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Examiners' Report/ Principal Examiner Feedback

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IGCSE

IGCSE Mathematics (4400) Paper 3H Higher Tier

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November 2010

IGCSE Mathematics
Specification 4400
Paper 3H

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

Generally students coped well with most aspects of this Higher paper. Traditionally challenging topics such as functions, surds and algebraic manipulation did not have a particularly high tariff and were structured in a way to enable most candidates to make a start and pick up some marks. Questions 15, 16 and 19 offered less guidance on how to proceed, and these proved to be good questions to discriminate between candidates.

Report on individual questions

Question 1

A question involving a mean average from a frequency table provided candidates with a straightforward start to the paper. Mistakes were rare in the method, although some made the made the error of $4 \times 0 = 4$ and some candidates rounded off their final answers to the integers 2 or 3. Full marks were awarded for a value of 2.64 seen in the body of the script. Without this, full marks were awarded for an answer of 3 (children per family) provided both method marks were gained before. An answer of 2 (children per family) potentially scored M2 A0 if 2.64 was not seen.

Question 2

All aspects of this question proved accessible to most candidates. Candidates were penalised if they took correct statements and then followed this by incorrect working. For example in part (a)(ii) $d^3 + 4d$ becoming $5d$ or $5d^3$ was awarded no marks. At Higher level such occurrences were extremely rare.

Question 3

Although Higher level candidates fared much better than their Foundation counterparts this question was the first that gave a opportunity to drop marks for a significant minority. This was usually due to a failure to give adequate explanations of how they arrived at either their final or intermediate answers. Abbreviations for "isosceles" or "alternate" were not deemed adequate. Although there were a variety of valid methods to get the correct answer of 40º, the key was to get angle BAC =70º and state the reason as relating to isosceles triangles. This gave two marks. A further mark was awarded for ABC = 40º or for an angle clustered around x other than angle BAC. The final mark was for the correct answer <u>and</u> a valid reason, typically angle PAB being alternate with angle ABC. Omission of the statement that the sum of the angles in a triangle is 180^{o} was condoned, although many candidates included it when using the alternate angle method to find x.

Question 4

The numerical calculation for the area of the circle was generally performed well. Confusion sometimes came through stating the units for area, metres or cm^2 being occasional wrong responses.

In part (b) 25 rather than 250 was often offered or 248.84 / 248.85 (2 decimal places).

Question 5

"Show that" questions involving fractions are common questions on both Foundation and Higher papers and it is an established principle that converting to decimals will be ignored and gain no credit. At Higher level this time, this was rarely seen. Candidates must also work on the fractions on the left side to reach an equivalent fraction on the right side. Treating fractional statements as an equation and swapping values from left to right, (and vice versa) will also gain no credit.

Although a variety of methods gained full credit, most successful candidates chose the more traditional method of taking the reciprocal of 4 in part (a) and converting from division to multiplication.

In part (b) the favoured method was conversion to improper fractions to arrive at 26/15. Both parts of this question were well executed, and most candidates scored full marks.

Question 6

Both parts of this question were well done, with the majority of candidates selecting an appropriate algebraic method rather than a numerical approach, which would have scored no marks. It was pleasing to see this even in part (b) where it was relatively easy to spot the correct answer through inspection. The minimum requirement for an algebraic treatment would be to see $7x - 2x = -4 - 3$ in part (a) and $16 - 5y = 2 \times 3$ or $16 - 5y = 6$ in part (b).

Question 7

In part (a)(i) replacing ∩ with "and" to give "Mr Smith's clothes and hats" as an answer was not sufficient to gain the one mark available.

Part (b)(i) proved more challenging and did not score especially highly. It was not essential, but the question would have been aided by a Venn diagram, and many candidates used this approach to reach the correct answer.

In part (b)(ii) students confused symbols for "is an element of" with the symbol for the universal set.

Question 8

In part (a) candidates who correctly selected the tangent ratio usually had no trouble reaching the correct answer. Premature rounding and not putting a value which rounded to 6.54 in the body of the script was the usual source of lost marks. A substantial minority of candidates used the sine rule, generally getting the correct answer.

Part (b) scored slightly less well. Some mistakenly though this second part of the question also involved trigonometry and pursued an unnecessary path. A small minority who recognized the question involved Pythagoras gained no marks by squaring and adding ($10^2 + 4.5^2$) to reach a side longer than the hypotenuse.

Question 9

Almost all candidates scored at least one mark in both parts and many scored full marks. In part (a) partial marks could be gained by giving three numbers with a median of 5 or a mean of 4. Several candidates did not read the question carefully enough and failed to give three different numbers. For example 2, 5, 5 was a common answer.

In part (b) it was a relatively easy skill to give four numbers with a single mode of 5 but it required a greater skill to reach this and deliver a median of 6 from the same four numbers.

Question 10

Candidates scored well on both parts of this question and a follow through on the method in part (b) was allowed for mistakes incurred in part (a). It was necessary not only to derive the scale factor of 1.4 but to use it correctly to score marks. Occasional mistakes included an answer of 8 for PR in part (a) (from $21 - 14 = 7$ therefore $PR = 15 - 7$). Weaker candidates who reasoned in this way often produced an answer of 24 for part (b) (from $18 - 15 = 3$ therefore $MN - 21 = 3$).

It was disappointing to note the number of candidates who attempted to use Pythagoras in both parts of the question.

Question 11

An occasional mistake was to take the midpoint of the horizontal axis and state the median in part (a) as 27.5 (from $55 \div 2$) which coincidentally gave the same value on the vertical axis. Mistakes like this were rare and in general, this was a high scoring question.

Part (b) gave more of an opportunity to make mistakes but overall candidates also did well here, however some thought that the IQR could be found by subtracting the position of the LQ from the position of the UQ. i.e. 30-10=20.

Question 12

Candidates that successfully managed to reduce the simultaneous equations to one equation and one unknown (usually either $18y = -36$ or $36x = 54$) often went on to secure full marks. One arithmetic mistake was condoned in reducing to one equation and this secured the first method mark and then no more. This was often seen in the form where the coefficients of x were made the same and then the subtraction carried out inaccurately to reach, for example $12y = -36$.

Question 13

Both components gave no problems to candidates who were familiar with factorising quadratics and recognised the case of the difference of two squares. In rare cases, some candidates treated part (a) as an equation to be solved and offered roots of $x = 5$ and $x = 3$ as their final answer. This was not penalised and full marks were awarded if these answers had come from correct factorisation. In rare cases candidates appeared not to recognise the quadratic expression in part (a) and factorised as $x(x\text{-}8) + 15$.

Question 14

In part (a) correct values for both roots were awarded with two separate accuracy marks regardless of whether the line $y = 2$ was drawn. In some cases candidates just gave the first root with the lower value.

In part (b) the question specifically requested a line to be drawn and hence here the accuracy marks were dependent on the line $y = x + 1$ seen. A number of candidates gave roots to a degree of accuracy that would have been difficult to obtain from a graph. This was overlooked, even if algebra manipulation followed by the quadratic formula was employed. It was possible that candidates were confirming their graphical answers were correct.

Question 15

No guidance was given and hence this was a challenging question. The most common mistake was to add a complete sphere volume to a cylinder volume. Provided correct volume formulae were used this gained three marks. Unfortunately as a result of the values selected for the shape, the volume of the hemisphere was numerically equal to half the surface area of the sphere. If candidates selected and used the wrong formula the correct answer of 35.3 to 35.4 was still obtained, and markers had to be vigilant to this rare case. A more common mistake was to see candidates use an incorrect formula such as $2\pi rh$ for the volume of the cylinder and $4\pi r^2$ or $\frac{4}{3}\pi r^2$ for the volume of the sphere.

Any value rounding to 35.3 or 35.4 (and not a multiple of π) was required to secure the final accuracy mark.

Question 16

In part (a) the mechanical process of differentiating was performed well by those familiar with calculus.

Part (b) required a full algebraic treatment to obtain full marks. This involved showing the working required (by factorisation or formulae) to solve the quadratic equation from part (a). If the correct coordinates of the turning points were not obtained, the substitution of the x values into the original cubic had to be demonstrated to secure the penultimate method mark. Stepping from the statement $3x^2 + 6x - 24 = 0$ directly to the correct answers would only result in one mark as it favours those who might be in the possession of increasingly sophisticated calculators able to solve quadratics directly.

Up to three follow through marks were awarded in part (b) for those making errors in their differentiation in part (a) but a "three part" quadratic had to be brought forward to avoid trivialising the question.

A common mistake was to substitute the x values back into the differentiated function rather than the cubic and give the turning points as (–4, 0) and (2, 0). Another common error was in the incorrect evaluation of the value of y at $x = -4$.

Question 17

This probability question proved to be a good source of marks even for weaker candidates who could usually pick up 2 marks in part (a). In rare cases candidates chose to add probabilities (1/6 + 1/6 +1/6 for no marks) or multiply the correct answer by 3 (1/6 x 1/6 x 1/6 x 3 for one mark).

Part (b) proved more demanding. A tree diagram was not especially usefully and most wisely did not go down this route. Able candidates usually scored three marks and weaker students no marks.

Any correct combination spotted (i.e. 1, ~1, ~1 = 1/6 × 5/6 × 5/6) gained one mark and many students left their answer as this. Astute students spotted that this combination could be rearranged in different ways.

Question 18

Gaining the final answer, with x isolated and unique, proved too challenging for many candidates, though many gained the first two marks by multiplying both sides by x and hence removing the denominator and multiplying out the brackets on the numerator. Gathering up x terms on one side of the formula and factorising was the obstacle that often impeded further progress. A common error was to get from $100x + Px = 100y$ to $101x = \frac{100y}{P}$.

Question 19

This question gave no guidance on how to proceed and hence spawned a variety of legitimate and illegitimate methods.

The majority of candidates that were fully successful chose the economical route of calculating angle A (through the sine rule) which led directly onto angle B and the use of "½ ab sin C". The marking scheme also took into account candidates who chose to calculate the base AC by a combination of trigonometry and Pythagoras and use ½ $AC \times 5 \times \sin 40°$ or ½ × AC × height. Another approach seen was to drop the perpendicular from B onto the line AC and with a variety of methods involving Pythagoras and trigonometry, find sum of the area of the two triangles so produced.

To gain all six marks on offer, candidates had to reach a final answer which rounded to 14.3, but through premature rounding or truncating often lost the final accuracy mark.

Many candidates scored no marks through the incorrect use of the sine rule and 9.64 (from ½ × 6 × 5 × sin 40º) was often seen.

Some thought $AC^2 = 6^2 + 5^2$ and then used this incorrect value of AC in ½ × AC × 5 × sin 40º. This again scored no marks as it was felt inappropriate at this stage in the paper to reward such a fundamental misunderstanding of Pythagoras.

Question 20

Although many candidates scores full marks in part (a), many scored nothing by stating $4^2 = 16$ and trying to work with powers of 4. Some candidates scored one mark for 16 = 2^4 but could proceed no further.

Breaking down eight as 8 = 4 × 2 in part (b) also proved the limit to where weaker candidates reached. Several candidates misunderstood the question and gave 256 (2^8) or 1/256 as the answer.

In part (c) most successful candidates favoured the route of multiplying by $\sqrt{a} / \sqrt{a}$ to rationalise the denominator rather than divide $\sqrt{a}$ into the two components of the numerator and then examine the index powers. Both methods required a full simplification down to $\sqrt{a} + 1$ to gain both marks. Weaker candidates replaced the algebra with numerical values by replacing a with 2 or 3. This scored no marks even if they went on to replace their numerical value by a in the final answer.

Question 21

Many able candidates familiar with functions scored well on this last question and often gained full marks.

In part (a) the correct answer without working was allowed as the tariff was only two marks and it was felt the very best candidates would gain the correct answer by inspection. A surprising number did decide that the inverse function $f^{-1}(x) = 2x - 1$ and scored zero.

If the correct composite function $hg(x) = (2 + x)^2$ was reached full marks usually followed by the quadratic reducing to a linear equation.

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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