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Principal Examiner Feedback

June 2011

GCSE Mathematics (1380)

Higher Calculator Paper (4H)

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June 2011

Publications Code UG028364

1. PRINCIPAL EXAMINER'S REPORT – HIGHER PAPER 4

1.1. GENERAL COMMENTS

1.1.1 Most candidates were able to show what they had learned, what they knew and what they could do on this paper.

1.1.2 Generally, presentation was good and many candidates had made an honest attempt to set their work out and to show working.

1.1.3 There is still evidence that candidates do not interact with their answers and allow obviously incorrect answers to stand (for example where the sample size is bigger than the population or the mean is bigger than the largest item in the sample).

1.1.4 Checking in questions which require the candidate to collate data could also result in a better outcome.

1.2. REPORT ON INDIVIDUAL QUESTIONS

1.2.1 Question 1

A well- answered question. In part (a) the vast majority of the entry knew that the sum of the probabilities was 1 and could calculate the missing value. Of those who gave the wrong answer the most common response was 0.3, some without working and others with which showed the candidate had the correct method with one computational error in adding decimals.

Responses to part (b) were almost as good, especially as candidates had access to a calculator. Nearly all successful candidates used the n × p approach: those that tried to use a proportion method almost always got the wrong answer. A few candidates did write the answer as the fraction $\frac{160}{800}$, thereby losing a mark. Some of the incorrect methods include dividing by 4 to achieve 200, or dividing by 0.2 to achieve an answer of 4000 or using some ad hoc method to split the 800 proportionally.

1.2.2 Question 2

Once again a simple question exposes the lack of facility that many candidates have with transformational geometry in general and enlargement in particular. Although many candidates drew the correct new shape in the correct place, there were many who could get the correct looking shape but tended to put the shape at P – either the bottom left hand corner on P or the whole shape centred on P. The other common misconception was to interpret a scale factor of 0.5 as a scale factor of 1.5 or of 2 or to add on half a square to each side. In many cases these were drawn appropriately with P as the correct centre. All transformational geometry at GCSE involves shapes and images which are congruent or similar and it does raise an important point when candidates copy and then leave an image that is clearly not.

1.2.3 Question 3

In part (a), candidates tried to solve the task of writing 45 as a product of its prime factors in different ways. Factor trees were of course common and usually lead to the award of 1 mark. Another approach seen was to use repeated division. Candidates were less clear what to do then. Many wrote a list - for example 3, 3, 5, or included the number 1 at least once - for example, $3 \times 3 \times 5 \times 1$ or wrote the prime factors as a sum $3 + 3 + 5$.

For part (b) many candidates drew another factor tree and then tried to work out what the highest common factor was. In some cases this involved candidates using a Venn diagram. Generally this was carried out correctly and the 15 identified. Some candidates tried to list all the factors of 30 and all the factors of 45 and then identify the largest number in both lists. This often led to an answer of 5 as candidates did not list their factors as pairs for each number and the pair 3, 15 was often not seen. Some candidates confused highest common factor with lowest common multiple and arrived at answers like 90 and 270.

1.2.4 Question 4

On the whole, this question was not very demanding at this level, even without a table to fill in. One glaring error often seen though was to draw a line with intercept -2 on the y axis but with a gradient of 8 presumably obtained by counting squares on the grid ('1 across and 4 up'). Some candidates did not extend their correct line to the limits of the grid and so lost the accuracy mark. There was also some evidence that candidates confused the gradient (4) with the intercept (−2).

Those that did produce their own table often went wrong on the negative values of x.

1.2.5 Question 5

Problems which require the area of a shaded region to be found can often be done by subtraction. This question was one of this type. Most candidates at this level can recall and use the formula for the area of a circle and here many went on to calculate the numerical equivalent of $36\pi - 25\pi$. A few candidates thought they could take a shortcut by doing $6 - 5 = 1$ and then doing $\pi \times 1^2$ or even $\pi \times 0.5^2$ Of course, there were some $\pi \times 6$ and $\pi \times 12$ but few candidates evaluated $\pi \times 6^2$ as $\pi \times 12$. Some candidates rounded their answers too early in the calculation and lost the accuracy mark.

1.2.6 Question 6

Candidates are well prepared for this type of question and part (a) was done competently enough. One aspect of collating data which some students do not seem to employ is to count the numbers in list and count their numbers in tables as a check for any omissions. This would have helped those candidates who were a number short in the stem and leaf diagram – often in the often. Many candidates omitted a key and those that remembered often did not include any units, although they were not penalised for this.

Answers to part (b) were disappointing for this level. Candidates who used the stem and leaf diagram often went straight for the 8th of the 16 ages or for the 9th giving wrong answers of 30 and 36 respectively. Many candidates started over again and tried to write the 16 ages in an ordered list. They were no more successful and often fared worse as they omitted an age from the list. Some candidates found the mean.

1.2.7 Question 7

This is a question that can be done with elementary fraction work but many candidates were either confused as to what was happening. They had lost their beads or at least some of them. There were, of course many good answers, but these were possibly outnumbered by those candidates who found $\frac{3}{4}$ of 120 followed by $\frac{2}{3}$ of 90 rather than of (120 – 90). One cause of difficulty was that candidates did not write down what the answers to their calculations meant. So there were few cases of 'Bob gives away 90 beads so he has 30 left' . This might have resulted is less wrong answers such as 60 and 20.

A higher order error, shown by a few candidates was to work out $\frac{3}{4} - \frac{2}{3} = \frac{1}{12}$; $\frac{1}{12} \times 120 = 10$ which is, of course, conceptually wrong.

1.2.8 Question 8

This question was very well answered. There were a few who rotated anticlockwise about O and a few who did 180° turn as well as a few who drew a translation of the correct answer.

1.2.9 Question 9

Responses to this question varied a great deal. At the top were those candidates who could see the 5 faces and calculated the correct areas followed by addition. They usually remembered to put in the correct units. Many candidates did not have the correct calculation for the area of the triangular faces, forgetting the $\frac{1}{2}$. Some candidates could not visualise the shape and looked to use areas of trapeziums or could not 'see' the 5 faces. Some candidates worked out the volume.

1.2.10 Question 10

Part (a) was well done with most candidates gaining the 2 marks. The most common error was to write $7e - 2f$ instead of the correct $7e + 2f$

Part (b) was surprisingly more of a challenge. Most candidates could expand the left hand side correctly to get $8x - 4$ although some gave $6x - 4$ or $8x - 1$. Many then, however, could not cope with the negative signs and produced simplified equations such as $5x = -23$ or $5x = 15$ Many candidates knew their mathematical limitations and achieved a correct answer by trial. It was unfortunate that so many candidates got to the correct stage of $5x = -15$ but then concluded that $x = -5$.

Part (c) was generally well done via the route $y + 4 = 5 \times 30$ although there were a few $y + 20 = 5 \times 30$ from multiplying both sides by 5, then expanding the brackets on the left hand side and cancelling the $5y$ with the 5 in the denominator. One common mistake was to take away the 4 first then multiply to give the answer of 130. Once again, as candidates had their calculators, there were many cases of trial and improvement.

1.2.11 Question 11

Astonishing numbers of candidates could not write down the mode to answer part (a). Common errors included 9 (the highest frequency) 2 and 7 (confusion with the median).

For part (b) many candidates calculated 52 ÷ 32 to get an answer of 1.625, although 1.6, 1.62 and 1.63 were also accepted. Many candidates felt uncomfortable about writing down a decimal for the mean number of children and rounded their answer to 2. These candidates were not penalised. Many candidates fell into bad ways and calculated 0 × 9 as 9 and/or were more creative with the final row in the table and gave a non-zero numerical answer to 'more than 4 × 0'. However, the most common incorrect answers were calculating 32/6 and 52/6, not noticing that these gave answers which were clearly too large. Some candidates used the blank column in the question to work out the cumulative frequency – some even tried finding mid-points.

1.2.12 Question 12

It is encouraging that most candidates can get at least half marks on this standard question. They have been well trained by their teachers. So, most candidates were able to calculate values of $x^3 + 5x$ correctly between 3 and 4 and many knew that they had to calculate the value at $x = 3.65$. Surprisingly many who did this still plumped for the wrong end of the interval and wrote down 3.6. Many candidates settle unknowingly for 3 marks by looking at how close the value of $x^3 + 5x$ is to 67 at $x = 3.6$ and at $x = 3.7$. This does not always work for cubics as the value of the function can increase substantially between the start and end of an interval. At the other extreme were those candidates who search for the root correct to many more decimal places than they were asked for. If they write down an answer to more than 1 decimal place then they will not get the final mark.

1.2.13 Question 13

It is some time since an evaluation question involving a trigonometric function was set. Many candidates fell at the first hurdle in the evaluation of 920 – 170 tan65° as 750 tan65°. Credit was given to those candidates who avoided this and showed a value of 555.43…. Other pitfalls included the evaluation of a fractional expression where the denominator is more than a single value and the requirement of taking a square root for the final answer. Again credit was given for an answer which was the square of the required one.

Part (b) showed the usual confusion between significant figures and decimal places and between rounding and truncation.

1.2.14 Question 14

This was essentially a multiple choice question. Many candidates could not recognise that having a 4 outside a pair of brackets implied that the expression would take even values if the bracket took integer values. Part (a)(ii) may have been better answered because the 3 in front of the bracket linked with the multiple of 3 in the demand.

Part (b) could be answered by factorising $4n^2 - 1$ (rare) or by trying some integer values of x (rarer). It was usually unclear what reasoning was being used to select an expression.

1.2.15 Question 15

The standard answer to (a) is an open circle at 3 and a directed line segment pointing in the positive x direction. An open circle and a line stretching to/beyond 5 were accepted for full marks. Many candidates were familiar with the use of either circles or with the use of arrowed lines, but often used a filled in circle. Candidates who live in an integer world often started their line from -2 instead of -3. Many candidates drew their line along the negative axis or circled all the numbers on the number line to the right of -4.

Part (b) proved tough for many candidates. Many turned the inequality into an equation and ended up with y = -4. Others tried to tackle the inequality, but employed $7y \leq 36 - 8$. For a few a little knowledge is a dangerous thing and passed from $7y \leq -28$ to $7y \leq -\frac{28}{7}$ There were a few successful attempts at trial and improvement.

1.2.16 Question 16

Candidates who recognised this as a reverse percentage problem had little difficulty with this question. Their procedure was to recognise that 90% of what they wanted was £4.86 and work on from their usually by dividing by 9 and then multiplying by 10. Many left their answer as 5.4 rather than use the correct money notation of 5.40. There was another group of candidates who recognised this as a reverse percentage problem but did not have the mathematical sophistication to deal with what is essentially a proportionality problem. However they put there calculator to good use and eventually came across 90% of 5.40 being 4.86.

The vast remainder of the candidates, did the equivalent of multiplying 4.86 by 1.1 and gained no marks.

1.2.17 Question 17

This is a similar question problem. The first part can either be done from $\frac{BC}{10} = \frac{12}{6}$ or from $\frac{BC}{12} = \frac{10}{6}$. Of the second method, most candidates used the equivalent scale factor of $\frac{10}{6}$ but often rounding to 1.7 or truncating to 1.6. There was some latitude allowed for this in part (a) where answers from 19.9 to 20.4 were accepted but in part (b) the answer had to be exact.

Most candidates used their scale factor again in part (b) by doing 18 ÷ their scale factor.

Many candidates thought that this was the 'Pythagoras question' and some thought that you added on a constant amount to the lengths of the small triangle to get the lengths of the large triangle.

1.2.18 Question 18

For part (a) the correct answer of c^8k^{20} was outnumbered by wrong answers of which $c\ k^9$ was one of the most common.

Part (b) was a standard expansion, which many candidates had been prepared for. The most common responses which still showed something meaningful were $29x - 5$ from $3x \times 4x = 12x$ and $7x^2 + 17x - 5$ from $3x \times 4x = 7x^2$. It was noticeable that many more candidates can now earn at least one mark from this type of question. Some candidates simplified $-3x$ and $20x$ and got 17, along with $-17x$ and $23x$. The most successful candidates used FOIL, a grid or the 'smiley face' to ensure all the four terms were calculated.

Part (c) was more challenging in that it involved a factorisation as the most direct way to get the answer. Many candidates could factorise successfully as 10 has only 4 factors. They usually went on to get full marks although a few write the factorised form on the answer line rather than the solutions. Some tried to use the formula – usually successfully and others availed themselves of their calculators again and found the root $x = 5$.

1.2.19 Question 19

Off into space. There were two problems in this question. Firstly, candidates had to select the correct operation to do with the two surface areas. For many this was already a conceptual challenge and they subtracted the surface area of the Earth from that of Jupiter or candidates inverted the division. For those who got over that hurdle was the problem of entering the numbers carefully into their calculator and then interpreting the calculator screen. Often 121.9033783 was converted to the standard form value 1.219033783×10^9.

1.2.20 Question 20

Candidates appeared to be well prepared for this question with many scoring at least 2 marks. Many had been trained to replace all letters by 'ls' and make a judgement from there.

1.2.21 Question 21

In part (i) the angle was frequently found but explanations in (b) did not generally find acceptance. At this end of the paper, it is expected that formal mathematical language is used – hence 'Angles in the same segment (are equal)' or 'Angles subtended at the circumference by the same arc (are equal)' is expected. Sometimes the word 'sector' was substituted for 'segment'. Long and involved attempts at descriptions were not acceptable.

1.2.22 Question 22

This was a standard stratified sample question and students were well prepared for it. The majority calculated the expression $\frac{700}{2035} \times 50$ or some variation of it – reciprocals or percentages, for example. Many candidates spotted that the numbers in the strata were similar and divided by 3 and then arranged the sample sizes of the 3 strata so that their sum came to 50. This was accepted for full marks. A few candidates left their sample size as 14.8 or 14.9 or rounded down to 14.

1.2.23 Question 23

This is a standard type of high demand question where candidates have to derive an equation, usually from a diagram and then follow it up with solving the equation and interpreting the solutions. Many candidates do not understand the logic of a question like this and think they have to solve the equation in part a. A circular argument involving substituting their found value of x back into the equation then leads to a value of (approximately) 0. They think they have done part (a). They then run into trouble on Part (b) where they are asked to do what they already have done in (a). In terms of marking, this is such a familiar situation that the mark scheme was initially designed so that marks done for relevant work in (a) could be earned in (b).

For those candidates who understood the logic of the question, there was little demand in part (a). Most (sensibly) took the most straightforward route of area of whole rectangle – area of shaded rectangle. Many wrote their initial expression for the area of the whole rectangle as $2x + 6 \times x$ but were forgiven if they went on to follow it with $2x^2 + 6x$

For part (b), those candidates who used the quadratic formula had to take care over the negative signs and the fact that the denominator was 4 and not 2. Those that did get two correct roots usually selected the positive one for the length although some candidates gave the area of the shaded rectangle as their final answer. Many candidates tried to find the length by trial and improvement and some succeeded. Some candidates who found the correct answer for the length went on to find the area of the smaller rectangle.

1.2.24 Question 24

This was an unstructured probability question so it was nice to see many candidates attempting to bring some structure in by drawing a tree diagram. Many put the correct probabilities on the branches and were then able to select the correct compound events and get the correct answer. Some of these good solutions were marred by arithmetical errors in fractions – typically $\frac{3}{10} \times \frac{2}{9} = \frac{5}{90}$ or $\frac{2}{10} \times \frac{1}{9} = \frac{3}{90}$, or rounding errors in decimals where probabilities were not written down to enough decimal place accuracy to guarantee a final answer correct to 2 decimal places. Other candidates treated the selection as with replacement and could get two of the 4 marks. Some candidates wrote down incorrect expressions like $\frac{5}{10} \times \frac{5}{9}$ for the probability of red followed by red. These expressions are not acceptable for marks as they display a profound misunderstanding of selection.

1.2.25 Question 25

Many candidates recognised the need to use Pythagoras in triangle *ABC*. Sadly many candidates calculated $8^2 + 3^2$ instead of the correct $8^2 - 3^2$. There were further problems when it came to find the hypotenuse of triangle *BCD*. Although many candidates recognised the need to use sine often the calculation was *BC* × sin50 rather than $\frac{BC}{\sin 50}$. Candidates who used the sine rule were generally more successful in getting this right. Many candidates thought they had to use tan (in both parts). For those candidates who had a clear idea of the method, marks were sometimes lost in part (a) through premature approximation – typically 7.4 cm being used for the height *BC* of the triangle.

The vast majority of reasonable attempts at part (b) depended on the use of the cosine rule. Candidates could usually set this up with 'correct' values substituted. Many candidates then failed to evaluate the expression in the correct order, working out $(b^2 \times c^2 - 2bc) \times \cos A$. Once again a mark could have been lost through premature approximation. A few very good candidates dispensed with the cosine rule, drew a line from C parallel to the base to cut ED and used right angled trigonometry.

1.2.26 Question 26

Many candidates simply worked out $\frac{218}{12.6}$(=17.3) and then followed it with 17.25. Those with more idea were able to write down at least one correct bound but often selected a wrong pair with $\frac{217.5}{12.55}$. Some candidates displayed calculations for all 4 possible combinations of upper bound and lower bound of the 12.6 and 218, but could not pick out the correct pair from the answers they had worked out. A minority of candidates calculated $\frac{217.5}{12.65}$ = 17.2 and then decided that they had to take off a further 0.05 to get the lower bound.

1.3 GRADE BOUNDARIES

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Order Code UG028364 June 2011

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