equal but had forgotten that the two angles both need to be on the circumference of the circle. Hence a very common error was for angle *ABC* to be given as 54^{o} (the same as angle *AOD*). The majority of the candidates who answered (b)(i) correctly were able to give the correct reason in (b)(ii).

1.2.19. Question 19

Part (a) was answered correctly by almost 60% of the candidates. Many candidates attempted to solve the simultaneous equations using an algebraic method instead of using the graphs. Most of these attempts were unsuccessful. Part (b) was answered correctly by less than half of the candidates. Many who did not give a fully correct equation were awarded one mark for an equation with either a correct gradient or a correct intercept.

1.2.20. Question 20

In part (a) many candidates did not show a good understanding of working with inequalities, often replacing the < sign with an = sign at the first opportunity. Algebraic manipulation within the inequality was often poorly handled and it was not uncommon for candidates to add 1 to both sides or add t to both sides. Some who showed $t < 5.5$ or $t < 11/2$ in their working then wrote $t = 5.5$, or $t = 5$ or just 5.5 on the answer line and could not be awarded the accuracy mark. Candidates were more successful in part (b). Those who were correct in part (a) generally achieved the mark in part (b) as well. Some candidates solved part (b) independently from part (a) by substituting integer values into the inequality.

1.2.21. Question 21

There were an encouraging number of fully correct answers. A large number of candidates, however, took M to be proportional to L instead of L^3 which resulted in 240 being the most common incorrect answer. Those who managed to get as far as $k = 20$ usually managed to complete the question successfully but it was not uncommon to see $20 \times 3^3 = 20 \times 9 = 180$. Some candidates incorrectly evaluated 2^3 as 8.

1.2.22. Question 22

This question was very poorly attempted with many candidates displaying a lack of understanding of histograms. The majority used the given frequencies to draw bars of different widths and some drew frequency polygons. Very few candidates gained full marks. Candidates who showed understanding of frequency density often made mistakes carrying out the divisions involved. Some wrote down no calculations at all and went straight to drawing the histogram, often with errors. The final bar was frequently drawn with an incorrect width. Even when correct histograms were seen the candidates often failed to gain full marks because they did not label the vertical axis or provide a key. Some candidates used frequency × class width as frequency density.

1.2.23. Question 23

Very few candidates failed to score any marks at all in this question. Part (a) was answered very well with most candidates completing the probability tree diagram correctly. Errors usually occurred on the right hand branches where some candidates put the values 0.5, 0.3 and 0.2 in the wrong order and some inserted the results of multiplying two probabilities together. A significant number of candidates were not aware that they needed to multiply the probabilities on the relevant branches in part (b) and many added 0.5 to 0.5 instead. Even when candidates did write down 0.5 × 0.5 this was sometimes evaluated incorrectly with answers of 0.5, 1 and even 2.5 seen quite frequently. Some candidates with incorrect answers lost the opportunity of gaining a method mark here because they did not show any working.

1.2.24. Question 24

Part (a) was very poorly answered. It was good to see some responses in which statements and justifications were laid out correctly but the majority of candidates had little idea of how to set out a formal proof of congruency. Statements were often vague and general, e.g. 'all sides are the same'. Even when candidates were able to give three correct statements it was not uncommon for the incorrect reason for congruency to be given – most frequently SAS when it should have been RHS. Full justification was rare. *BD* = *DC* was stated in numerous responses with candidates failing to realise that this was a consequence of congruency. The most common errors were not justifying the statements made and not providing the reason for congruency. Some candidates thought that AAA and ASS were sufficient for congruency. Very often the working was difficult to follow. More candidates were able to gain one mark in part (b) but very few realised they needed to use congruency to justify *BD* = *DC.*

1.2.25. Question 25

Many candidates gained one mark in part (a) for a correct substitution but very few were able to progress any further. Most went on to add 2½ to 3⅓ and then gave either $5\frac{5}{6}$ or the reciprocal of it as the final answer. Some candidates attempted to use a common denominator of 2½ × 3⅓ but frequently made errors in their calculations. A small number of candidates converted the fractions to $\frac{4}{10}$ and $\frac{3}{10}$ respectively and obtained $\frac{7}{10}$ easily but some then forgot to invert. Many candidates showed considerable working which was often poorly set out and difficult to follow. Only the very best candidates were successful in part (b). Most were unable to manipulate the terms correctly. Some simply inverted everything and $u + v = f$ became $u = f - v$. Others attempted to clear the fractions but forgot to multiply all the terms by f (or v or u). Those who managed to get to $1/u = 1/f - 1/v$ sometimes went on to gain one mark for $u = 1/(1/f - 1/v)$.

1.2.26. Question 26

Part (a) was answered quite well with a good proportion of candidates recognising the transformation and remembering how to write the equation down. Many candidates used a combination of f, x and 4 but opted for the wrong one so that $y = f(x + 4)$ and $y = 4f(x)$ were common incorrect answers. Relatively few fully correct answers were seen in part (b). Where one of the two marks was awarded, this was usually for drawing a graph with the correct amplitude. Graphs with the correct period but incorrect amplitude were much rarer. Some candidates doubled the period rather than halving it. Marks were sometimes lost because the curve was not drawn accurately enough or only drawn for part of the given range. Not all candidates attempted this question but most of those who did tried to draw some sort of wave.