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Examiners' Report Summer 2009

IGCSE

IGCSE Mathematics (4400)

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IGCSE Mathematics
Specification 4400

There was an entry of just over 27,000 candidates, a thousand more than a year ago. This comprised 17,900 from the UK and 9,100 from overseas. Although the UK entry fell slightly, this was more than compensated for by an increase in the overseas entry. All papers proved to be accessible and the vast majority of candidates were able to demonstrate positive achievement.

Centres should tell candidates to write their answers in the spaces provided in the question paper. They should not write on the formulae page, in blank spaces or on blank pages.

Fewer candidates than last year handed in additional sheets which they had used for checks and re-working of questions. Such work is marked only if it continues or replaces work in the answer booklet.

Candidates should 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.

Paper 1F

Introduction

This paper gave 1750 candidates the chance to show what they knew. Most questions had an encouraging success rate, although Q15(b) (use of formula) and Q20 (surface area of a prism) proved demanding. Methods were generally well explained and working clearly shown.

Report on individual questions

Question 1

Most candidates found this straightforward. The only wrong answers which appeared with any regularity were 6700 and 6790 in part (b), ‘tenths’ in part (c) and 122, the difference between the numbers, in part (d).

Question 2

Almost all candidates found the next two terms in part (a) and gave an acceptable explanation in part (b), typically “Add 9.” or “It’s the 9 times table.” Part (c) was also usually correct, generally using 9 × 20 or by counting on.

Question 3

In part (a), it was not unusual to see ‘pm’ omitted from the 12-hour clock time and 10 40 appeared occasionally. The 24-hour clock time was usually correct. In part (b), the temperature was almost always read accurately and, in part (c), there were very few errors in marking −8°C on the thermometer.

Question 4

Errors were rare on this bar chart question, although 'China' appeared occasionally as the answer to part (b).

Question 5

In part (a), most candidates drew the line of symmetry successfully and gave a version of 'isosceles' which was, if not correct, at least recognisable. The majority drew all four lines of symmetry in part (b) but a substantial minority drew only two, usually the horizontal one and the vertical one.

In part (c), many candidates gave the correct answer 'octagon' but only a small proportion were able to explain why the polygon was not regular. The successful minority usually gave answers like 'The angles are not all equal.' but explanations like 'It should have 8 lines of symmetry.' appeared occasionally and were acceptable. There was a wide range of incorrect explanations, often referring to the number of sides. "The sides are all equal." appeared regularly, as did "Not all the sides are equal."

In part (d), many candidates realised that the flag had no lines of symmetry but 2 and, to a lesser extent, 4 were wrong answers which appeared regularly. The order of rotational symmetry was often correct but 4 was a popular wrong answer and 180º appeared occasionally.

Part (e) was well answered but the fraction was sometimes given as $\frac{1}{2}$ and, less often, as $\frac{3}{5}$. Correct conversion of the latter to a decimal received credit. Occasionally, the decimal equivalent of $\frac{2}{5}$ was given as 0.2 or 2.5.

Question 6

Part (a) had a high success rate. Predictably, the selection of a prime number proved most demanding but even this appeared to cause fewer problems than in previous years. The probabilities in part (b) were usually correct; those who gave the correct numbers in unacceptable forms such as 5 : 9 were penalised only once.

Question 7

Almost every candidate wrote down their full calculator display for $\sqrt{7}$ in part (a) and many rounded it correctly to 2 decimal places, although both 2.64 and 2.6 occurred frequently. In part (b), 0.29^2 was almost always evaluated accurately but rounding to 1 significant figure proved very demanding and there were many wrong answers. The most common of these was 0.1 but 0, 1 and 0.8 also appeared regularly. The majority gained full marks in part (c) and, of those who did not, many scored 1 mark for the correct evaluation of one of the terms, usually 1.5^3. A few candidates gave answers of 1.75, the value of $\frac{1.5^3+1}{2.5}$, or interpreted 1.5^3 as 1.5×3.

Question 8

The majority of candidates successfully found the median in the first part. Of the rest, many scored 1 mark for putting the numbers in order, even if they then went on to give incorrect answers such as 6, 10 and 6, 10. The most popular wrong answer was 7, which was both the mean of the ten numbers and the mean of the middle two numbers in the unordered list.

Many found the range correctly but wrong answers, especially 10 and 7, the mean, were also common. Answers, 1-10 for example, which showed evidence of understanding of range were awarded 1 mark but these were rare.

Question 9

The majority gave the correct answer of $4q$ to part (a) but a very substantial minority gave q^4. In part (b), the success rate was high, the mark being awarded usually for $5np$ but sometimes for $5pn$ or $n5p$. Answers which retained even one multiplication sign, such as $5n \times p$, received no credit. The solution of the equation in part (c) proved straightforward and the equation in part (d) was also well answered, although the rearrangement was more challenging. $8y = 5 - 1$ led to $y = \frac{1}{2}$ or $y = 2$ and even the correct rearrangement $8y = 6$ was no guarantee of full marks, sometimes leading to $y = 2\ (8 - 6)$, $y = -2\ (6 - 8)$ or $y = 1\frac{1}{3}$ $\left(\frac{8}{6}\right)$.

Question 10

In the first part, many candidates ordered the fractions correctly, usually by converting them to decimals but occasionally using a common denominator of 120. It was clear that some incorrect answers were the result of using 0.6 as the decimal equivalent of $\frac{2}{3}$ and it seemed that some candidates thought that the number of decimal places had a bearing on the size of the number. The most common wrong method was to order the numerators or the denominators.

In the second part, there were many correct answers. 12 was often used as the denominator, sometimes 48 and, occasionally, 24. To score full marks, both the subtraction and the un-simplified fraction, $\frac{4}{12}$, $\frac{16}{48}$ or $\frac{8}{24}$, had to be shown. Any method involving conversion of the fractions to decimals received no credit.

Question 11

There were many completely correct answers, usually with clear working. The popular wrong answers to part (a) were 69, from the use of ‘alternate’ angles, and 48, from either a misunderstanding of which two angles were equal in the isosceles triangle or from the assumption that all three angles were equal. Candidates who made an error in the first part could still score full marks in the second part, if they showed their working and made correct use of their incorrect value of x.

Question 12

This question was well answered, especially the first part. In part (a) a minority of candidates mistakenly shared 80 in the ratio 5 : 2 and found $\frac{2}{7} \times 80$ giving answers of 22 or 23. Answers of 200 $\left(800 \times \frac{5}{2}\right)$ were also seen. In part (b), division by 3, instead of by 4, appeared regularly, leading to answers of 27. A few candidates lost a mark for answers of 60 $\left(\frac{3}{4} \times 80\right)$ or 20 : 60.

Question 13

The majority of candidates used the relationship distance = average speed × time but $\frac{\text{average speed}}{\text{time}}$ and $\frac{\text{time}}{\text{average speed}}$ were also often used. There were many correct answers but, as a result of errors in dealing with the time, there were also three incorrect answers which appeared regularly. These were 526 (40 × 13.15), the most popular, 31 800 (40 × 795) and occasionally 536 (40 × 13.4).

Question 14

There were many correct enlargements, although a substantial number of candidates either did not attempt the question or translated the triangle without changing its size. Translations of the correct triangle appeared regularly, especially with the right angle at (5, 0) or (9, 4). Triangles with a correct base of 5 squares but an incorrect height of 9 squares appeared occasionally, the result of either miscounting squares or a slight measuring inaccuracy in a construction method. Enlargements with scale factor 2 were not uncommon.

Question 15

Many candidates evaluated A accurately but a variety of errors in using the formula appeared often enough to be noticed. LW was sometimes interpreted as $L + W$, $2LW$ as $2L \times 2W$ or the formula as $A = 2LW + HW + HL$. A few candidates preferred to substitute in LWH.

In part (b), a minority of candidates gained full marks but many made no headway. Some candidates scored a mark for substituting the given values into the formula but could not cope with the algebra needed to make further progress. Trial and improvement methods, even if successful, received no credit.

Question 16

Part (a) was usually correct, although 731 (86% of 850) and 60.7 $\left(\frac{850}{14}\right)$ appeared occasionally.

Part (b) was more demanding but still well answered. When an answer was wrong, it was often either 65% or obtained using $\frac{760}{266}$. It was noticeable that 226 or 260 was sometimes used instead of 266.

Part (c) had a fair success rate. 61.2 (30% of 204) was a frequent wrong answer. Others were 346.8 and 265.2, obtained by increasing 204 by 70% and by 30% respectively. Methods using 100% = 3 × 30% + 10% were popular but often unsuccessful, the stumbling block being 10% of $204.

Question 17

Many candidates gave completely correct explanations. Typical acceptable explanations were "10 × 0.35 = 3.5 and half beads are impossible.", "The probability of a red bead has only one decimal place." and "0.35 = $\frac{7}{20}$ and so you need 20 beads." Candidates scoring 1 mark out of 2 often did so by mentioning $\frac{1}{10}$ or 0.1. The most common misconception was that it was necessary to know the colours of all the beads in the bag, although candidates who included this with an acceptable explanation were not penalised. The three lines provided for the answer were thought to be sufficient but proved too restricting for some candidates. In general, clear, concise explanations are more likely to be rewarded than lengthy, rambling ones.

Question 18

Although often correct, the factorisation in part (a) was outside the algebraic scope of many candidates. Misconceived 'simplification' of $p^2 + 7p$ was prevalent, as $9p$, $7p^2$ or $7p^3$, for example.

Part (b) was beyond weaker candidates but a fair number of abler ones obtained the correct solution and usually showed sufficient algebra. The step $5x = 2$ or $-5x = -2$, which was required for full marks, occasionally yielded the solution $x = 2\frac{1}{2}$ and faulty rearrangement sometimes led to $5x = 6$ or $5x = -2$.

The majority of candidates added the powers in part (c), although multiplication occasionally resulted in t^{18}.

The quality of algebra in part (d) varied greatly. A fair proportion of candidates expanded the brackets correctly as $12y + 10 - 10y - 15$ and obtained the right answer, $2y$, but many gave + 15 as the last term and so had an answer of $2y + 30$. Otherwise, when candidates were able to make a meaningful attempt, it was not uncommon to see a coefficient of 22 for y, even when the first three terms in the expansion were correct or $3(4y + 5)$ expanded as $12y + 5$.

Question 19

Many candidates knew what was needed and scored either 3 marks, if they made an error in the calculation, or 4 marks for a correct answer. There were also many who were unable to make a meaningful attempt. Such candidates used a wide range of wrong methods, such as dividing the sum of the halfway values by 5 or multiplying each frequency by 20. Between these extremes were candidates who used upper limits instead of halfway values, scoring 2 marks if their method was otherwise correct. 2 marks were also scored by candidates who found the sum of the products of the halfway values and the frequencies but divided it by 5 to obtain a value for the mean which was not sensible.

Question 20

Many Foundation candidates find this type of question difficult and it was pleasing to see a substantial number find the surface area correctly, usually with clearly explained working. Those who had some appreciation, albeit imperfect, of what was required came to grief in many different ways. For example, $\frac{1}{2}$ was sometimes omitted when finding the area of a triangle or included when finding the area of a rectangle. The area of one or more of the rectangles or the area of the triangles was frequently omitted from the calculation. Some confused area with volume but could still score 1 mark for finding the area of a triangle correctly. Finally, there were many who were either unable to make a start or unable to make any relevant calculations. Such candidates found the sum or product of some or all of the values shown on the diagram. The sum, 63, of all these values was a particularly popular answer.

Question 21

It was not unusual to see {1, 3, 9} as the answer in the first part. The reason for this, when it was apparent, was the omission of the number itself from the two lists of factors, rather than confusion between union and intersection.{3, 9} also appeared regularly, often the result of the omission of both 1 and the number itself from the lists.

In part (b), although a significant minority ticked the ‘No’ box, many ticked the ‘Yes’ box and gave an acceptable explanation such as “No factors of 27 are even.” Answers which showed understanding of the statement itself, such as “There are no numbers in both *A* and *C*.” were also accepted. Some of those who ticked the ‘No’ box then gave an acceptable reason but could receive no credit.

Question 22

Many candidates achieved some success on this routine trigonometry question and a substantial number gained full marks. The most common errors involved rounding in one of two ways. The first was rounding $\frac{3.6}{7.9}$ to 0.45, 0.46 or even 0.5 with the consequent loss of the answer mark. The second, which also cost 1 mark, was rounding the answer to 27, without showing in the working a value to a greater degree of accuracy. The calculators of a small number of candidates were set in the wrong mode.

Paper 2F

Introduction

Overall, this paper met the appropriate demands of candidates and nearly all questions had encouraging success rates. There was some evidence of good basic skills, particularly in questions requiring numerical calculations. Questions requiring algebraic manipulation fared less well.

Report on individual questions

Question 1

Many of the candidates answered all components of this question correctly. Occasionally a number from the list was missing in (a)(i). In (a)(ii) a surprising number thought 1990 was odd. A few candidates chose to ignore the list and chose any two numbers (typically 2000 and 1000) whose difference was 1000 in (a)(iv).

Part (b)(ii) proved to be quite testing. Although many responses started with the digit 8 to make the number as large as possible, the fact that the number also had to be even was an added complication that led to many wrong answers.

Question 2

Allowing leniency for mis-spellings made this question fairly high scoring. Mistakes that did occur were “diamond” for the kite, “rhombus” or “rectangle” for the parallelogram and “rhombus” for the trapezium.

In part (b) the reflex angle was much less well known than the acute angle, many thinking it was either an “external” or “outside” angle or obtuse.

Question 3

This question was generally well answered, but the letter C sometimes appeared in a randomly wrong position or exactly above the zero (0). This was despite a fair degree of tolerance allowed here, (greater than zero and less than 25% in from the left of the line).

Question 4

Both components of this question scored well despite part (b) being harder. In this latter part candidates could score 1 mark by converting the word formula to algebra, (C = 5 x ? +12 was allowed) but most chose to reverse the arithmetic processes correctly.

Question 5

Many candidates in part (a) did not write down all four factors, frequently missing out 1 or 33.
Part (c) was surprisingly well done with very few of the expected answers of 15 (3 x 5).

In part (d) some found the square root of 17576 and rounded off to 133, (or down to 132).

Question 6

Generally this question was very well answered, and a good early source of 3 marks. Even candidates who did not achieve the final correct answer provided a structure to their reasoning in which method marks could be awarded, typically for 7 x 1.20 + 6 x 0.75 at the start.

Question 7

In rare cases 17 was given as the answer for the mode, presumably because mode is equivalent to most, and "most" equated to the largest number.

Part (b) usually produced the correct answer of 11 but many thought that Marcus had scored zero or one in his ninth test. Most of the candidates in part (c) who obtained 11 did so as a result of an unnecessary calculation (88 +11) ÷ 9

Question 8

Too often 15 was given as the answer in (a) by candidates failing to read the question properly and calculating the area rather than the perimeter. Part (b) gave the weaker candidates licence to perform a variety of wrong operations on the two numbers given. This was usually a subtraction of 7.2 from 46.8 but squaring and adding was also more common than should have been.

Question 9

Both sections of part (a) were well answered, 4/20 the most common incorrect answer in (a)(i).

Part (b) was poorly attempted. Decimal treatments of the fractions gained no marks and this affected many. Others stated directly that 2/3 ÷ 5/9 = 6/5 which wasn't enough. Better candidates inverted the second fraction and multiplied. Depending on what their first fraction had become, or if cancelling had taken place, this led to answers of 54/45 or 18/15 or 6/5 all of which were enough for full marks.

Question 10

In part (a) candidates usually scored at least one mark and stating the units of area as cm^2 was usually the easiest mark to gain. A range of 11 to 13 was accepted for 1 mark for those who tried to count the squares enclosed in the parallelogram, but a majority gave 12 as the correct answer.

Many who tried to rotate the parallelogram in (b) ended up with an image whose longer sides were in a horizontal orientation.

Question 11

Thirty was a common wrong answer in part (a) obtained by ignoring the rules of BIDMAS and entering the numerical expression in their calculator as 10 + 5 x 4. Likewise 8 was often offered as the wrong answer in (b) from ***8*** +5 x 4(= 28) and -28 was commonly seen in part (c) from ***-28*** +5 x 4 = -8.

Algebra attempts in part (d) were poor, 4(x+5) or 4x+20 were required for 2 marks but *4x* +5 was allowed for 1 mark. Many lost marks when they preceded or followed their expression with "*x*=" eg *x* = 4x+5 or 4(*x*+5) = x

Question 12

Parts (a) and (b) scored well here, but with the absence of specific amounts for pounds or dollars to work with, resulted in part (c) faring worse. The most common wrong answer was 0.85 found by subtracting £1 from $1.85. It was clear that some candidates had no experience of currency exchange rates and gave some nonsensically large answers in (c) for the number of pounds a single dollar could be exchanged for.

Question 13

This pie chart question was a good discriminator for those looking to achieve the top grades in this paper. In part (a) most candidates recognised that the size of the sector angle was in direct proportion to the number of students choosing their favourite sport. To jump from 40^0 to 90^0, rather than simply multiplying by 2.25 many tried a build up method (90^0= 40^0+40^0 +10^0 so as 90^0=12 hockey players 90^0= 12 + 12 + 3 tennis players). Unfortunately, this usually broke down at the last stage and the answer became 12+12 +10 or something similar.

In part (b) many failed to appreciate they were working out a fraction of a whole circle and calculated 130/240 x 100 instead of 130/240 x 360. Many thought this part was an extension of the question in part (a).

Question 14

Fully correct answers for all components of this question were rare.

In (a) the 1 mark that would have been given for x-5 was often taken away for x = x-5. In (b)(i) candidates often failed to distinguish between an equation and an algebraic expression.
3(x-5)=39 or 3x-15 = 39 or x-5 =13 were needed to gain the 2 marks available. Some conditions were set out before follow through rules could be applied in (b)(ii). A linear equation of the form ax+b=c where a>1 and b,c $\neq$0 was needed as a previous answer. Two marks were awarded in (b)(ii) for an answer of 18 with or without working.

Question 15

The majority of candidates obtained the correct answer, usually by correctly evaluating the contents of the brackets as -8 and from this -48 as the numerator. For those who gained wrong answers, the most common error was to try to expand the brackets and obtained -54+1 for the numerator instead of -54+6. Substitution of b=9 instead of b=-9 was not treated as a misread as it reduced the level of difficulty and gained no marks.

Question 16

Finding the “middle” value from the frequency table, to gain the method mark, was attempted by most. The majority tried to do this by laboriously writing the complete list of data values and then counting along to find the middle value, rather than stating its position as 33.5 (67÷2) or the 34^{th} ((67+1)÷2) data item. Elsewhere many candidates picked out the middle value from the shoe size row and declared it was 8. The few who calculated the mean as 7.56 and rounded down to 7, despite their extensive calculations, gained no credit.

Question 17

Despite clearly listing the circumference formula on page 2 a disturbing number chose to use the area formula in part (a).

Part (b) proved to be more challenging although it was extremely rare not to award any marks. The easiest mark was for the area of the rectangle (8 x 10). The area of the circle suffered occasionally from premature truncation (28.2 not 28.3). Whilst the method mark here remained intact, (from π x 3^2) the final accuracy mark for values not rounding to 51.7 was lost. Many followed the lead from part (a) and subtracted a circumference value from the area of the rectangle, thereby gaining only the first mark.

Question 18

There was little evidence of working as the probability values in the table were easily dealt with and the calculations required were not difficult. Full marks were awarded in most cases. When errors did occur, it was predominantly in part (b) with answers of ½ appearing, presumably, because candidates thought 50% of the numbers were odd and ignoring the probability values given in the table.

Question 19

For those who had revised Pythagoras thoroughly part (a) was a good source of three marks. Some who had not prepared so well tried to use trigonometry (without success) or left the calculation as 36.25 (from $5.1^2 + 3.2^2$).

Trigonometry provided a sterner test in part (b), but better candidates scored well here.
A relatively easy one mark was available just for selecting the tangent function despite what followed from it. Taken together, sine and cosine were almost as likely to be selected as tangent.

Question 20

Without some algebraic discipline, this proved to be a taxing question. Many tried a trial and error approach or an educated guess and scored no marks, even for the correct answer. One line of correct algebra was the minimum requirement, usually for $12–x$=7x3, though many jumped straight to $12 – x$ =21. 9 rather than -9 was a common wrong answer for those who could not complete the final stage.

Question 21

This was a well answered question so close to the end of the paper. Factor trees remain the favoured method in deriving the prime factors of a number, closely followed by repeated division "ladders". Some candidates lost the final accuracy mark by either failing to bring the correct factors down from the ladder or tree or not expressing the final answer as a *product* of prime factors.

Question 22

The essence of the question was to work out an approximate answer for the numerical expression given, without the aid of a calculator or resorting to lengthy multiplication or division. 38.2 needed to be approximated to 36 to use its square root of 6 for one of the three marks. 84.2 and 41.6 needed to be reduced to either of the pairs (80 and 40) or (84 and 42) for another mark. Ideally, candidates would spot that, on dividing, both these pairs led to the quotient of 2 and hence 2 x 6 =12.

Many candidates missed the subtleties of this question and even better candidates embarked upon 84 x 6 = 504…..504 ÷ 42. This was not penalised but was unnecessary.

The final mark for an answer of 12 was dependent on the award of the previous two marks so candidates generally did not score highly, many resorting to decimal approximations for √38 or √40 early on.

Paper 3H

Introduction

The standard of this paper proved to be appropriate and gave candidates the opportunity to show what they knew. Many of the 25,000 candidates gained high marks and almost all showed their working clearly.

All questions were accessible and had a pleasing success rate. In the first half of the paper, only the Venn Diagram in Q8 (c) caused significant problems. In the second half, there were several questions which challenged even the most able candidates, notably Q15 (Functions and gradient), especially parts (c) and (d), Q16 (Surface area and volume factor), Q18 (Algebraic fraction), Q20 (Bounds) and Q21 (Cosine Rule).

Report on individual questions

Question 1

This posed few problems. In part (a), $\frac{2}{5}\times 80$ was the usual method but some candidates calculated the total number of candidates $\left(80\times\frac{7}{5}=112\right)$ and then found $\frac{2}{7}\times 112$. A minority of candidates mistakenly shared 80 in the ratio 5 : 2 and found $\frac{2}{7}\times 80$ giving answers of 22 or 23. In part (b), division was occasionally by 3, instead of by 4. A few candidates lost a mark for answers of 60 $\left(\frac{3}{4}\times 80\right)$ or 20 : 60.

Question 2

The vast majority of candidates used the relationship distance = average speed × time and there were many correct answers. As a result of errors in dealing with the time, however, there were also three incorrect answers which appeared regularly. These were 526 (40 × 13.15), the most popular, 536 (40 × 13.4) and 31 800 (40 × 795).

Question 3

There were many correct enlargements but translations of the correct triangle were not uncommon, especially with the right angle at (5, 0), (9, 4) or (16, 16). Triangles with a correct base of 5 squares but an incorrect height of 9 squares appeared occasionally, the result of either miscounting squares or a slight measuring inaccuracy in a construction method.

Question 4

Many candidates gave completely correct explanations, answers frequently containing two or three explanations, each of which, on its own, would have gained full marks. Typical acceptable explanations were "$10 \times 0.35 = 3.5$ and half beads are impossible.", "The probability of a red bead has only one decimal place." and
"$0.35 = \frac{7}{20}$ and so you need 20 beads." Candidates scoring 1 mark out of 2 often did so by mentioning $\frac{1}{10}$ or 0.1. Only a minority gained no credit. The most common misconception was that it was necessary to know the colours of all the beads in the bag, although candidates who included this with an acceptable explanation were not penalised. The three lines provided for the answer were thought to be sufficient but proved too restricting for some candidates, who needed at least twice as much. In general, clear, concise explanations are more likely to be rewarded than lengthy, rambling ones. It is pleasing to note an overall improvement in the clarity of explanations.

Question 5

In part (a), errors with the factorisation were rare. When they occurred, it was often the result of a misconceived 'simplification' of $p^2 + 7p$, usually as $7p^2$ or $7p^3$.

In part (b), the majority obtained the correct solution and showed sufficient algebra, usually improving their chances of reward by setting this out clearly. The step $5x = 2$ or $-5x = -2$, which was required for full marks, occasionally yielded the solution
$x = 2\frac{1}{2}$ and faulty rearrangement sometimes led to $5x = 6$.

In part (c), the answer was almost always correct.

In part (d), many candidates expanded the brackets correctly as $12y + 10 - 10y - 15$ and obtained the correct answer, $2y$, but a substantial minority gave + 15 as the last term and so had an answer of $2y + 30$. Much less frequent errors were a coefficient of 22 for y, even when the first three terms in the expansion were correct, and
$3(4y + 5)$ expanded as $12y + 5$.

Question 6

Both parts of this question on percentages proved straightforward and errors were rare, the few there were in the first part often being the result of using 226 or 260 instead of 266. In the second part, 346.8 and 265.2 appeared occasionally as answers, obtained by increasing 204 by 70% and by 30% respectively.

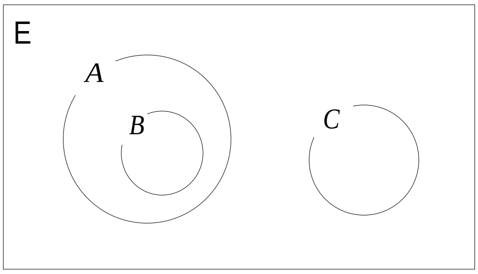
Question 7

This routine trigonometry question was very well answered. The most common errors involved rounding in one of two ways. The first was rounding $\frac{3.6}{7.9}$ to 0.45, 0.46 or even 0.5 with the consequent loss of one mark. The second, which also cost 1 mark, was rounding the answer to 27, without showing in the working a value to a greater degree of accuracy. The calculators of a small number of candidates were set in the wrong mode.

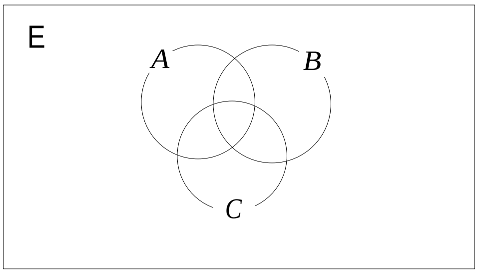
Question 8

The quality of answers to this question varied widely. Errors were most likely with the Venn Diagram in the last part but it was not unusual to see {1, 3, 9} as the answer in the first part. The reason for this, when it was apparent, was the omission of the number itself from the two lists of factors, rather than confusion between union and intersection. {3, 9} also appeared regularly.

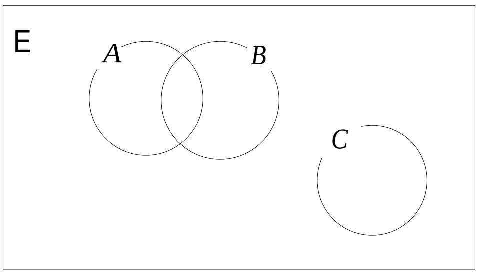
In part (b), although a significant minority ticked the 'No' box, sometimes with an explanation which clearly justified 'Yes', many ticked the 'Yes' box and gave an acceptable explanation such as "No factors of 27 are even." Answers which showed understanding of the statement itself, such as "There are no numbers in both *A* and *C*." were also accepted. Some candidates lost the mark by referring to the factors of 9 in their explanations.
To score full marks for the Venn Diagram in part (c), the layout had to be correct and the sets labelled.

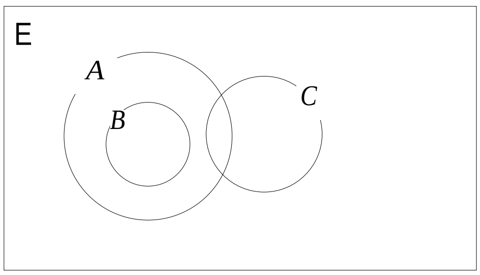


Many candidates drew a 'standard' outline, which received no credit, even if individual members were entered correctly with some areas empty.



1 mark was awarded for diagrams which showed either $B \subset A$ or both $A \cap C = Ø$ and $B \cap C = Ø$.





Question 9

The majority of candidates gained full marks. A minority found the length of *OB* correctly and went no further. A few, having found *OB*, either divided it by 3 or, less often, tried to use intersecting chords in order to find the length of *BC*.

Question 10

In the part (a), most candidates successfully found an estimate for the mean. The two most common errors were using upper limits instead of halfway values and multiplying each frequency by 20, the class width. Division by 5 instead of 40, which appeared quite regularly in the past, was seldom seen.

In part (b), errors in the use of the graph scales were seen regularly, especially with 25 on the Distance axis.

A fair number of candidates thought that the answer to part (b) had to be used in part (c), finding the cumulative frequency for a distance of 75 and then subtracting from this the answer to part (a). Others calculated $\frac{3}{4}$ of 40 or 41 and $\frac{1}{4}$ of 40 or 41 but were unsure what to do with their results, sometimes just finding the difference. Occasionally, the median or one of the quartiles, usually the lower one, was found. Some candidates obtained answers in the acceptable range by finding the difference between the cumulative frequencies for distances of 10 km and 30 km but this method was penalised.

Question 11

There were many correct solutions to the simultaneous equations, elimination being the most popular method. Appropriate multiplication was sometimes followed by an incorrect operation and this received no credit. Errors were most likely in dealing with $-15y - 8y$. Having obtained the value of the first variable, to score full marks, candidates had to show their method, usually substitution, by which they obtained the value of the second variable. Here, not surprisingly, errors occurred more often when $y = -1$ was substituted. It was noticeable some candidates multiplied both sides of the first equation by 2.5 and then used subtraction. This method had a high success rate, as did the use of substitution.

The second part proved far from trivial, even though the mark was awarded for both the correct coordinates and for ones which were consistent with the candidate's answer to the first part. Ignoring the fact that this part was worth only 1 mark and had hardly any working space, a minority of candidates embarked on a fresh, but usually doomed, method, using algebra, tables of values or sketch graphs, which often overflowed into, and sometimes filled, the rest of the page.

Question 12

The majority of candidates scored full marks on the first part. 1.5×10^7 was the most common wrong answer; this gained 1 mark. Answers, such as 15×10^7, which were equal to 150 million but not in standard form received no credit. Answers in calculator notation, 1.5^8, also received no credit but these were rare.
The second part proved more demanding but only a minority of candidates achieved no success. Many gained full marks and, of those who did not, a high proportion scored 1 mark for 0.72. A few just expressed 108 million in standard form or started with the wrong quotient $\frac{150}{108}$.

Question 13

In part (a), most candidates substituted the given values into the formula and solved the resulting equation correctly, showing sufficient algebraic working. Occasionally, $2(LW + HW + HL)$ was interpreted as $2L \times 2W + 2H \times 2W + 2H \times 2L$. Trial and improvement methods, even if successful, received no credit.

There was a wide range of responses to part (b), which proved to be a demanding rearrangement. Some candidates did not have the algebraic skills to make a meaningful attempt, while others obtained a correct formula, showing concise, accurate working. In between, correct expansion or division by 2 gained 1 mark and going on to isolate the W terms correctly gained a further mark. Candidates who reached the next stage, a correct equation with W as a factor, generally went on to score full marks. Some fell at this hurdle, however. Having obtained $A - 2HL = 2LW + 2WH$, instead of factorising, they tried to divide by $2L$ and then by $2H$.

Question 14

Knowledge of geometry and circle theorems varied widely. Part (a)(i) had the highest success rate and, if only 1 mark were scored on the whole question, it was usually this one. ‘Corresponding’ instead of ‘alternate’ appeared in part (a)(ii) and no marks were awarded either for ‘Z angles’, ‘zig-zag angles’, ‘parallel lines’ or ‘alternate segment’. Part (b) was quite well answered and there were no common wrong answers. In part (c)(i), 77, the size of angle ADE, appeared regularly. An acceptable reason in part (c)(ii) had to include the term ‘alternate segment’.

Question 15

This proved to be a demanding question. Part (a) was generally well answered but only the ablest candidates gained full marks on the other parts.

Amongst those who understood part (b), the most common reasons for the loss of a mark were the omission of a solution, usually $x = 0.2$, or embedding the solutions in pairs of coordinates. No marks were, of course, awarded for just y coordinates.
In part (c), 1 mark was awarded for the evaluation of g(1) as 5, even if fg(1) were subsequently interpreted as f(1) × g(1) or f(1) − g(1) for example.
In part (d), many did not appreciate that a tangent was required but those who did generally drew it accurately and often went on to try to find its gradient using $\frac{\text{vertical difference}}{\text{horizontal difference}}$, the most likely error being with the scales on the axes.

Candidates who assisted markers by indicating on their tangent the triangle or points they were using increased their chances of credit but the related division was also required for full marks. Even if a tangent were not drawn, some credit was given for a clear attempt to find the gradient of a line joining two suitable points on the curve. Many used the coordinates (1, 16) to obtain answers such as 16 and $\frac{1}{16}$.

Question 16

Hardly any candidates failed to score on this question. By far the most common error in the first part was the omission of the area of the base. In the second part, correct answers were usually obtained by cubing the scale factor. A method which involved calculating the volumes of the two cones was accepted but, for full marks, the answer had to be sufficiently accurate. When this approach was used, a common error was the use of the slant height instead of the vertical height. Many candidates scored 1 mark by giving 1.5, the scale factor, as their answer. A few squared this value, which received no further credit.

Question 17

There were many completely correct solutions. The first part had a significantly higher success rate than the second, in which the most common error was to consider only one additional combination with a sum of 6, instead of the necessary two. The use of tree diagrams reduced the risk of this error and some candidates used sample spaces successfully. Inevitably, a minority answered the question as if there were replacement. Those who did this consistently could score a maximum of 2 of the 5 marks available.

Question 18

There was a high proportion of correct expressions but a significant minority did not understand what was wanted. Some factorised $50x^2 - 2$ as $2(25x^2 - 1)$ but could not factorise it further. Having obtained a correct answer, a few candidates lost a mark by going on to 'simplify' it wrongly.

Question 19

Many candidates calculated the perimeter of the segment accurately and a few were unable to make a start. In between these extremes, the most common error was to use areas in one or both parts. Some candidates who did find the arc length correctly either thought this was the perimeter or realised that it was not and added two radii to it. A variety of methods was used successfully to find the length of the chord *AB*, although the Cosine Rule was occasionally 'collapsed' from $6^2 + 6^2 - 2 \times 6 \times 6\cos 78°$ to $\cos 78°$.

Question 20

This question discriminated well between candidates. Finding the lower bound, 15 cm, for the length of a side correctly was no guarantee of a correct answer. 15 cm was sometimes given as the final answer or the 'lower bound' of 15 cm was found (usually 14.5 cm) and used to find the perimeter. Realising that the lower bound of the area was 225 cm^2 was obviously a necessary step and the award of any marks was dependent on the appearance of 225 in the working. A minority thought that 229.5 cm^2 was the lower bound for the area or started by just finding $\sqrt{230}$.

Question 21

There was a complete range of responses to this question. Some candidates simply did not know what was required and did not attempt the question. Others believed wrongly that they did know what was required and tried to use a variety of inappropriate approaches, including the Sine Rule. Then there were those who realised that the Cosine Rule was needed but stated it incorrectly. The first mark was awarded for a correct statement of the Cosine Rule in terms of x and cos 60°; further reward depended on this. This correct statement could be in the form either $(x + 4)^2 = x^2 + (x + 6)^2 - 2x(x + 6)\cos 60°$ or $\cos 60° = \frac{(x+6)^2 + x^2 - (x+4)^2}{2x(x+6)}$. Candidates starting with ‘cos 60° =’ seemed more likely to reach a successful conclusion. Many candidates scored a second mark for expanding correctly $(x + 4)^2$ and $(x + 6)^2$, although $x^2 + 16$ and $x^2 + 36$ appeared occasionally. Dealing with the cos 60° term proved to be a major, and often insurmountable, obstacle. Probably the most common mistake was to simplify $-2x(x + 6)\cos 60°$ as $-2x^2 - 12x\cos 60°$ with the result that $x^2 + x^2 + 12x + 36 - 2x(x + 6)\cos 60°$ became $36\cos 60°$. The substantial number of candidates who cleared this obstacle frequently went on to gain full marks. A few candidates dropped a perpendicular from *C* onto *AB* or from *B* onto *AC* and successfully used Pythagoras’ Rule twice in the two right-angled triangles created, in effect using the Cosine Rule from first principles.

Paper 4H

Introduction

This paper gave candidates many opportunities to demonstrate a thorough understanding of a variety of topics, and there was much evidence throughout the paper of good basic skills. Most of the questions proved accessible and the majority had a high success rate.

Candidates scored particularly well in the first half of the paper with only Q2 and Q11 causing some problems by the candidates misunderstanding what was required. This was also the case with Q20 (Trigonometry), later in the paper. The demanding questions proved to be Q18(c) (Vectors), Q21(b) (Equation solving) and Q22 (Standard Form). It was pleasing to note how many of the ablest candidates rose to the challenges here, and produced well-worked, complete solutions.

In a minority of cases, candidates did not heed explicit advice given in previous examiners' reports that purely algebraic questions required an algebraic treatment. Q9 and 21(a) therefore received no credit if correct answers were derived by trial and error, inspection or with no working shown.

Report on individual questions

Question 1

This question was intended to be carried out without a calculator. Decimal conversions of fractions gained no credit. Many good attempts were seen in which arithmetic processes were carried out on the left-hand side of the statement to reach an improper fraction equivalent to $1\frac{1}{5}$. The most common method was to invert the second fraction and change the division process to multiplication leading to $\frac{2}{3}$ x $\frac{9}{5}$ to equal $\frac{18}{15}$.

The second most popular method was to make both fractions have a common denominator 9, (or a multiple of 9) and go directly from $\frac{6}{9} \div \frac{5}{9}$ to equal $\frac{6}{5}$.

Those who wrote $\frac{2}{3} \div \frac{5}{9} = \frac{6}{5}$ were less convincing and scored no marks.

Question 2

In part (i) the question required an equation to be set up from Angelou's initial x sweets. Responses which gained the full 3 marks here were $3(x\text{-}5)\text{=}39$, $3x\text{-}15 = 39$ or $x\text{-}5\text{= }39/3$. In all three of these cases the separate components of removing 5 sweets from the initial x, multiplying by 3 and involving the 39 sweets is implicit or implied. Responses which fell short of this were given partial credit for x-5 (1 mark) or $3x$-5=39 (2 marks if x-5 seen, otherwise 1 mark). Candidates who therefore wrote x= 5 +13 or similar gained no credit at this stage, as x was simply being assigned to a numerical value.

In part (ii) a full follow through was allowed for the algebraic solution to a "non-trivial" linear equation eg $ax+b=c$ ($a>1$, $b,c \neq 0$) or for 18 as an answer with or without working. In the latter case, candidates who had shown little or no working, but effectively reached the correct answer, gained 2 of the 5 available marks.

Question 3

The majority of candidates obtained the correct answer, usually by correctly evaluating the contents of the brackets as -8 and from this -48 as the numerator. For those who gained wrong answers, the most common error was to try to expand the brackets and obtained -54+1 for the numerator instead of -54+6. Substitution of b=9 instead of b=-9 was not treated as a misread as it reduced the level of difficulty and gained no marks.

Question 4

Finding the "middle" value from the frequency table, to gain the method mark, was attempted well. The majority tried to do this by stating its position as 33.5 (67÷2) or the 34^{th} ((67+1)÷2) data item. Despite the information presented in a user-friendly form, it was quite common to see candidates laboriously writing out the complete list of data values and then counting along to find the middle value. Those who calculated the mean as 7.56 and rounded down to 7, despite their extensive calculations, gained no credit.

Question 5

Finding the circumference in part (a) presented little difficulty, though a few chose to work out the area. This was despite both circle formulae clearly given on the formula sheet on page 2 of the paper.

Part (b) proved to be more challenging, although it was extremely rare not to award any marks. The area of the circle suffered occasionally from premature truncation (28.2 not 28.3). Whilst the method mark here remained intact, (from π x 3^2) the final accuracy mark for values not rounding to 51.7 was lost.

Question 6

There was little evidence of working as the probability values in the table were easily dealt with, and the calculations required were not difficult. Full marks were awarded in most cases.

Question 7

In part (a) the image of the parallelogram ended up in an identical position for a 90^0 clockwise or anti-clockwise rotation and so the majority of candidates gained maximum marks. The most common wrong answer was to see the image of the parallelogram with its longer sides in a horizontal orientation.

Candidates scored less well in part (b). One mark was lost for not stating that a translation had occurred. The second mark was awarded for getting the details of the translation correct. A column vector (with brackets) of $\begin{pmatrix}-4\\5\end{pmatrix}$ would gain 1 mark but (-4, 5) would not. A common error was to reverse the signs on 4 and 5, effectively going from Q to P. Written descriptions that gave the size and direction of **both** *x* and *y* components (eg 5 up, 5 north, 4 west, 4 to the left) gained the mark. Unacceptable written descriptors included "backwards" and "across".

Question 8

Both parts of this question were extremely well managed. Requesting the hypotenuse in part (a) rather than the length of one of the shorter sides led to many successful answers. A small minority of candidates chose to treat this as a trigonometry exercise. Full marks were awarded here for a complete method that led to the correct answer.

In part (b) most sensibly opted to use tangent. Just selecting this option led to the award of the first method mark. A small minority opted to use the sine rule, making use of 32^0 and 58^0. Although a slightly longer method, this was deemed perfectly acceptable and the mark scheme took this into account. The number of candidates whose calculators were not in degree mode was very small.

Question 9

Solving an equation such as this, which needed more than one step, required an algebraic treatment to gain full marks. An example of a minimum requirement here would be
$12 - x = 7 \text{x} 3$. Imbedded correct answers of -9, or -9 as an answer with no working, or a numerical treatment leading to -9 scored no marks. The overwhelming majority of candidates heeded the past guidelines given and scored full marks, usually opting for $12 - x = 21$ as their first line. Less successful attempts usually resulted from not dividing the denominator of 3 into both components of the numerator.

Question 10

Factor trees remain the favoured method in deriving the prime factors of a number closely followed by repeated division "ladders". Some candidates lost the final accuracy mark by either failing to bring the correct factors down from the ladder or tree and/or not expressing the final answer as a product of prime factors.

Question 11

The essence of the question was to work out an approximate answer for the numerical expression given, without the aid of either a calculator or resorting to lengthy multiplication or division. 38.2 needed to be approximated to 36 to use its square root of 6 for one of the three marks. 84.2 and 41.6 needed to be reduced to the pairs (80 and 40) or (84 and 42) for another mark. Ideally, candidates would spot that on dividing, both these pairs led to the quotient of 2 and hence 2 x 6 =12. Many candidates on reducing 84.2 to 84 proceeded to work out
6 x 84 = 504 and then divided this by 42. Candidates were not penalised for this, as there was no evidence that calculators were used. The final mark for an answer of 12 was dependent on the award of the previous two marks.

Question 12

Generous use of follow through marking made this a high scoring question.

In part (a) ½ x was occasionally seen rather than ½ and was awarded one mark of the two available.

The gradient in part (a) was allowed to follow through in part (b) for full marks. One mark was deducted here for the omission of "y ="

In part (c) a follow through was allowed either from the gradient in part (a) or any equation of a line, in the correct form, that was parallel to their line in (b). Most candidates recognised they just had to change the value of the y intercept to get a parallel line.

Question 13

Similarity in triangles is a topic examined regularly and therefore it is surprising to see how many candidates fell into the trap in part (a) and applied a scale factor to increase the angle of 60^0, (usually to 75^0).

Depending upon the pairing of lengths there were a variety of scale factors to use on the sides, including 0.8, 1.25, 1.5 and 2/3. Method marks were awarded for the correct use of (rather than just seeing) the scale factor.

Some candidates, seeing that the difference in the corresponding sides AB and PQ was 5-4 =1 cm, then followed this logic to state y = 7.5-1 (=6.5) and in (c) z = 3+1 (=4)

Question 14

Completing the tree diagram in part (a) was done well, candidates producing the correct binary structure of branches and adding both the probability labels and values to their diagram. Alternative abbreviations for heads (H) and tails (T) which were accepted were H', ~H etc.

In a minority of cases, the probabilities for the two tail branches in part (b) were added rather than multiplied, and gained no marks, or an intention to multiply ¼ x ¼ resulted in 1/8 and gained 1 mark.

Question 15

Part (a) was usually answered well though some candidates tried to "factorise" the expression and ended up with $c^2d(3c^3 \text{ x } d^3)$.

Part (b) proved more challenging but still scored highly. The most common error was failing to generate 16 and by either retaining the value 2, or assuming $2^4 = 8$.

There were a couple of ways in part (c) that correct answers could be obtained by incorrect algebraic manipulation, (cancelling the x in the numerator with x^2 in the denominator the most common, or cancelling the 3 with the 6). All such methods scored no marks as a correct factorisation of numerator and denominator, and then correct cancelling from this was required.

Question 16

Of the large number of candidates who factorised the quadratic expression correctly, most used their factors to solve the quadratic equation in part (b). A small minority however, used the quadratic formula, often successfully but unnecessary. For candidates that did not achieve the correct factors, a follow through in (b) was allowed provided that both roots were stated and they came from linear factors containing integers.

Question 17

The basic procedures of differentiation were followed correctly in part (a) to obtain two correct separate terms of $2x$ and 3. This gained the award of two marks even if they went on to process the algebra incorrectly resulting in $6x$ or $5x$. Follow through was only allowed for the gradient value in (b) if -4 was substituted into $ax + b$ ($a,b \neq 0$). A minority substituted -4 into the original equation.

Marks were only awarded in (c) that showed valid algebraic working, typically "$2x+3$"=0. Both correct x and y values were needed for the accuracy marks. Candidates that tried to derive their answers by a graphical argument by drawing the curve gained no marks.

Question 18

A substantial number of candidates found the first two stages of this question quite straightforward, but the last part proved more taxing.

Part (a) usually gained full marks but it was common to see un-simplified answers, typically
$-\frac{1}{2} y - x + \frac{1}{2}$ y. This was not penalised.

In (b) most gave the correct answer, however x-y and x+2y were occasional responses, the latter appearing to come from thinking that ND = y

In part (c) candidates were equally likely to derive expressions for AP rather than PA and this, if completed correctly, scored 2 of the possible 3 marks. Many found this part difficult. One failure was not recognising that PA goes from P to A via C and hence the reverse of the given vector CP could have been used. PA=PC +CA would have secured one mark.

Question 19

Candidates chose a number of approaches with this histogram question, particularly in the second part. The most successful and shortest method was to calculate and mark on the vertical axis the frequency densities. As the 3-4 bar in part (a) was only one unit wide, and had a frequency of 15 leaves, this was fairly easy to do. One mark was awarded for any frequency density value in the correct position and no errors elsewhere on the vertical axis. This led to the efficient method of 4 x 2 = 8 for the correct answer in (a).

In (b) once the frequencies for the intervals 4–5 and 5–6 (or 5-9) were established candidates simply had to take fractions of these bars covering these intervals, typically ½ of the 4-5 bar added to ½ of 5–6 bar. This yielded 6 +3=9. Of the candidates who tried a different approach and set 1 cm^2 to 2.5 leaves or 1 small square to 1/10 of a leaf, some were successful but it was difficult to unravel the reasoning for the ones who were not.

Question 20

To gain one mark, in part (a)(i), candidates had to state, or mark on the diagram, either BM = 1 or CM=1. Cos 60^0 = ½ was a natural progression from there.

In (a)(ii) either some lines of Pythagoras, establishing AM to be √3, or the correct use of the sine rule on triangles ABM or AMC were needed to gain full marks. Many scientific calculators now give the sine of 60^0 directly as √3/2, in surd form, and in some cases candidates either stated this with no working, or attempted to work backwards from this position to establish lengths of sides on the triangle.

In part (b) exact values of cos 60^0 and sin 60^0 were asked for so the decimal value 0.866…. for sin 60^0 gained no further credit. Some candidates assumed by writing down all the decimal digits from their calculator display, they were using the exact value.

Question 21

Most candidates moved directly on to using the quadratic formula in part (a). It was not enough to quote the formula from the sheet on page 2 to gain the first method mark, values had to be substituted in at the appropriate places and one sign error was allowed. Some candidates lost the accuracy mark at the end by premature rounding or truncation, as 3 significant figures or better were required for both final answers.

Part (b) proved to be a challenging question for most candidates, usually requiring several lines of correct algebra to arrive at $x^2=2$. Both positive and negative roots of 2 were required either as $\pm\sqrt{2}$ or $\pm 1.414….$ for full marks. It is important that candidates retain the structure of an equation throughout their working rather than treat the algebra as an expression to be simplified.

Question 22

The apparent complexity of the question put many candidates off making a serious attempt.
In part (a) the removal of the index powers of 10 was required rather than stating simply
$z = (x \times 10^5 + y \times 10^4) \div 10^5$. Some gave the answer as $x + 0.y$ instead of $x + 0.1y$

Parts (b)(i) and (b)(ii) were inextricably linked. Many opted wrongly for a =0.75 and this led to p = m–n as a result. This error gained 1 of the 3 available marks. Not retaining the structure of an equation resulted in most errors as candidates lost sight of the link with a and p on one side and the values 0.75 and the powers on the other side of the equation.

Statistics

Overall Subject Grade Boundaries

Foundation Tier

Grade	Max. Mark	C	D	E	F	G	U
Overall subject grade boundaries	100	72	57	42	27	12	0

Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Overall subject grade boundaries	100	81	63	45	27	15	9

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