Examiners' Report/ Principal Examiner Feedback

November 2010

IGCSE

IGCSE Mathematics (4400)
Paper 4H Higher Tier

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Specification 4400
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For November 2010 the total IGCSE Mathematics entry was approximately 2000 candidates, a figure broadly in line with the two previous November sessions. There was a significant drop in the number of Foundation candidates from last year (from 600 to 300) and a corresponding increase of around 300 in the number of Higher level candidates.

Most of the 352 Foundation tier and 1812 Higher tier candidates took the opportunity the papers gave them to show what they knew.

Papers are marked online and it was pleasing to note, that with very few exceptions, most candidates kept their written responses within the areas designated for both working and answers, and did not stray outside these boundaries. Candidates should continue to use a pen with black ink, or HB pencil (or darker) for diagrams.

Introduction

The standard of this paper proved to be appropriate. Apart from Q19(b)(ii), on which only the best candidates scored full marks, and, to a lesser extent, Q10, success rates were commendable. Even most of the more demanding later questions were very well answered. In general, methods were well explained and working presented clearly and neatly.

Report on individual questions

Question 1

The vast majority of candidates evaluated the expression accurately and rounded it correctly. On the rare occasions that a rounding error occurred, it usually led to answers of 3.43, 3.4 or 3.40. As the question specified a decimal answer, $\frac{363}{106}$ was not accepted.

Question 2

Many candidates scored full marks, usually by converting 1 hour 15 minutes to 1.25 hours and evaluating 248 × 1.25. Some used fractions, finding, for example, the sum of $\frac{1}{4}$ of 248 and 248. 1 mark was awarded for expressions like 248 × 1.15 and 248 × 75, which demonstrated some understanding of the relationship “distance = average speed × time”. The minority who gained no credit often made the mistake of using “distance = $\frac{\text{average speed}}{\text{time}}$”.

Question 3

Most candidates successfully found the midpoint in part (a) but incorrect coordinates in part (b) were numerous and varied. It appeared that many candidates were unable to interpret graphically the geometric information.

Question 4

Errors were rare on this probability question. There was no noticeable pattern to the few wrong answers, apart from 53 (160 ÷ 3), which appeared occasionally in part (c), based on the incorrect assumption that each shape was equally likely to be taken.

Question 5

Many candidates converted the currencies correctly and scored full marks. Incorrect answers which appeared occasionally were 15 347.22 (50 ÷ 0.72 × 221) and 11 050 (50 × 221), each of which gained 1 mark.

Question 6

In part (a), many candidates substituted correctly into the formula and evaluated V accurately. Part (b) was also well answered; candidates could score 1 mark out of 2 simply by substituting the given values into the formula, that is, $35 = \frac{2}{3} \times h \times 2.5^2$, although division by $\frac{2}{3}$ sometimes caused problems later. Occasionally, the formula was misinterpreted as $V = \frac{2}{3} \times (h \times y)^2$, which led to answers of 10.14 in part (a) and a doomed start of $35 = \frac{2}{3} \times (h \times 2.5)^2$ to part (b).

In part (c), a high proportion of candidates successfully changed the subject of the formula, although the algebra skills of a minority were not up to this task. While the simplified formula $y = \sqrt{\frac{3V}{2h}}$ was hoped for and often appeared, any correct formula, however inelegant, was accepted, $y = \sqrt{\frac{V}{\frac{2}{3}h}}$ being the most popular of these. A few candidates sacrificed at least 1 mark with an incorrect square root sign in their answer, $y = \frac{\sqrt{V}}{\frac{2}{3}h}$, for example; this answer could also be the result of faulty algebra $\sqrt{V} = \frac{2}{3}hy$. Steps like $V - \frac{2}{3} = hy^2$ and answers like $y = \sqrt{V - \frac{2}{3}h}$ revealed serious weaknesses.

Question 7

Many candidates produced completely correct solutions. In part (a), the correct shape sometimes appeared in the wrong position, scoring 2 marks out of 3. In part (c), a single transformation was specified and so a combination of transformations received no credit, even if it included items which, on their own, would have been rewarded. If one error were made in describing the transformation, it was often with the coordinates (1, 8) of the centre of enlargement.

Question 8

Few candidates failed to score at least 1 mark out of 3 for $19.6 \times 50\,000 = 980\,000$ cm. Many used this result to obtain the correct distance but a substantial number either gave this value as their final answer or made an unsuccessful attempt to convert 980 000 cm to kilometres. Answers such as 980 km, 98 km and 0.98 km thus appeared regularly.

Question 9

Apart for a significant minority who were unable to make a meaningful attempt, most candidates gave two or three correct inequalities. Predictably, errors were most likely with $x + y \leq 8$, both $y \leq x + 8$ and $y \leq x - 8$ being quite popular. Occasionally, $x \geq 2$ and $y \geq 1$ appeared instead of $x \geq 1$ and $y \geq 2$.

Question 10

A fair number of candidates successfully found the size of angle *APC* but many others failed to appreciate that it was necessary to join *OC* or *BC* and so made no headway. There were a number of common misconceptions. One was that angle *ACP* was a right angle. Another was that either triangle *CBP* or triangle *ACP* was isosceles; these led to answers of 34.5° $\left(\frac{1}{2}(180-111)\right)$ and 21° respectively. Detailed working or clearly labelled diagrams gave candidates a better chance of gaining credit.

Question 11

There were many completely correct solutions to the first part, obtained by a variety of valid methods. Almost everyone gained some credit, even if it were only 1 mark for subtracting 1269 from 1350 to find the loss, \$81, which sometimes led to an answer of 0.81%. There was also 1 mark for $\frac{1269}{1350}$, although it was not unusual for this just to be converted to a percentage, 94%, which was then given as the answer, instead of being subtracted from 100. It is pleasing to report that 1269 seldom appeared as the denominator in candidates' expressions.

Many recognised the second part as reverse percentages and scored full marks. Those who did not generally calculated 14% of \$9519 as \$1332.66 and then either gave this as their answer or subtracted it from \$9519 to obtain the most popular wrong answer, \$8186.34. A few gave an answer of \$10851.66, the sum of \$1332.66 and \$9519.

Question 12

Although there were many completely correct solutions, a sizeable minority were either unable to make a serious attempt or unable even to make a start. Some candidates found and used a gradient of 2, instead of −2 but could still score 4 marks out of 5. A very common wrong answer in part (b) was $y = -2x + 3$, (3, 0) being taken to imply that $c = 3$ in the general equation $y = mx + c$.

Question 13

This question polarised candidates. A substantial number were either unable to make any attempt or produced working which showed no real understanding. Of those who had partial understanding, some made errors with basic geometrical facts, believing that the sum of the exterior and interior angle at a vertex is 360° or that the sum of the exterior angles of a polygon is 180°. The result of either of these errors was often an answer of 12. Another regular error was to use $\frac{360}{11}$ to find the size of each exterior angle. The minority who tried to construct equations sometimes started wrongly with exterior angle = 11 × interior angle but could still gain some credit for individual correct terms, such as $\frac{360}{n}$ for the size of each exterior angle or $\frac{180(n-2)}{n}$ for the size of each interior angle, although the denominator was sometimes omitted from the latter. There were, however, many completely correct, concise solutions, often comprising simply $x + 11x = 180$, $12x = 180$, $x = 15$, number of sides = $\frac{360}{15} = 24$.

Question 14

Many candidates gained full marks for completing the tree diagram and calculating the probability. The two usual types of error appeared regularly, however. Some candidates' tree diagrams were appropriate for 'with replacement' rather than 'without replacement' but even those who made this mistake could still score 2 marks out of 3 in part (b), if they used the probabilities on their diagram correctly. Others considered only the combination Red Blue, omitting Blue Red, but the presence of the tree diagram probably reduced the frequency of this error. A few candidates found the two correct products but then multiplied them, instead of adding.

Question 15

The majority gave the correct answer, 3.6×10^{15}, to the first part, 36×10^{14}, being the most popular wrong answer.

The quality of attempts varied widely in the second part. Many candidates produced correct, elegant solutions but there were also many who gained no credit. In part (i), successful candidates used one of two approaches. The first was to express xy as $3.5 \times 10^{m+n+1}$ leading to $m + n + 1 = 12$. The second was to express xy as $35 \times 10^{m+n}$ and 3.5×10^{12} as 35×10^{11}. In part (ii), obtaining $m - n = 27$ was no guarantee that the correct values of m and n would be found. Many did solve the simultaneous equations $m + n = 11$ and $m - n = 27$ algebraically but trial methods, with varying degrees of success, were not uncommon. Some just found a pair of values which satisfied $m - n = 27$, not appreciating the need to satisfy $m + n = 11$ as well.

Question 16

There were many completely correct solutions but a substantial number of candidates gained no marks. Either through misunderstanding or misreading, the most common wrong answer in part (a) was $P = \frac{3}{4}V$. To score full marks for this part, P had to be the subject of the formula in the answer. In part (b), $3V = \frac{432}{V}$ was occasionally followed by $4V = 432$ but even some of those who correctly obtained $3V^2 = 432$ gave $3V = \sqrt{432}$ as their next step. Some candidates thought the value of P was still 18 in part (b) and so solved $3V = 18$.

Question 17

Wrong answers were frequent in the first part, especially 27 $\left(\frac{9}{12} \times 36\right)$ obtained by comparing the heights of the two given bars. In the second part, many completed the histogram correctly. If an error were made, it was usually with the bar for $4 < w \leq 6$, often drawn with a height of eight little squares, instead of six.

Question 18

Many candidates gained full marks but a substantial number sacrificed a mark through evaluating one of the roots as −0.28, giving less than the 3 significant figure accuracy specified in the question. As noted in the comments on the June 2010 papers, because of the availability of calculators capable of solving quadratic equations, substitution into the formula does not qualify as ‘sufficient working’ for the award of full marks. Full simplification is required. Centres are further advised that, when substituting into the quadratic formula, candidates should show clearly that the division line extends under the whole numerator.

Question 19

In part (a), many candidates knew the intersecting chords theorem and applied it successfully. A few even found the correct answer from first principles, using similar triangles, although some using this approach misidentified corresponding sides. Some misquoted the theorem. $5 \times AE = 16 \times 4$ and $4 + AE = 16 + 5$ appeared regularly, leading to answers of 12.8 and 17 respectively. Answers of 12 $\left(\frac{3}{4} \times 16\right)$ and 21 (16 + 5) were also seen occasionally.

Part (b)(i) was quite well answered but only a small minority of candidates gained full marks on part (b)(ii). Those who were successful usually used the Cosine Rule in triangle *OED* but there were several other equally valid approaches. Some tried to use the Cosine Rule in triangle *AED* but this gave an equation with two unknowns. Of those who made an attempt, the most common error was to wrongly assume that an angle, often angle *ACE* or angle *EBD*, was a right angle and then use basic trigonometry. Centres should make candidates aware that, when (i) and (ii) occur in a question, there will be a link between the two parts. So, in this case, as the radius had to be found in part (i), it could be assumed that this result would be used in part (ii).

Question 20

There was a high success rate for this question, usually by factorisation. Many candidates scored either full marks or lost 1 mark for failing to find the values of y. Those who used the quadratic formula had to develop it at least as far as $\frac{7 \pm \sqrt{49-40}}{2}$ to gain credit.

Question 21

In the first part, candidates who had an understanding of vectors found part (i) very straightforward and part (ii) only a little less so. Although still well answered, part (iii) proved more demanding. Unsimplified expressions were accepted but they had to be punctuated correctly. So, for example, $\mathbf{b} + \frac{1}{4}(3\mathbf{a} - \mathbf{b})$ was accepted but $\mathbf{b} + \frac{1}{4}3\mathbf{a} - \mathbf{b}$ was not. As answers in terms of $\mathbf{a}$ and $\mathbf{b}$ were required, expressions such as $\mathbf{b} + \frac{1}{4}\overrightarrow{SQ}$ were not accepted either.

A deeper understanding of vectors was needed in the second part but a fair number of candidates showed this. "Parallel" and "proportional" appeared regularly in part (i) but "collinear" or the equivalent was required.

Question 22

The vast majority of candidates fell into one of three categories. Many candidates' algebra was equal to this task and they scored full marks for $\frac{2x+7}{x+4}$. Some gained 2 marks out of 4 for $1+\frac{x+3}{x+4}$, which was not regarded as 'fully' simplified. The rest produced incorrect algebra, notable mainly for its idiosyncratic cancelling.

Statistics

Overall Subject Grade Boundaries – Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Overall subject grade boundaries	100	78	60	42	24	14	9

Paper 3H – Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Paper 3H grade boundaries	100	80	61	42	24	14	9

Paper 4H – Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Paper 4H grade boundaries	100	77	59	41	24	14	9

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