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Examiners' Report Summer 2008

IGCSE

IGCSE Mathematics (4400)

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Summer 2008

Publications Code UG020267

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IGCSE Mathematics
Specification 4400

There was an entry of just over 26,000 candidates, almost 40% more than in May 2007. The papers proved to be accessible and most candidates were able to demonstrate positive achievement.

Centres should note that candidates' work on supplementary sheets is marked only if it replaces or continues that in their answer booklets. Checks and the re-working of questions, for example, are not marked.

Paper 1F

Introduction

This paper gave 2100 candidates the chance to show what they knew. All questions proved to be accessible, although some of the later questions, especially Q15 (Transformations), Q18(b) (Trigonometry) and Q19 (Equations and Inequalities) were challenging for Foundation candidates.

Report on Individual Questions

Question 1

The vast majority of candidates found this question very straightforward and errors were rare, the only one which appeared with any regularity being 1372, instead of 326, in the final part.

Question 2

In part (a)(i), most candidates gave a correct name, usually 'cuboid', but 'rectangular prism' was a frequent answer. 'Rectangle' was the most common wrong name. If 'prism' appeared in part (ii), the mark was awarded, even if it were preceded by an incorrect adjective, such as 'hexagonal'. The most common wrong answer was 'pentagon' but 'hexagon' and 'polygon' were also popular. In part (iii), the answer was almost always correct.

Many candidates answered part (b) correctly but a sizable minority gave 4, 6 or 12 as the answer.

Question 3

Errors were rare in part (a).

Part (b) was also usually correct. Sometimes, incompletely simplified fractions such as $\frac{5}{25}$ and $\frac{2}{10}$ were given as the answer in part (ii). More surprising was the occasional appearance of $\frac{2}{5}$, the result of initially writing 20% as $\frac{20}{50}$.

Most candidates gained the mark in part (c), usually for an answer of 14%.

In part (d), both answers were almost always correct.

In part (e)(i), most candidates drew the bar correctly, although bars just below 30 appeared with some regularity. In part (e)(ii), wrong answers were seldom seen.

Question 4

The drawing in part (a) was almost always correct.

Few candidates had any difficulty in applying the rule accurately in part (b).

The majority of candidates found the pattern number successfully in part (c), either using inverse operations or trial. Using the correct inverse operations in the wrong order led to answers of 17.5; 75 ($2 \times 37 + 1$) also appeared regularly.

A wide variety of acceptable explanations were given in part (d), including concise answers such as '60 is even.' and 'The number of sticks is always odd.' A popular explanation involved showing that 60 sticks required a pattern number of 29.5, although less rigorous reasons like '59 can't be divided by 2.' were accepted.

The formula in the part (e) was often correct, usually in the form $n = 2p + 1$ or $n = p \times 2 + 1$, but, of course, any equivalent formula was accepted. $p = 2n + 1$ and $n = p$ were regular wrong answers.

Question 5

Many found the range, 7, correctly in the first part, answers such as 18-25 appearing occasionally and gaining one mark. The most popular wrong answers were 176, the sum of the values, and 22, their mean.

The second part was well answered, although a median of 22 was not uncommon. If this was the result of a calculation of the mean or if no working was shown, this scored no marks. If the answer was incorrect, 1 mark was awarded for putting the numbers in order, even if one of the 24s was omitted.

Question 6

In part (a), a high proportion of candidates found the area of the parallelogram correctly, usually using either base × vertical height or square counting, although the shape was sometimes split up into a square and two triangles. By far the most popular wrong answer was 27 cm^2, the result of multiplying the base by the slant height.

Few candidates failed to score in part (b), many gaining full marks for a perimeter of 21 cm, although answers in the range 20.6 cm to 21.4 cm were accepted. Others who took the slant height as 4 cm gained 1 mark for a perimeter of 20 cm. In the first two parts, there was occasional confusion between area and perimeter but it was not a widespread problem.

In part (c), the majority correctly gave 0 as the number of lines of symmetry possessed by a parallelogram but 2 was also a popular answer and so, to a lesser extent, were 4 and 1.

Part (d) had a high success rate, 4 being the most common wrong answer.

In part (e)(i), most candidates measured the angle with sufficient accuracy to obtain an answer in the acceptable range 115°-119° inclusive and, in part (ii), described it as 'obtuse', although a minority gave answers of 'acute' or 'reflex'. In part (e), the coordinates of the midpoint were usually correct.

Question 7

Part (a) was well answered. p^2 appeared regularly, as did the incomplete simplification $4p - 2p$, which also received no credit.

Part (b) also had a high success rate, the most popular wrong answer being xy^4.

Many candidates scored full marks for part (c) and, of those who did not, a substantial number gained 1 mark for one correct term, often the first one, $9g$. Common wrong answers included $9g - h$, $9g + h$, $9g + 5h$ and $g - h$.

Question 8

All of part (a) was well answered. 21 was given occasionally as a prime number in the final part but there were no other consistent errors.

The majority of candidates stated the correct probability in part (b). Of the rest, many gained 1 mark for a fraction with a denominator of 9. Unacceptable forms of the answer such as 5 : 9 and 5 out of 9 were rare but scored 1 mark.

Question 9

In part (a), most candidates found a fraction equivalent to $\frac{4}{9}$, usually $\frac{8}{18}$, but many other correct alternatives were seen. Attempts to simplify $\frac{4}{9}$ led to $\frac{2}{3}$, the most frequent wrong answer.

The majority of candidates successfully calculated $\frac{4}{5}$ of 65 kg in part (b).

In part (c), many candidates scored full marks for correctly ordering the fractions and a substantial proportion of the others gained 1 mark for either converting at least two of the fractions to decimals or for listing three of the fractions in the correct order. It was noticeable that the accurate conversion of all four fractions to decimals was no guarantee of a correct final answer, suggesting that the underlying problem was with ordering decimals. Some candidates left the fractions in the original order, presumably thinking that both numerators and/or denominators were already in increasing order of size.

Question 10

Few candidates failed to gain full marks.

Question 11

The first part was not well answered. Candidates made two distinct types of error. The first was to evaluate either the cube root or square root of 19. The second was to omit the final zero when writing 8659 correct to 3 significant figures, 685 and 686 being very popular wrong answers. 6850 and 6900 also appeared regularly.

In contrast, the calculation in part (b) proved straightforward, only a minority failing to score full marks and many of these gained 1 mark for the correct evaluation of either 3.6×4.8 or $5.6 - 3.2$.

Question 12

There were many correct constructions but an accurate equilateral triangle without the appropriate construction arcs received no credit.

Question 13

Many candidates gained full marks on the first part, usually by finding 4.8% of $23 500 and adding the result to $23 500, although a few used the multiplier 1.048. The most common error was to find 4.8% of $23 500 ($1128) and give this as the answer.
Although the second part was more demanding, a fair proportion of candidates scored full marks, usually using $\frac{29832-28250}{28250}$ but $\frac{29832}{28250}$ was sometimes the starting point. A substantial number used the final value, 29832, as the divisor, instead of the initial value, as a result of which 5.3 was the most popular wrong answer. Those making this error could still score 2 marks out of 3. Some candidates began a correct method but evidently believed they had finished after only the first stage, leading to answers such as 105.6% and 1.056. Others just found the increase ($1582) and gave this or 15.82 as the answer.

Question 14

This was well answered but a substantial minority of candidates performed only the first stage of the calculation, subtracting 0.6 from 1 but failing to divide the result by 2.

Question 15

In part (a), there were many correct descriptions of the enlargement, although a significant number of candidates either omitted this part or were unable to make a meaningful attempt. The most common errors were to omit the centre of enlargement or to give its coordinates wrongly or as a vector instead of coordinates. Sometimes the scale factor was omitted.

In part (b), there were fewer correct descriptions, the incorrect ones often being rotations or combinations of rotations and reflections. ‘Flip’ and ‘mirrored’ were not accepted.
In both parts, candidates who gave an answer consisting of a combination of two transformations, either explicitly stated or implied, received no credit.

Question 16

Many candidates scored full marks. Of those who did not, some started the calculation correctly with $\frac{280}{4}=70$ but did not complete it. The most common wrong method was to start with $\frac{280}{3}$, which led to answers of $93.\dot{3}$ or $186.\dot{6}$. The answer 840 (280 × 3) appeared occasionally.

Question 17

There was a wide range of answers to part (a). Both parts were quite well answered but some confusion was apparent between the meanings of $\cap$ and $\cup$. The answer $\{5, 13, 25, 33\}$ appeared regularly in both parts. In part (i), some answers, such as $\{1, 9\}$ and $\{9, 17\}$, probably indicated carelessness. In part (ii), no marks were awarded for lists in which one or more of the members 1, 9 or 17 appeared twice.

It was not unusual to see part (b) not attempted but, when it was, candidates often gave a clear explanation, typical acceptable ones being ‘None of the numbers in *A* and *C* are the same.’ and ‘The sets have no members in common.’

Question 18

Many candidates were successful in finding the triangle’s area in the first part, although, predictably, 24 cm^2 (8×3) was the most popular wrong answer. More surprisingly, a significant number of candidates used Pythagoras’ Theorem to calculate the length of the hypotenuse and gave answers such as 8.54 and 73.

Knowledge of trigonometry varied widely. Many candidates successfully used tan to obtain the correct value of x. Some candidates rounded to 1 decimal place incorrectly but those who had previously stated the value of x to a greater degree of accuracy avoided any mark loss for this. It was noticeable how often $\tan x = \frac{3}{8}$ resulted in a wrong value of x, especially 6.5 (using the digits of $\tan \frac{3}{8}$), 6.55 (using the digits of $\frac{\tan 3}{8}$) and 8.9 $\left(\frac{\tan^{-1} 3}{8}\right)$.

Question 19

While many candidates successfully solved the equation in part (a), the question was beyond the algebraic skills of a substantial number. Between these two extremes, some candidates scored 1 mark either for the correct expansion of $7(x - 1)$ or for correct rearrangement following the expansion of $7(x - 1)$ as $7x - 1$. A significant proportion scored 2 marks, progressing as far as $9x = 12$ but then giving $x = \frac{9}{12}$ as the solution. Incorrect rearrangement of the x terms or the constant terms or both was very much in evidence. Solutions expressed as decimals should generally be given to at least two decimal places, but candidates who stated an acceptable answer, such as $x = 1\frac{1}{3}$, $x = \frac{4}{3}$ or $x = \frac{12}{9}$ and then gave their solution as $x = 1.3$ were not penalised.

Although there was a fair proportion of completely correct answers to both parts of part (b), inequalities proved even more demanding than equations for many candidates and it was not unusual for at least one of the two parts not to be attempted. To score full marks in part (i), a candidate’s final answer had to be the inequality $x \leq 4$, not $x = 4$ or 4. Merely solving the equation $4x + 5 = 21$ received no credit, unless $x \leq 4$ was stated on the answer line. Some candidates simplified the inequality to $4x \leq 16$, scoring 1 mark, but went no further. A few gave $n \leq 4$ as the answer to part (ii). Many more, though, appeared to make a fresh start, often using trial methods, and this was probably often to their advantage. A common error was to list 0 in addition to the four correct values but positive integers were specified. Also, 4 was sometimes either omitted from the list or appeared on its own.

Question 20

There was a wide variety of answers but a fair proportion of candidates stated both bounds correctly. If one bound were correct, it was more likely to be the lower bound, typically 57.4 kg and 56.5 kg. Popular wrong pairs had an upper bound of 60 kg and a lower bound of 55 kg or 50 kg.

Question 21

There was a high success rate for this question. A few used end points instead of halfway values and occasionally, there were slips in evaluating products but these incurred only a 1 mark penalty, if all the other steps were performed correctly. Some candidates found the sum of the halfway values or the sum of the frequencies and divided the result by 5, while others gave the modal interval, $60 < p \leq 70$, as their answer.

Paper 2F

Introduction

The paper offered ample opportunity for all candidates to demonstrate positive achievement on a wide range of topics, as well as presenting a few more challenging items to those aspiring to the higher grades available. Much clear working was seen but some candidates struggle to present their answers with sufficient coherence to gain partial credit when the final response is not completely correct.

Report on individual question

Question 1

Few candidates were troubled by ordering the numbers in part (a) or picking out –7 as the lowest value in part (b). Just a few mistakes were made in part (c), some picking only one of the even numbers; others including either an odd number or an even number not in the list; and the odd person listing all of the odd numbers. Nearly all candidates understood what was required for part (d). Numbers other than correct factors were rare, but some candidates omitted 1 or 35 or both.

Question 2

All parts of this pictogram question were answered very well.

Question 3

Candidates were comfortable in dealing with the pictorial representation of fractions. $\frac{3}{8}$ was the most common mistake in (a), and $\frac{5}{3}$ was also seen. A small number of candidates shaded 2 ½ sectors in part (b).

Question 4

There was a wide range of responses to this question on sequences. A substantial number of candidates wrote down the next two terms correctly in part (a). Most of these were able to describe the rule either as doubling the previous term or adding it to itself. Many of the mistakes took the form of treating it as an arithmetic sequence, usually adding 3, 6 or 12. This was then reflected in their description of the rule. Those who resorted to looking at differences tended to get confused, often concluding that the differences went up by 3 each time, making the next term 39.

Part (b) also started well, though 6, 4 was not uncommon, possibly because candidates considered 8 to be the first term. -2 was seen in (ii) for the same reason. This part was usually done by listing the six terms, normally leading to the correct value, but some candidates tried $10 - 6 \times 2$. The final part tended to sift out the stronger candidates. Their most likely mistake was $10 - 100 \times 2$, which gained one mark for the method. Those who were unable to generalise in this way usually attempted to use repeated subtraction, sometimes term by term and sometimes in blocks of ten terms. Mistakes were frequent with this approach.

Question 5

The majority of candidates wrote down a word that was recognisable as isosceles part (a). The most common mistake was to describe the triangle as equilateral. It was good to see that the meaning of the word congruence was well understood, only a few candidates confusing it with similarity by giving the answer **B** and **C** or **C** and **D** in part (b). The word *enlargement*, or a derivative of it, was expected in part (c). Candidates were not penalised if this was accompanied by further detail, usually indicating some form of translation, so many achieved this mark. Answers describing a change of size without using appropriate terminology were not accepted.

Question 6

This question attracted a good batch of clear and accurate answers, but there is still a significant proportion of candidates who have difficulty interpreting the magnitude of probabilities. **A** and **B** were often correct, but they were also seen at just about any positions on the line, including 0. **C** was often placed at 0, or very close to it, or between 0.5 and 1. A generous tolerance was allowed for those who placed it on roughly the correct part of the line. A few candidates failed to label their crosses. They gained no credit.

Question 7

Numerous candidates overlooked the significance of the word *metric* in this question so it was quite common to see *feet* given for the height of the bus in part (a)(i). *Metres* were usually selected by those who did choose a metric unit, but credit was also given to the few who opted for *centimetres*. *Stones* were seen sometimes in part (a)(ii), but *tonnes* or *kilograms* were more common, both gaining a mark. Spelling is not penalised providing the answer is unambiguous, thus some care is needed to distinguish between *ton* and *tonne*. The area in part (a)(iii) caused much more difficulty. Many linear units were given and even a few cubic ones. Some simply stated words such as *length*, *width* or *area*. A mark was awarded for *square metres* and to the few who put *hectares* or *ares*, but not for *square kilometres*. In part (a) numbers were often given with the units. Though many of these were of a completely wrong order of magnitude, candidates were not penalised.

The conversion of squared units in part (b) was one of the least well answered questions on the paper. 520 was very common and 5200 was seen frequently. Some divided 5.2, usually by 10, 100 or 1000. The factor of 10^4 was rarely seen. 5.2 was sometimes squared, leading to an answer of 27.04 or 2704.

Question 8

Many answers were correct in part (a) though $12 - 4 = 8$ was a common mistake. One mark was awarded to those who wrote -16. The most likely mistake in part (b) was $3 - 4 = -1$, but this part was correct more often than part (a).

Question 9

The majority of responses gave an acceptable expression for 3.25 pm using the 24 hour clock, but there was much less clarity with attempts to find the length of the programme. A mark was awarded for trying to find the difference between the times. In many cases working was either not shown or so muddled that this mark was not gained. Perhaps the most common attempt was to use a calculator to subtract $5.10 - 3.25$, giving 1.85, which was normally converted to 2 hours and 25 minutes. $5 - 3 = 2$ and $25 + 10 = 35$, leading to an answer of 2 hours and 35 minutes was common. The most successful approach was to add 35 minutes, to take the time to 4.00 pm, then 1 hour, and finally 10 minutes, but the last 10 minutes was sometimes overlooked.

Question 10

There were plenty of accurate answers to this question, especially to part (c), but there was also a tendency to overcomplicate it, and candidates did not worry about values that were obtuse or even reflex angles. Vertically opposite angles were often overlooked in part (a) and replaced by an incorrect method. $x = y$ was sometimes assumed and used with angles on a straight line to give 75°. Others thought that $x = 180^\circ \div 3$. Incorrect values of x were followed through for full marks when used in part (b), though it was better simply to use the straight line CD. Some tried to use angles around a point, usually losing 30° to give $y = 190^\circ \div 2$. The most likely mistake in part (c) was to assume that $z + 85^\circ = 180^\circ$.

Question 11

Candidates are obviously familiar with pie charts. Faced with the direct question of finding an angle in part (b) when provided with the total frequency and the frequency for a particular sector, many were successful. There were incorrect attempts too, such as $\frac{50 \times 150}{360}$ and $\frac{150 \times 360}{50}$, and some tried to incorporate values from part (a). Candidates were far less happy in part (a) where no total frequency was given. There was confusion between angles and frequencies. Sometimes no attempt was made to measure any angles. It was not uncommon to see the *Walk* sector labelled 28°. Those who did make a meaningful start to the question often struggled to present any organised working. They earned a mark for measuring angles for the two sectors concerned but only the stronger candidates were able to use these to find a correct answer. $60 - 28 = 32$ followed by $90 - 32 = 58$ was often seen, as was $2 \times 28 = 56$. There were some rather creative attempts to match angles with frequencies, such as
$28 \times 2 + 4 = 60$ so $\frac{90-4}{2} = 43$. $\frac{90 \times 28}{60}$ showed greater understanding than some other attempts, though the answer of 193° should have provided a warning of the mistake.

Question 12

Part (a) was answered well. A few candidates calculated $0.10 \times (580 + 4)$. Most candidates realised that something different was needed in part (b), often trying to start by substituting numbers and rearranging the equation in the same first step. This inevitably caused mistakes, most commonly
$78.60 \div 0.10 - 4 = 782$ and $78.60 - 4 \div 0.10 = 38.6$. Some avoided a formal approach and resorted to trial and improvement.

Question 13

The ratio in part (a) was often simplified correctly. Occasionally it was given as 7.5 : 12.5 or expressed as a fraction or decimal value, none of which gained the mark. Candidates also responded well to part (b). Some gave $\frac{15}{40}$ without simplifying and a few wrote $\frac{3}{5}$ or $\frac{5}{8}$.

Question 14

It is worth stressing that the instruction for this question requires *sufficient working* to be shown. Answers achieved by trial and improvement or without any formal method may be awarded no marks. It is encouraging to report that very few candidates lost marks in this way.

Most candidates scored a mark for part (a), just a few writing $v = 18 - 3$. Part (b) was also quite successful, $8w = 10$ and $w - 7 = 9$ being the most frequent mistakes. Responses to part (c) were more mixed. Many candidates failed to collect the terms correctly, giving equations such as $8x = -6$ or
$8x = 20$, and some lost the equal sign completely. Those who did arrive correctly at $4x = -6$ sometimes gave $x = -\frac{4}{6}$. There were plenty of correct answers to part (d). The most common mistake was $y - 2 = 20$ and a few went from $\frac{y}{5} = 6$ to $y = 1.2$.

Question 15

The accuracy of measurements in this question was good but candidates were unsure of the angle they needed to measure and many were confused between acute and obtuse angles. There were many incorrect answers to both parts. 70^{o}, 110^{o} and $360^{o} - 70^{o} = 290^{o}$ were all common in part (a). Only a minority of candidates managed to show *C* in an appropriate position and indicate the bearing required in part (b). Most who got this far gave a correct answer. $360^{o} - 125^{o} = 235^{o}$ was by far the most frequent responses from others. 125^{o} and $180^{o} - 125^{o} = 55^{o}$ were also common.

Question 16

Candidates who understood the frequency table were usually successful in finding the median correctly, though a few thought that the midpoint between 6 and 6 was 6.5, and some others presented a calculation for the mean. They tended to list all 20 values rather than work from the table. The meaning of the table confused many, however, leading to a wide range of incorrect answers. Some ignored the frequencies, giving 7 either as the middle value or the mean of the shoe sizes. Others looked only at the frequencies, giving either 5 as the middle value on the table, or 3 after reordering. Some considered the table as ten separate data values, giving the median as 5.5.

Part (b) defeated the majority of candidates on this paper. Answers needed to establish that the addition rule is only valid for mutually exclusive events, though it was not necessary to use this terminology. An answer of *yes, providing no person has both* or *no, because a person might have both*, would each have scored full marks, for example. More commonly, candidates said *yes, because the fractions add up* or they justified where the fractions had come from. Such responses were awarded no marks. Others said it was working out the probability of *both* and some said that the probabilities should be multiplied.

Question 17

Many candidates benefited from showing a clear substitution in part (a). Those who wrote $3 - 5 \times -2 = -2 \times -2 = 4$, gained one method mark, for instance; those who wrote 4 with no working gained no mark. $3 - 10 = -7$ was quite common and a number of candidates gave the answer -13. Some lost the multiplication altogether, managing to make $3 - 5 - 2 = -4$ or 0. A reasonable number of candidates did achieve the correct answer.

The expansion in part (b) was usually correct, with occasional answers such as $10y$, $-10y$ and $y^5 - 10$. There were also plenty of correct factorisations in part (c). Mistakes were usually of the form $5w^2$, $6w^2$, $7w$ or $5w^3$.

Question 18

Most candidates realised that 30×0.2 was required in part (a), though both $30 \div 0.2$ and $0.2 \div 30$ were seen. Some went on to give their answer as $\frac{6}{30}$, losing their accuracy mark. The pattern was similar in part (b). A few answers of 0.2 were seen, but most achieved 0.3. Some then lost the final mark by multiplying by 30 to give an answer of 9.

Question 19

This question required candidates to demonstrate an understanding of the procedure for adding fractions. Showing the addition $\frac{8}{12} + \frac{3}{12}$ provided sufficient evidence. Many candidates did present a formal addition to earn their marks; others tried to argue the case in a less organised way without ever showing the fractions with a common denominator. Marks were awarded in the more convincing cases. Attempts to show the result by using decimal approximations were not rewarded.

Question 20

Many candidates understood the laws of indices and quickly achieved correct answers to parts (a) and (b). Some attempted to do these questions by expanding the indices, but they were invariably unsuccessful. Common mistakes were 9^{14} and 3^{48} in (a) and $7^{2.5}$, 1^7 and 7^7 in (b). Part (c) was far more challenging. Trial and improvement was often seen and this was sometimes successful. Few were able to rearrange the equation correctly, showing steps such as $5^n = \frac{5^2 \times 5^3}{5^7}$ and
$5^n \times 5^3 = 5^{14}$.

Question 21

There was some confusion between surface area and volume, so $3 \times 4 \times 15$ and $\frac{1}{2} \times 3 \times 4 \times 15$ were regular answers. A few candidates just multiplied all of the four dimensions together and some added dimensions to give a full or partial sum of the lengths of the edges. The area of the triangle was sometimes given as 3×4. Many thought that the three rectangular faces were all the same; others included only one rectangle. In both cases, 5×15 was usually the face identified. Working was muddled amongst those who had difficulty visualising the areas required, but there were also many answers which were accurate and clearly presented.

Question 22

There was a requirement to show *sufficient working* in this question. No marks were awarded for answers given without any working, or for those obtained by trial and improvement. Surprisingly few candidates simply added the equations. Those who did normally achieved full marks, but some failed to find a correct y value after obtaining $x = 1.5$, often losing a negative sign. Other attempts to add or subtract the equations led to $-2x = -4$ or $2y = -4$. Those who tried to manipulate the equations before combining them usually made mistakes or simply failed to eliminate one of the variables at all.

Question 23

Most candidates recognised that N was the midpoint of AB, correctly giving the length of AN. A few measured the lengths of AN and ON, ignoring the statement that the diagram was not drawn accurately. Some thought that $ON = \frac{1}{2} \times 5$. Attempts to find ON using trigonometry were rarely successful. Those who used Pythagoras' Theorem in part (b) achieved a good success rate, but some left the answer as 1.96, or even squared this value. $ON^2 = 5^2 + 4.8^2$ occurred periodically.

Paper 3H

Introduction

The standard of this paper proved to be appropriate and gave almost 24,000 candidates the opportunity to demonstrate positive achievement, many achieving high marks. For the ablest candidates, at least one of the final four questions usually provided a challenge and it is pleasing to report that many responded with solutions which were not only correct but also mathematically elegant. The majority of candidates showed their working clearly and presented their working neatly.

Report on Individual Questions

Question 1

This proved to be a straightforward start to the paper for the vast majority of candidates. Of the few who failed to obtain the correct answer, most scored 1 mark for evaluating accurately either 3.6×4.8 or $5.6 - 3.2$. Answers of 14.88 ($17.28 - 2.4$) and $-0.114...$ $\left(\frac{3.6 \times 4.8}{5.6} - 3.2\right)$ appeared occasionally.

Question 2

Errors were rare, although a small minority of candidates performed only the first stage of the calculation, subtracting 0.6 from 1 but failing to divide the result by 2.

Question 3

In part (a), there were many correct descriptions of the enlargement. The most common errors were to omit the centre of enlargement or to give its coordinates wrongly, usually as either (3, 4) or
(5, 5), instead of (1, 3), or to give it as a vector instead of coordinates.

In part (b), many candidates realised that the transformation was a reflection, although ‘rotation’ appeared sometimes. ‘Flip’ and ‘mirrored’ were not accepted. Usually, the mirror line was defined by its equation but unambiguous descriptions, such as ‘the line from (2, 2) to (5, 5), were also accepted.

In both parts, candidates who gave an answer consisting of a combination of two transformations, either explicitly stated or implied, received no credit. So, for example, translation $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ with a description of the enlargement scored no marks.

Question 4

The majority of candidates scored full marks. Of the minority who did not, some started the calculation correctly with $\frac{280}{4} = 70$ but did not complete it. The rest usually gave answers of either 840 (280×3) or 93.3 $\left(\frac{280}{3}\right)$.

Question 5

Part (a) caused few problems. The only errors which appeared with any regularity were confusion between intersection and union and, to a much lesser extent, {5, 13, 25, 33} given as the answer to part (a)(ii).

In part (b), many candidates gave a clear explanation, typical acceptable ones being 'None of the numbers in *A* and *C* are the same.' and 'No members in *A* are also in *C*.'

Question 6

This question was very well answered, most of the successful candidates efficiently using tan to obtain the correct value of x. Some candidates rounded to 1 decimal place incorrectly but those who had previously stated the value of x to a greater degree of accuracy avoided any mark loss for this. Inefficient methods, if mathematically correct, were, of course, not penalised but, in these cases, premature approximation often led to the loss of the final accuracy mark. $\text{Sin}x = \frac{3}{8}$ appeared often enough to be noticed and received no marks.

Question 7

Most candidates succeeded in finding the circumference, some using $C = \pi d$ while others preferred to find the radius first and then use $C = 2\pi r$, which appears on the formula sheet. Those who confused these two formulae obtained the most popular wrong answer, 47.8, using $C = 2\pi d$ and a small minority found the area.

Question 8

The formula in the first part was almost always correct, usually in the form $n = 2p + 1$, but, of course, any equivalent formula was accepted. $p = 2n + 1$ and $p = \frac{n}{2} - 1$ were regular wrong answers.

Although still well answered, changing the subject of the formula in the second part proved considerably more demanding. $\frac{n}{2} = p + 1$ was a frequent wrong starting point, and $p = n - \frac{1}{2}$ probably the most common wrong answer.

Question 9

Many candidates solved the equation successfully in part (a). Of the rest, some progressed as far as $9x = 12$ but then gave $x = \frac{9}{12}$ as the solution, probably the most common single error, and a few expanded $7(x - 1)$ as $7x - 1$. Solutions expressed as decimals should generally be given to at least two decimal places, but candidates who stated an acceptable answer, such as $x = 1\frac{1}{3}$, $x = \frac{4}{3}$ or $x = \frac{12}{9}$ and then gave their solution as $x = 1.3$ were not penalised.

Part (b) was also well answered. To score full marks in part (i), a candidate's final answer had to be the inequality $x \leq 4$, not $x = 4$ or 4. In part (ii), the most common error was to list 0 in addition to the four correct values though positive integers were specified in the question.

Question 10

A high proportion of candidates scored full marks in the first part, using either $\frac{29832 - 28250}{28250}$ or $\frac{29832}{28250}$. A substantial minority, however, used the final value, 29832, as the divisor, instead of the initial value, as a result of which 5.3 was the most popular wrong answer. Those making this error could still score 2 marks out of 3. Some candidates began a correct method but evidently believed they had finished after only the first stage, answers such as 105.6% and 1.056 appearing regularly. Answers of 17.9% $\left(\frac{28250}{1582}\right)$ appeared occasionally.

Many candidates gained full marks in the second part but it proved quite demanding. Predictably, the most popular wrong answer was \$26 677.67, obtained either by finding 5.2% of \$28 141 and subtracting the result from \$28 141 or by finding 94.8% of \$28 141. A few candidates took only the first step down this wrong road, finding 5.2% of \$28 141 and giving \$1463.33 as their answer.

Question 11

The vast majority of candidates gave the correct modal class in part (a), the only incorrect answer which appeared with any regularity being $70 < p \leq 80$, the middle interval.

In part (b), most candidates successfully found an estimate for the mean. A few used end points instead of halfway values or divided the correct sum of the products (4350) by 5, although the resulting pulse rate of 870 beats/min should perhaps have struck them as surprisingly high. Occasionally, there were slips in evaluating products but these incurred only a 1 mark penalty, if all the other steps were performed correctly. Some candidates added the halfway values of the class intervals and divided the result by 5.

In parts (c) and (d), most candidates used the cumulative graph accurately. A minority made errors in reading values from the graph; those who indicated their methods with appropriate lines on the graph minimised their mark loss for this. Some candidates failed to subtract their cumulative frequency reading from 60 in part (d) but, overall, the success rate was high. Occasionally, the median was given as 115 (midway between 90 and 140).

Question 12

This question proved quite demanding but still had a pleasing success rate. The best method was to use the fact that all circles are similar. Squaring the scale factor ($3^2 = 9$) and multiplying 4 by 9 then led directly to the answer. Many used this approach. The alternative route, much more hazardous, was to find the radius of **S**, multiply it by 3 and substitute the resulting value of r into $A = \pi r^2$. There were many fallers at the first of these hurdles and a surprising number could not safely negotiate the final one. Candidates who used the alternative approach could gain full marks and many did but only if they avoided the pitfall of premature approximation. The most common example of this was the use of $r = 3.39$ to obtain an answer of 36.1 cm^2, which scored 1 mark out of 2. For the rest, the most popular answer was 12 cm^2 (4×3).

Question 13

Many candidates obtained the answer $n = 12$ by a correct method, firstly finding the interior or exterior angle of the hexagon, then doing the same for the n-sided polygon and finally using either the angle sum of the external angles or constructing an equation for n involving 150°, the size of the interior angle of the n-sided polygon. A substantial minority obtained the answer $n = 12$ but either showed no working or showed working which was inadequate or incorrect and clearly contrived to obtain the desired result. It was, for example, not unusual for candidates to confuse the interior and exterior angles of a hexagon but still go on to obtain $n = 12$. Such responses received no credit. For example, the correct answer accompanied only by a sketch or working such as $\frac{6 \times 4}{2} = 12$ scored no marks. The only incorrect answer which appeared with any regularity was
$n = 10$.

Question 14

In the first part, most candidates factorised $10y - 15$ correctly as $5(2y - 3)$. The only other answers which appeared to a noticeable extent were $10(y - 1.5)$ and $2y - 3$, neither of which received any credit.

The majority succeeded in completely factorising $9p^2q + 12pq^2$ in the second part. Sometimes the factorisation was correct but incomplete, especially $pq(9p + 12q)$, and $21p^3q^3$ appeared occasionally as the answer, presumably an attempt at simplification.

In the third part, of the large number of candidates who factorised the quadratic expression correctly in part (i), most then used their factors to solve the quadratic equation in part (ii). Some, however, used the formula to solve the quadratic equation, often successfully but not always. Others wrote only the positive solution $x = 2$ on the answer line but, if the solution $x = -8$ appeared in their working, this omission was not penalised.

Question 15

In part (a), errors were rare with the lower bound but slightly more frequent with the upper bound, both 57.4 kg and 57.49 kg appearing quite regularly. Although part (b) was well answered, wrong answers were more likely. The main ones were 5 kg (62.5 – 57.5), where two upper bounds were used, and 5.5 kg [(62 − 57) + 0.5], where, in effect, the upper bound of 5 kg was found. Answers of 4 kg (61.5 − 57.5) also appeared occasionally. The use of the recurring decimal $62.4\dot{9}$ as the upper bound for 62 often led to arithmetical errors.

Question 16

Probability was well understood and there were many completely correct solutions. Part (a) had a significantly higher success rate than part (b), in which the most common error, made by a substantial number of candidates, was to consider only two combinations instead of the necessary four. Although most candidates worked in fractions, some used decimals, which were accepted, provided at least 2 decimals places were shown. A minority did not take into account "and replaces the card", either because they misread the question or because they did not appreciate the significance of the phrase, and answered the question as if there were no replacement. Those who did this consistently could score a maximum of 2 marks of the 5 available.

Question 17

While many candidates scored full marks, knowledge of proportionality varied widely. For those who obtained the correct equation in part (a), the most likely subsequent error was in part (c), where $\sqrt{h} = \frac{61.2}{3.6} = 17$ was sometimes solved as $h = \sqrt{17}$. In part (a), an equation of $d = k\sqrt{h}$ on its own gained only 1 mark out of 3 but, if *k* were evaluated correctly as 3.6 in the second or third parts, 3 marks were awarded in part (a). It was not unusual for direct proportionality or proportionality to h^2 to be used. These were regarded as mathematical misunderstanding, rather than misreading, and received no credit. $d = \sqrt{h}$ was a regular starting point and, occasionally, $d = k + \sqrt{h}$; these also gained no marks.

Question 18

A high proportion of candidates realised that the Sine Rule was required and the majority applied it successfully. Of those who were unsuccessful in its application, the most likely cause was an incorrect rearrangement of $\frac{a}{\sin 35°} = \frac{6.8}{\sin 64°}$ to $a = \frac{6.8 \sin 64°}{\sin 35°}$. There were, however, several other possible causes. For example, some just evaluated $\frac{6.8}{\sin 64°}$ (7.57) and gave this as their answer, while others had their calculators set in the wrong mode. A minority treated the triangle as if it were right-angled and tried to use basic trigonometry.

Question 19

There were many clear, complete proofs, which usually involved rationalising and expressing $\sqrt{8}$ as $2\sqrt{2}$. Some candidates, however, successfully used other approaches, displaying considerable ingenuity and skill in the manipulation of surds. In questions like this, when a result is given, the onus is on candidates to show the marker every necessary step in the working and it is better for them to err on the side of showing too much working, rather than too little. A common error was to assume that the given result was true and then to cross multiply and simplify to get, for example

12 = 12 or 18 = 18. Such methods scored 1 mark out of 2. The numerical evaluation of the given expressions, however, received no credit.

Question 20

In the first part, the size of the angle was usually correct, although 62° (180 − 118) appeared occasionally. The expected reason was either ‘Angle at the centre is twice the angle at the circumference.’ or ‘Angle at the circumference is half the angle at the centre.’ Many candidates gave one of these but other answers were marked with some tolerance, if they clearly showed that the candidate understood the principle involved and were phrased in general terms. So, for example, ‘Angle in the middle is twice the angle at the edge.’ was accepted but ‘Angle *POQ* = 2 × angle *PRQ*’ was not.

In the second part, the safest initial equation was $\frac{1}{2}x + x + 36 = 180$, most candidates who started with this coping with the fractional coefficient and scoring full marks. Those starting with $180 - (x + 36) = \frac{1}{2}x$ or $x = 2(180 - (x + 36))$ were in greater peril and it was not unusual to see 180 − (x + 36) simplified as 180 − x + 36. Candidates who made this error could still gain 3 marks out of 5 if they continued correctly. Occasionally, candidates confused the angle at the centre and the angle at the circumference and started with equations such as $(180 - (x + 36)) = 2x$.

Question 21

This proved to be a demanding question. A substantial number of candidates did not appreciate what was required and omitted some or all of the parts. From those who attempted the question, the quality of answers varied widely.
In part (a), those who realised that a tangent was required usually drew it accurately and many then 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. Even if a tangent were not drawn, some credit was given for an attempt to find the gradient of the line joining two points on the curve with x coordinates between 2.5 and 3.5. Many candidates used the coordinates (3, 6.5) in some way and gave answers such as 6.5 and $2.1\dot{6}\left(\frac{6.5}{3}\right)$.
In part (b), many candidates successfully used the graph to solve the equation f(x) = 0. The most popular wrong answers were 0 and 16 [f(0)].

In part (c), it was anticipated that candidates would draw the line through the points (−1, 11) and (1, 13), find c as its intercept on the y-axis and then produce the line to find the third solution. A high proportion of those who made a realistic attempt at part (c)(i) used this method but others obtained the correct answer by finding either the midpoint of the line joining the two points or the equation of the line passing through them.16 [f(0)] appeared frequently as the answer to part (i) and 0 was a regular answer to both parts.

Question 22

Many candidates produced completely correct solutions and few failed to score, even if it was only 1 mark for finding the area of triangle *BCD*. A very wide range of methods was employed; the most popular ones involved calculating the length of *BD* or $\frac{BD}{2}$ and the perpendicular distance from *A* onto the line *BD*. The quality of these methods ranged from the elegant and concise, sometimes with impressive manipulation of surds, to the untidy and incomprehensible. Candidates who showed their working clearly on this question gave themselves the best possible chance of receiving credit from the examiner. The loss of marks through premature approximation was not uncommon and 10 cm was occasionally used as the perpendicular height of triangle *ABD*.

Paper 4H

Introduction

There were a few questions, such as the tree diagram, that provided marks for nearly all candidates, and a few where only those at the top end of the ability range scored full marks. Some were frustrated by Q22, for instance, because they were unable to find an obtuse angle to satisfy the question. Most questions attracted a wide range of responses, according to the strengths and weaknesses of individual candidates. Many answers were clearly presented, making good use of mathematical notation. It was encouraging to see that relatively few candidates offered answers without some appropriate working to support them.

Report on individual question

Question 1

The linear equation in part (a) was solved well. A few obtained $4x = -6$ correctly and then went on to give $x = -\frac{4}{6}$. Some lost the sign in the final answer. $2x - 6x = 7 - 13$ was one of the more frequent mistakes, and some candidates miscalculated $7 - 13$. *Sufficient working* was required in this question, so those who found a root by trial and improvement or who wrote down an answer without working were awarded no marks. Solutions to part (b) were also good. There were a few cases where $\frac{y}{5} = 6$ was followed by $5y = 6$, but the most common mistake was $y - 2 = 20$.

Question 2

The accuracy of measurements in this question was good but some candidates were unsure of the angle they needed to measure and there was confusion between acute and obtuse angles. 70°, 110° and $360^\circ - 70^\circ = 290^\circ$ were all common in part (a); correct values were also frequent. The point *C* was usually marked in an appropriate position on the diagram but the angle required for the bearing in part (b) was not always identified correctly. Indeed, many answers were less than 270°. A frequent response was 235° ($360^\circ - 125^\circ$ or $180^\circ + 55^\circ$) and $180^\circ - 125^\circ = 55^\circ$ was also quite common.

Question 3

A significant minority of candidates gave a concise solution in part (a), sometimes adding a cumulative frequency column to the table. Others arrived at the correct median by listing all 20 numbers. There was rarely any evidence of confusion with the mode, but numerous calculations to find the mean were seen. 7 was a common wrong value, obtained by ignoring the frequencies and then finding either the mean or median of the shoe sizes.

Part (b) defeated many candidates. Answers needed to establish that the addition rule is only valid for mutually exclusive events, though it was not necessary to use this terminology. An answer of *yes, providing no person has both* or *no, because a person might have both*, would each have scored full marks, for example. More commonly, candidates said *yes, because the fractions added up correctly* or they justified where the fractions had come from. Such responses were awarded no marks. Others said it was working out the probability of *both* and some said that the probabilities should be multiplied. There was also a tendency to mix several ideas, such as *both can not happen because they are independent.*

Question 4

The whole of this question was answered correctly by most candidates. 3 – 10 = –7 was the most common mistake in part (a), but most of those who wrote this collected a method mark by first showing the substitution correctly. Errors were rare in part (b) and there were just occasional misconceptions in part (c), usually where single terms like $5w^3$ or $5w^2$ were given as the answer.

Question 5

Most candidates realised that 30 × 0.2 was required in part (a), though some went on to lose their accuracy mark by giving their answer as $\frac{6}{30}$. The pattern was similar in part (b). A few answers of

0.1 × 0.2 were seen, but most achieved 0.3. Some then lost the final mark by multiplying by 30 to give an answer of 9 or by writing the answer as $\frac{0.3}{30}$.

Question 6

This question required candidates to demonstrate an understanding of the procedure for adding fractions. Showing the addition $\frac{8}{12}+\frac{3}{12}$ provided sufficient evidence. Many candidates did present a formal addition to earn their marks; others tried to argue the case in a less organised way without ever showing the fractions with a common denominator. Marks were awarded in the more convincing cases. Attempts to show the result by using decimal approximations were not rewarded.

Question 7

Nearly all candidates understood the laws of indices and quickly achieved correct answers to parts (a) and (b). There were also some good answers to part (c) but a significant number of candidates made errors with the indices as they tried to rearrange the equation. $5^n \times 5^4 = 5^2$ was sometimes seen, and $5^7 \times 5^2$ was occasionally simplified to 5^{14}. A few of those who obtained $5^n = 5^6$ argued that $n = \frac{5^6}{5^1} = 5^5$ and other just left the answer as 5^6. Trial and improvement was sometimes seen, as were attempts to achieve a result from $\frac{5^n \times 125}{78125} = 25$. The most concise answers used laws of indices immediately to give $n + 3 - 7 = 2$, from which the answer followed without difficulty.

Part (d) was straightforward for those who understood the relationship between prime factors and the highest common factor for two numbers. Many were able to write down a correct answer without any further working, either as $2^3 \times 3$ or 24. Some selected the lowest power of 2 or 3, giving either 8 or 3 as their answer, and others added $2^3 + 3$. There were those who opted for the lowest common multiple, and a significant number who fell somewhere between the HCF and LCM with values such as $2^8 \times 3^5$, $2^5 \times 3^4$, and $2 \times 3 \times 5 \times 7$. Those who felt that it was necessary to evaluate *A* and *B* first inevitably got nowhere.

Question 8

Many candidates were able to see exactly which areas they were trying to find and they had no problems in completing the calculations correctly. Common mistakes were 3×4 for the area of the triangle, missing out one or two of the rectangular faces, and assuming that all three rectangular faces were the same, usually 5×15. There was some confusion between surface area and volume, so $3 \times 4 \times 15$ and $\frac{1}{2} \times 3 \times 4 \times 15$ were seen sometimes. The better solutions were set out systematically so that it could be seen which areas the calculations referred to.

Question 9

It was good to see that nearly every candidate observed the requirement to show *sufficient working* in this question. Indeed, many solutions were presented very clearly. No marks were awarded for answers given without any working, or for those obtained by trial and improvement. The majority of solutions took the obvious step of adding the equations to obtain $8x = 12$, from which the correct roots were usually found. Just a few thought that it was necessary to subtract the equations, usually giving $2x = 4$. Mistakes were more frequent when the equations were manipulated to eliminate x or when substitutions were used. $2y = 4$, $2y = -4$ and $2y = 44$ were typical wrong lines of working.

Question 10

Most candidates recognised that N was the midpoint of AB, correctly giving the length of AN as 4.8, though 5 was also seen occasionally in part (a). Pythagoras' theorem was usually identified as the most appropriate approach to part (b). There were those who started with $ON^2 = 5^2 + 4.8^2$, but the majority began with a correct statement and they usually achieved the answer of 1.4cm. Just a few forgot the final square root.

Question 11

This turned out to be a neat way of examining decimal places and significant figures, requiring a little more thought than the traditional instruction to round a single number. The most systematic approach was to add two columns to the table, rounding to 1 decimal place in one column and to 3 significant figures in the other. Those who did this normally rounded accurately and achieved a correct answer. Less organised approaches tended to give rise to more mistakes, but most candidates who failed to give the correct pair managed to rescue one mark by finding a pair of numbers that were equal to 1 decimal place. Just occasionally 123.47 and 123.43 were given, possibly making the mistake of looking for numbers that were equal to 3 significant figures but different to 1 decimal place.

Question 12

The majority of candidates were happy simply to write down 63, the required value for *x*. There were isolated cases of 20, and even fewer of 97. The most common mistake in part (a), which appeared with surprising regularity, was to scale the angle, usually giving $\frac{5}{8} \times 63 = 39$. Both parts (b) and (c) were answered well, usually using the scale factor of 1.6 or $\frac{5}{8}$. In a few cases the scale factor was applied incorrectly, leading to calculations such as $y = 4 \times 1.6 = 6.4$. Some preferred to compare sides of the same triangle, neatly arguing that $4 = 8 \times ½$ so $y = 5 \times ½$. Those who did not understand the theory of similar triangles tried looking at differences, $8 – 5 = 3$ so $y = 4 – 3 = 1$ and $z = 6 + 3$, for instance. The few attempts to find values for *y* and *z* using trigonometry were awarded full marks provided that the method was carried through completely and correctly.

Question 13

Tree diagrams were nearly always completed correctly. Labels were occasionally omitted and there were just isolated cases of incorrect probabilities being marked on the branches. A small number of candidates added the probabilities on the branches, giving $\frac{1}{3} + \frac{1}{3}$ for the probability of 2 goals, for instance, but nearly all understood that multiplication was required. Many were able to select the correct outcomes and sum their probabilities to give the answer of $\frac{5}{9}$ in part (b), but it was not unusual to see $\frac{4}{9}$ given as the probability of *exactly* one goal.

Question 14

Most answers for the gradient of the line were given either correctly as $\frac{2}{4}$ or incorrectly as $\frac{4}{2}$. No further penalty was imposed if the wrong gradient was then used appropriately to find the equation of the line. Candidates were generally familiar with the format $y = mx + c$ for the equation of a straight line and successful answers were common. Inadequate notation was the cause of a lost mark on some scripts, when the equation of the line was given as $½ x + 1$ or $L = ½ x + 1$.

The link between the equation in part (a) and one of the inequalities in part (b) was usually recognised and a good number of candidates used their answer correctly. Many also gave $x \le 4$ and $y \ge –1$ correctly. Typical mistakes were to put some or all of the inequalities the wrong way round or to mix up *x* and *y*, giving answers such as $y \le 4$ and $x \le ½ x + 1$. A few candidates even missed out the variables completely, making statements like ≤ 4.

Question 15

A small minority of candidates did not manage to make a meaningful start to the question. Some of these treated *ABC* as a right-angled triangle and others thought that there was a way forward using the sine rule. Most identified the need to use the cosine rule, sometimes after experimenting with other approaches, and they usually substituted values to give a correct expression for AC^2, gaining the first mark. Many went on to complete the question correctly, normally maintaining sufficient accuracy to achieve an answer correct to 3 significant figures, but a significant number made the mistake of calculating $3.1^2 + 3.9^2 - 2 \times 3.1 \times 3.9$ before multiplying by cos 80^o.

Question 16

Some candidates thought that they could solve the equation by factorisation but most moved immediately to using the quadratic formula. Some lost negative signs in the initial substitution and a few others only divided the square root term by 2, but most managed to get started correctly. -5^2 was sometimes evaluated as –25 which obviously caused a problem with the square root of the discriminant. Those who got as far as $x = \frac{5 \pm \sqrt{13}}{2}$ usually evaluated the roots correctly, but it was not unusual for the smaller root to be given as 0.70, failing to achieve the 3 significant figure accuracy required. It is a good policy to write down answers to a greater accuracy than that required before rounding them for the final answer. Answers to this question that were not supported by sufficient working or that were obtained by trial and improvement were awarded no marks. Such cases were very rare.

The most common answer to part (b) was $y < 3$, which gained one mark. A few wrote $y > 3$, $y = 3$ or just 3. Those who realised that –3 was also involved could not always write down the required interval correctly, giving answers such as $y < \pm 3$. Some of the stronger candidates found a sketch graph helped them to identify the correct interval.

Question 17

Many candidates did not have a sufficient understanding of histograms to enable them to tackle this question effectively. They used heights or widths, but not areas. Typical answers to part (a) were $\frac{2}{8} = 25\%$, using widths and $\frac{4}{2+4+3+2+1} = 33\%$ using heights., though there were also other responses that were less easy to interpret. The same candidates were likely to give the median as 9 ÷2 or 10 ÷2 in part (b). Those who knew that frequency was represented by area made good progress. There was no frequency density scale so the total frequency was not defined. A few candidates marked the scale in multiples of x in order to calculate the areas, but most just took the heights as 1cm to 1 unit. Any consistent scale was accepted. The majority of correct answers to part (a) came from using 8 for the frequency of the group 2 – 4 and 20 for the total frequency. In part (b) the median caused some difficulty even to those who used areas. There were some very neat arguments from the candidates who understood that the median divided the total area in half. Putting the 7 – 9 block on top of the 4 – 6 block gave a shape with $x = 4$ as the line of symmetry, for instance. Some flexibility was allowed with the detail of the method used provided that the general principle was correct, but a value of 4 obtained from an incorrect method received no marks.

Question 18

The intersecting chords theorem was not well known. Those who were able to state it obtained a correct answer very quickly. Many others succeeded by working with similar triangles. Typical mistakes were $4(4 + x) = 3(3 + 14)$, $\frac{4}{x} = \frac{3}{14}$ and $\frac{x}{3} = \frac{4}{14}$. Some candidates assumed that AC = BD, stating that $x = 17 – 4 = 13$.

Question 19

Nearly all candidates were happy to have a go at differentiating s and most were able to give a correct derivative or one that was partially correct. This expression was not always identified as being the velocity required in part (b), so it was not unusual to see 5 substituted into s rather than v. Some of those who did find the value of v when $t = 5$ went on to divide by 5 to give the answer of 0.8. This received no marks. A substantial minority understood that they needed to differentiate their answer to part (a) in order to find the acceleration and they had no difficulty in finding the value 2. Others put $t = 5$ into their answer from part (a) and some conjured the value 2 by finding the value of s when $t = 4$. Values from part (b) were also used incorrectly to find $\frac{v}{t} = \frac{4}{5}$ as the acceleration.

Question 20

Answers to part (a) were generally good though responses like 45×10^{12}, 45×10^{24} and 14×10^{24} were not uncommon. It was pleasing to observe that answers of the form 1.4e13 from a calculator display were rare. Part (b) was more demanding. Candidates may have found the mixture of notation intimidating. Some tried experimenting with numbers but relatively few were able to make an organised attempt at solving the question. n was frequently given as 15, possibly accompanied by $r = p + q$, which directly contradicts the conditions given for p, q and r. Another common mistake was $n = 31$.

Question 21

A substantial number of candidates found this question quite straightforward, stating correct answers and using good notation. Others were less confident with the use of vectors, not always understanding that equal vectors must have the same direction as well as the same length. Part (a)(i) was normally answered correctly. More mistakes arose in part (a)(ii) where it was not unusual to see **b** featuring in the answer even though the vector was parallel to **a**. A wrong answer for part (a)(ii) was usually followed by another wrong answer in part (a)(iii). It might have helped candidates to mark $\overrightarrow{OP}$ as **a** and $\overrightarrow{TO}$ as **b** on the diagram. Success in part (b) was often unrelated to the accuracy of answers in part (a). For some candidates it was the only part they got right, and for others it was the only part they got wrong. Those who understood that they were simply looking at the lengths of lines were usually able to write down the correct answer. Others complicated the issue by trying to find a vector expression for $\overrightarrow{UR}$. This was often done correctly but the modulus of **b** – **a** + **b** – **a** was then frequently given as 2.5 + 2.5 + 2.5 + 2.5 = 10, or sometimes as 2.5 – 2.5 + 2.5 – 2.5 = 0. Some simply left 2**b** – 2**a** as the answer.

Question 22

Various attempts were made to use the cosine rule or trigonometry based on a right-angled triangle, but the great majority of candidates made use of the formula *area* = ½ *ab* sin *c*. This was applied correctly in most cases and many candidates obtained an angle of 30^o. Some accepted this as their answer; others did try to find an obtuse angle. The more able candidates succeeded, often by sketching a sine graph. 120^o was a common wrong answer. A few candidates clearly spent much time trying to find an obtuse angle, even suggesting that the question was wrong because they were sure that 30^o was correct.

Question 23

Candidates who were less secure in their algebraic skills tended to start by cancelling x^2 to give $\frac{-9}{3x}$. Most did appreciate the need to factorise, however, and many were able to do so correctly and achieve the simplified expression required in part (a). Only the most able candidates went on to score full marks in part (b). A reasonable number of others scored 1 mark for using their answer to part (a) to write down an expression for fg(x) without being able to simplify it. Mistakes included cancelling $\frac{1}{x^2}$ to give an answer of –3, writing fg(x) = f(x) x g(x) = $\frac{x-3}{x} \times \frac{1}{x^2}$ and using an expression for gf(x) instead.

Statistics

Overall Subject Grade Boundaries

Foundation Tier

Grade	Max. Mark	C	D	E	F	G	U
Overall subject grade boundaries	100	71	56	41	27	13	0

Higher Tier

Grade	Max. Mark	A*	A	B	C	D	E
Overall subject grade boundaries	100	83	64	45	27	14	7

Grade		Max. Mark	A*	A	B	C	D	E	F	G	U
Overall subject grade boundaries	**Paper 1F**	100				72	57	42	28	14	0
	Paper 2F	100				69	54	40	26	12	0
	Paper 3H	100	81	63	45	27	14	7			
	Paper 4H	100	83	64	45	27	14	7			

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