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Examiners' Report/ Principal Examiner Feedback

Summer 2010

IGCSE

IGCSE Mathematics (4400)
Paper 3H Higher Tier

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IGCSE Mathematics
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There was an entry of just over 29,500 candidates, 2,500 more than a year ago. This comprised 19,000 from the UK and 10,500 from overseas. The Foundation tier entry actually declined slightly but this was more than compensated for by a 10% increase in the Higher tier entry.

All papers proved to be accessible, giving candidates the opportunity to show what they knew, an opportunity taken by the majority of them.

Paper 3H

Introduction

The demands of this paper proved to be appropriate; the vast majority of the 27,900 candidates were able to demonstrate positive achievement and many scored high marks. Most candidates gave sufficient explanation and showed their working clearly.

The questions which candidates found more demanding and so provided good discriminators were Q12(c) (differentiation), Q13 (circle geometry), Q14(c) (bounds), Q16 (surds), Q17 (similar solids), Q20 (3-D trigonometry) and Q21 (simultaneous equations). Even these questions had pleasing success rates, however.

The attention of centres is drawn particularly to the principal examiner's comments on Q13, Q16 and Q21. Further guidance as to what constitutes 'sufficient working' will be found in the published version of the mark scheme.

Candidates who use additional sheets should be aware that the work on these is marked only if it continues or replaces work in the answer booklet. They should also be aware that, if they make more than one attempt at a question, without indicating which one should be marked, then all attempts will be marked but the lowest mark will be awarded.

Report on individual questions

Question 1

Full marks were common on this straightforward starter. The few errors that were made were usually the result of premature approximation or misreading the question.

In part (a) rounding $\frac{100}{6}$ to 16.7 or truncating it to 16.6 led to answers of 250.5 g and 249 g respectively.

In part (b), misreading 'cooking apples' as 'sugar' or 5 as 15 led to answers of 83.3 g and 2250 g respectively. In all such cases, candidates scored 1 mark out of 2, if they showed their working, but 0 otherwise.

Question 2

Both angles were usually correct but providing reasons proved much more demanding, even though they were marked quite tolerantly. Correct reasons were more frequent than incorrect ones but there was a wide variety of the latter. There was some confusion between ‘alternate’ and ‘corresponding’ while ‘opposite’, ‘interior’ and ‘parallel’ all appeared regularly. ‘Z angles’ and ‘F angles’ are not accepted as alternatives to ‘alternate’ and ‘corresponding’ and, on their own, receive no credit. Nor do abbreviations, such as ‘alt’.

In part (b)(ii), a noticeable minority gave the reason ‘opposite and alternate’, which was, of course, accepted.

Question 3

Success depended on interpreting a statistics question expressed algebraically. It was quite well answered, particularly the first part.

Many candidates appreciated that the median increased by 2 and the range was unchanged, although, in the second part, 9 (7 + 2) appeared regularly and 13 (7 + 2 + 2 + 2) occasionally.

Some candidates gave algebraic answers, such as $b + 2$ for the median $(c + 2) - (a + 2)$ for the range.

Question 4

The expansion of $5(n + 6)$ was almost always correct. Errors were almost as rare in part (b), although y^5 and, to a lesser extent, $6y$ were sometimes seen. The majority of candidates successfully solved the equation, showing a complete algebraic method, which was required for full marks. The usual first step was expansion of the brackets, although occasionally both sides were divided by 4. There was a range of errors, all of them infrequent, including incorrect rearrangement of $4x - 8 = 3$ as either $4x = 5$, $4x = -5$ and, more surprisingly, $4x = 12$.
A minority obtained $4x = 11$ but then gave the solution as $x = \frac{4}{11}$.

Question 5

Many candidates obtained the correct answer to the first part, the overwhelming majority by finding $\frac{3}{10} \times \frac{5}{6}$ and a small minority by inventing the number of members of the tennis club.

Of the remaining operations, division had the most support but both addition and subtraction were occasionally used, even though the former gave an answer greater than 1.

In the second part, many candidates appreciated that the LCM of 12 and 8 was required and found it routinely, either by inspection or using the prime factors of the numbers. Many others, however, perhaps influenced by the first part, decided that they must have to perform some operation on $\frac{7}{12}$ and $\frac{3}{8}$. Addition was most popular, but multiplication and subtraction were also used occasionally. Fractions, therefore, were often given as final answers but these received no credit. 12 and 32 also appeared regularly as the answer.

Question 6

The modal class in part (a) was almost always correct.

In part (b), the majority of candidates successfully found an estimate for the mean. Errors were rare but the most common one was the use of upper limits instead of halfway values. Occasionally, candidates multiplied each frequency by 100, the class width, or divided by a number other than 80, often 6 (the number of intervals).

Cumulative frequency was also well understood and the majority of candidates gained full marks in parts (d) and (e). As usual, the most common error with the graph was plotting points in the middle of intervals. Less predictably, graphs which went from (400, 30) to (600, 80), missing out (500, 74) appeared often enough to be noticed. In both cases, if candidates went on to use their graph correctly and showed their method, the overall penalty incurred was only 1 mark.

Question 7

Few candidates failed to score full marks on this routine trigonometry question. The majority used $6.8\cos 41°$ but the Sine Rule was occasionally used, usually successfully. A small minority used unnecessarily involved methods, $6.8\sin 41°$ followed by Pythagoras' Rule, for example. If mathematically correct, such methods were not penalised but, as is often the case with inefficient methods, there is a greater risk of loss of accuracy through premature approximation.

Question 8

Candidates' marks on this question were polarised. The majority recognised it as 'reverse percentages' and gained full marks. A substantial minority, though, made the usual type of error and increased $1786 by 24%, scoring no marks. A small minority made a subtraction error and then calculated $\frac{1786}{0.86}$ or $1786 \times \frac{100}{86}$. They gained 2 marks out of 3, if they showed their incorrect subtraction, but no marks otherwise.

Question 9

The majority of candidates either scored full marks or lost only one mark. There were various ways of losing one mark. Some lost it by giving an incorrect equation for the mirror line in either part (a) or part (c), generally $y = x$, or, less often, $-y = -x$ in part (a) and $x = 1$ in part (c). Others lost one mark for rotating the triangle clockwise in part (b), but were not penalised further if they then followed through correctly in part (c). Combined transformations, which receive no credit when a single transformation is asked for, seemed less common than in previous years.

Question 10

There were many correct inequalities in part (a) but a large number and wide variety of incorrect ones as well. The most popular was $-4 < x \leq 3$ but $-4 \leq x \leq 3$ and $-4 < x < 3$ also appeared regularly. Each of these gained 1 mark out of 2, as did inequalities in which one 'end' was correct, such as $-4 \leq x > 3$. A substantial minority of candidates did not appreciate the notation required and gave answers like $-4 < 3$ or $-4 > 3$.

Part (b) was well answered. To score full marks in part (i), a candidate's final answer had to be $x > -4$, not -4 or $x = -4$. In part (ii), the most common error was to list -4 in addition to the three correct values but few candidates made the error of including 0. It was not unusual for candidates who failed to solve the inequality in part (i) to make a fresh start in part (ii) and, using trial methods, complete it successfully.

Question 11

Calculating the area of a circle was routine for most candidates. Three incorrect answers appeared with some regularity, however. 50.3 cm^2 came from use of a formula for circumference or substitution of $r = 4$ into πr^2 or doubling 8, instead of squaring it. 632 cm^2 was the result of evaluating $(\pi \times 8)^2$, instead of $\pi \times 8^2$.

804 cm^2 came from either substitution of $r = 16$ into πr^2 or substitution of $r = 8$ into $4\pi r^2$.

The second part had a high success rate and few candidates failed to score at least the 1 mark which was awarded for the accurate evaluation of two of the terms inside the brackets. Many candidates showed their substitution and then used their calculators to go straight to the answer. If the answer was correct, which was usually the case, they scored full marks but, if it was not, no marks were scored. In questions of this type, it is good exam technique to show intermediate working. It is also good exam technique to show, before rounding, an answer to a greater degree of accuracy than that required in the question. For example, candidates who showed the value 5046.7 in their working and then rounded it incorrectly to 505 were not penalised.

Question 12

The majority of candidates gained full marks for the table and the graph in the first two parts, although a few lost a mark for joining their points with line segments, instead of with a curve. Only two other errors appeared often enough to be noticed. One was plotting the points with negative x-coordinates as if they had negative y-coordinates. The other was plotting the point (4, 18) at (4, −18).

The final part was well answered but a substantial minority were unable to make a meaningful attempt or, occasionally, any attempt. The most popular wrong answer in part (i) was $3x - 12$, which gained 1 mark out of 2 and a further 1 mark in part (ii), if the candidate showed substitution of $x = 5$ into this expression. Also, the derivative of 2 was sometimes given as 2. A substantial number of candidates differentiated correctly in part (i) but did not appreciate the link between this answer and part (ii). Many substituted $x = 5$ into the equation of the curve, which led to an answer of 67, and a few solved an equation involving $3x^2 - 12$, usually either $3x^2 - 12 = 0$ or $3x^2 - 12 = 5$. Some of those who substituted $x = 5$ into the correct derivative, obtaining 63, went on to perform further, incorrect steps, such as subtracting it from 67 or dividing it by 5.

Question 13

The quality of answers varied widely. At one extreme, candidates made no headway at all. At the other, candidates produced completely correct solutions with concise, conventionally expressed reasons. In between, candidates were able to find the sizes of the relevant angles but unable to give acceptable reasons. Some tolerance was allowed in the marking of both reasons. While 'angle in a semicircle is a right angle' or something similar was hoped for, the omission of 'is a right angle' was not penalised. Also accepted were reasons such as 'the angle at the circumference that is subtended by the diameter' and 'the angle at the centre, which is 180°, is twice the angle at the circumference'. Similarly, with 'angles in the same segment', references to 'same arc' or 'same chord' were also accepted. The examiners tried to strike an appropriate balance between maintaining standards and rewarding evidence of understanding expressed in a mathematically correct but unconventional way. Common errors included the assumption that at least two of the triangles in the circle were isosceles, that angles *SRQ* and angle *SPQ* were right angles and that angle *SRP* and angle *QPR* were alternate angles.

Question 14

This question enabled candidates with any knowledge of bounds to gain some credit but only those with a detailed understanding scored full marks. There were several common errors. In part (a)(i), 19.5 cm was a popular lower bound for the length of *AB* while, in part (b), the lower bound for the area of triangle *ABC* was regularly found using $\frac{1}{2} \times 20 \times 8.3$.

In part (c), 8.3 was often used as the numerator and 15 or 19.5 as the denominator in the evaluation of tan x°. It was also not unusual to see the fraction inverted. The value of x was frequently given as the answer in part (c), even though the value of tan x° was required. If the correct value of tan x° appeared in the working, this incurred no penalty but, otherwise, a mark was lost.

Question 15

Many candidates produced completely correct solutions. Of the rest, some answered the first two parts correctly but, in the final part rearranged $1600 = \frac{10000}{r^2}$ as either $r^2 = \frac{1600}{10000}$ or $r^2 = 1600 \times 10000$. Others obtained 6.25 but did not go on to find its square root. An inexplicably large number of candidates used the wrong sort of proportionality, usually taking E as either directly proportional to r^2 or inversely proportional to $\sqrt{r}$. Such responses were regarded as mathematical misunderstanding, rather than misreading, and received no credit.

Question 16

To gain full marks, candidates had to show where all the terms had come from. The majority scored 1 mark out of 2 for including in their working $-3\sqrt{5}-3\sqrt{5}$ or, less often, $-2\times3\sqrt{5}$, to explain $-6\sqrt{5}$. Only a minority, albeit a substantial minority, explained the 14. Working of 3^2 for 9 was not required, although many gave it, but an explanation of +5 was required. In an expansion, this could be provided in a variety of ways, such as, $+\sqrt{5}^2$, $+\sqrt{5}\times\sqrt{5}$ and $+\sqrt{25}$. This evidence did not have to be part of the main expansion; it could be subsidiary working, for example $-\sqrt{5}\times-\sqrt{5}$ = +5. The Chief Examiner felt that these demands were reasonable, as the answer was given. The demands were also consistent with information which was previously circulated to centres about the marking of this type of question and is currently available on the Edexcel International website. Of the candidates who scored no marks, many just used their calculators to evaluate each side of the given equation.

Question 17

Most candidates either scored full marks or scored 1 mark for finding the scale factor, 1.5, and using this, rather than 1.5^2, as their multiplier. Many found the area successfully but 816 cm^2 was a very popular wrong answer. Occasionally, a multiplier of 1.5^3 or $\sqrt{1.5}$ was used or the correct multiplier, 1.5^2, found but divided into 544.

Question 18

The majority simplified the expression correctly but a sizeable minority 'cancelled' x^2 to obtain either $\frac{6x}{-36}$ or $\frac{x}{-6}$.

Question 19

The first part was well answered but there were several regular errors. Some realised that the probability of taking a 20 cent coin was $\frac{3}{6}$ each time and gave this as their answer. Others realised that an expression in which $\frac{3}{6}$ occurred twice was needed and so found $\frac{3}{6}+\frac{3}{6}$. This often led to an answer of 1, which did not seem to cause any concern. Even those who understood that a product was required sometimes found $\frac{1}{6}\times\frac{1}{6}$ or $\frac{2}{6}\times\frac{2}{6}$.

The second part was also well answered. By far the most popular method was to find P(5, 10) + P(5, 20) + P(10, 20) and evaluate $\frac{1}{6}\times\frac{2}{6}+\frac{1}{6}\times\frac{3}{6}+\frac{2}{6}\times\frac{3}{6}$. The most frequent error in the use of this method was the omission of P(5, 20). The main alternative method was to find P(5, 10 or 20) + P (10,20) and evaluate $\frac{1}{6}\times\frac{5}{6}+\frac{2}{6}\times\frac{3}{6}$. Predictably, a minority answered the question as if it were without replacement. Those who did this could score a maximum of 2 of the 5 marks available.

Question 20

There was wide variation in the understanding of trigonometry and Pythagoras' Rule in three dimensions. Many candidates scored full marks, often, but not always, with working clearly and neatly shown. A substantial number were unable to make a start or gained 1 mark for indicating an angle of elevation on the diagram. Even this mark was not trivial, however, and angles of elevation were sometimes shown as angles with the vertical. The most common wrong answer was 48.1 m, resulting from premature approximation. A considerable range of methods was employed. Any mathematically correct method was, of course, accepted but the more inefficient the method, the more likely it was that premature rounding would lead to loss of accuracy.

A minority of candidates mistakenly thought the triangle formed by joining *AC* to the top of the flagpole was right-angled. Some who could not visualise the situation in three dimensions mistakenly thought that the line joining *A* to the top of the flagpole and the line *BC* had a point of intersection.

Question 21

This question produced a wide range of responses. There were many completely correct solutions, factorisation being a more popular method than use of the quadratic formula. Those using the formula were expected to show their working as far as $\frac{3 \pm \sqrt{121}}{4}$; failure to do this incurred a loss of marks. Because of the availability of calculators capable of solving quadratic equations, substitution into the formula was not regarded as 'sufficient working'. Two other regular causes of mark loss were slips in algebra and failure to find the *y* values, after the *x* values had been obtained successfully. Of the remaining candidates, some gained 1 mark for $2x^2 = 3x + 14$ and a further mark if they rearranged it as $2x^2 - 3x - 14 = 0$, even if they were then unable to solve the equation. Others substituted for *x* in terms of *y*, obtaining $y = 2\left(\frac{y-14}{3}\right)^2$ but were then unable to expand the brackets accurately. Finally, there was a large number of candidates who were unable to make a meaningful attempt.

Statistics

Overall Subject Grade Boundaries – Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Overall subject grade boundaries	100	79	61	43	26	14	8

Paper 3H – Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Paper 3H grade boundaries	100	80	62	44	27	14	7

Paper 4H – Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Paper 4H grade boundaries	100	78	60	42	25	14	8

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