CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/11
Non-calculator (Core)

Key messages

To succeed with this paper, candidates must

- have completed the full Core syllabus
- read the questions carefully, focussing on instructions and key words
- be confident with a variety of non-calculator strategies
- need to check that their answers are accurate, are in the correct form and make sense in the context.

General comments

Key formulae are provided but some candidates did not use these. Candidates need to learn other formulae, such as $speed = \frac{distance}{time}$ (**Question 7**).

Candidates need to read the questions carefully, noting the command words and any key information.

Calculators are not permitted on this paper, so candidates need to be familiar with a range of non-calculator methods and strategies, including when working with decimal values (**Question 1c**, **Question 7**). Candidates who used efficient non-calculator methods were more likely to reach the correct answers than those who used longer methods.

Comments on specific questions

Question 1

(a) Most candidates gave the correct answer. The most common error was to work left to right, evaluating 10 – 2 and then multiplying the answer by 3**.**

(b) Most candidates made some progress here, with many reaching the correct answer or gaining a mark for 2 or 3 correct figures. Some candidates did not treat this as a column addition problem. For example, some put 11 in the answer space under the units column, instead of writing 1 in that box and carrying the tens digit to the next column.

(c) There were some excellent answers here, but many candidates had difficulty. The most common errors were to give answers with incorrect place values, such as 0.1 or 1, or to give the answer 0.2, sometimes with working showing 0.1 × 2, suggesting that some candidates thought that squaring was equivalent to a multiplication by 2.

Question 2

Most did well here. Common errors included the answers 88 (from rounding up from 87.49), 90 (from rounding to the nearest 10) and 87.5 (rounding to 1 decimal place). Candidates are advised to read the question carefully to ensure that their answer matches what is required.

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Question 3

(a) Most gave the correct answer, but a significant number were unable to complete the conversion correctly. Many used incorrect conversion factors, leading to common wrong answers such as 5, 5000 and 0.05. A few showed the correct conversion factor but made errors in the calculation, with some opting to divide instead of multiply.

(b) Most gave the correct answer, either writing $\frac{12}{24}$ or simplifying this to $\frac{1}{2}$.

Question 4

Most gave the correct answer. A few gave answers with the digits 67 but incorrect place values, such as 6.7 per cent or 670 per cent. A small number left this question blank.

Question 5

(a) Most candidates plotted the correct point. A few plotted incorrect points such as (1, −3) or (−3, −1).

(b) A minority drew the correct ruled line. A small number drew a line segment that had a gradient of 0 but was much too short. Very few understood that a gradient of 0 implied a horizontal line. The most common approach was to plot (1, −2) and then draw the line through this point and the point plotted in **part (a)**.

Question 6

(a) This question was done well by some, with many showing excellent working. However, many candidates did not place the data in order of size and so they gave the median as the mid-point between the two values in the middle of the unordered list. A significant number of candidates made calculation errors, for example writing $\frac{2+3}{2} = \frac{6}{2} = 3$ or $\frac{3+3}{2} = \frac{9}{2} = 4.5$. Some candidates found either the range or the mean instead of the median.

(b) Most did well here. A few attempted to find the mean. Some gave the answer 5 (the largest value) instead of the range.

Question 7

Many realised that they needed to work out 1.1 × 90, gaining one mark, but a significant number of candidates were unable to complete this calculation correctly. 90.9 was a common wrong answer. Some did not realise that they needed to convert the time to seconds. Some converted 1 min 30 seconds to 1.3 minutes and used this value in their calculation.

Question 8

(a) Most candidates were able to collect the terms in a, but many had difficulty resolving $-3b + b$. The most common wrong answer was $5a - 4b$.

(b) This was done well by the highest achieving candidates, but most candidates were unable to simplify the given expression. Most gave their answer as a fraction, but some wrote $\frac{7}{2}$ as 3.5.

Many candidates were unable to resolve $\frac{x}{x^2}$ correctly.

(c) Most candidates gave at least one correct term. Common errors included simplifying $8a \times 2a$ to $16a$ instead of $16a^2$ and omitting to multiply the second term in the bracket by $8a$.

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Question 9

There were some excellent answers here. Successful candidates used a variety of strategies, including starting by working out that $\frac{1}{5}$ of the total was 3, or using reverse calculations to find $6 \times 5 \div 2$. Unsuccessful candidates were usually unable to identify a correct first step. A variety of incorrect methods were seen, including various calculations involving 2, 5 and 6 and attempts to find $\frac{2}{5}$ of 6.

Question 10

(a) Most candidates did well here and there were many fully correct answers. Some candidates identified that 9 mapped onto 27 but could not complete the inverse process to find the value that maps onto 42.

(b) The majority reached the correct solution, but a significant number were unable to make any progress here. The most common error was to substitute 6 for x, rather than writing $5x - 4 = 6$. A small number completed the first step correctly, writing $5x - 4 = 6$, but made errors when solving the equation.

Question 11

There were some excellent answers, but overall, this question proved challenging for many candidates. A significant number left one or both parts of this question blank.

(a) Some showed a correct method but made calculation errors, often when dividing. A common error was to divide 280 by 5 and then to divide 280 by 2, leading to the wrong answer 56 and 140.

(b) The highest achieving candidates usually reached the correct final answer. Some candidates were able to give correct partial simplifications. As in **part (a)**, calculation errors were common.

Question 12

(a) Most candidates gave the correct answer. A few attempted to find the nth term, not the next term. Candidates are advised to read the questions carefully.

(b) This question required a convincing explanation that 31 does not appear in the sequence. A common correct approach was to show that 29 and 33 both appear in the sequence, so 31 is missed out. Some candidates gave incomplete explanations, for example stating the nth term but not using it to show that 31 was not in the sequence. Some candidates restated the question, saying that 31 was not in the sequence, but without explaining why.

Question 13

There were a small number of fully correct answers. These candidates showed clear and methodical working and usually took the approach of calculating the total of the interior angles and then dividing this by 8. Some candidates gained 1 mark for a partially correct method, these usually divided 360 by 8 to find the size of an exterior angle but did not know how to go on to find the size of an interior angle. A large number used 135 in their calculations, which is not an acceptable approach when they have been asked to show that this value is correct. This question was omitted by some candidates.

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Question 14

There were some excellent answers seen, but this question proved to be challenging and less than half of the candidates were able to reach the correct answers.

(a) Some candidates showed working where they were attempting to find the correct power of 2. In some cases, this led to the correct answer, but a significant number gave the answer 5. Common errors included finding $\sqrt{64}$, leading to a final answer of 8, and working out 64 ÷ 2 and giving 32 as the final answer.

(b) Many candidates did not realise that the power of 4 would be negative. Common wrong answers included 1, $\frac{1}{4}$ and −2.

Question 15

(a) Most candidates were able to separate the numbers into stems and leaves, and many completed the diagram correctly. A few made slips or did not order the numbers in their stem-and-leaf diagrams. A number had difficulty with they key. Some omitted the key, others referred only to the stem when interpreting the key, for example writing '1|4 represents 10'. A significant proportion of the candidates did not know what to do here. Most of these candidates wrote two-digit numbers in the stem-and-leaf diagram but a few drew other charts and diagrams, including pictures of plants and flowers.

(b) Most candidates gave the correct answer. This part of the question could be answered using either the stem-and-leaf diagram or the original data. Many of the candidates who were unable to access **part (a)** gave the correct answer here. Candidates are advised to attempt all parts of every question.

Question 16

Candidates who started by writing $\pi r^2 = 36\pi$ usually went on to arrive at the correct answer. A common error was to state that $\pi r^2 = 36$. This error led candidates to some very difficult arithmetic involving decimal approximations for π, but they did not realise that this was an indication that their method was likely to be incorrect. Some candidates reached $r^2 = 36$ but then divided 36 by 2 instead of finding the square root.

Question 17

(a) There were many fully correct answers. Very few candidates included incorrect factors in their answers, however some candidates omitted factors, often 1 and/or 35. A few showed a full list of factors in their working but then omitted some of these on the answer line. A small number appeared to be writing 35 as a product of its prime factors rather than listing the factors of 35.

(b) There were some excellent answers here. Some candidates opted to list multiples and others used prime factorisation; both approaches were successful. Some candidates found a common factor rather than the LCM.

Question 18

Part (a) asked candidates to identify parts of a circle. There were some fully correct answers, but many candidates were unable to give the mathematical names, and a significant number left the answer spaces blank. It is important that candidates are familiar with the required mathematical vocabulary.

(a) (i) Only a minority were able to identify the line as a chord. The most common incorrect answer was 'diameter', but a wide variety of responses were seen, including 'radius', 'sector, 'segment' and words that are not circle terminology, such as 'ratio'.

(ii) About half the candidates gave the correct answer. Wrong answers included 'chord', 'diameter', 'straight line' and 'perpendicular'.

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(b) To answer this question, candidates needed to identify the angle in the semi-circle as 90°. Those who did this usually went on to arrive at the correct answer. The diagram was clearly marked as 'not to scale', however a significant number of candidates measured angle *ACB* with a protractor. Some assumed that the triangle was isosceles and that angle *ACB* was 46°. Some candidates seemed unsure which angle was required and gave their value for angle *CAB* as the final answer.

Question 19

There were some very clear and efficient solutions seen, however many candidates seemed unsure how to approach this question. The two similar triangles were presented in a single diagram. Some realised they needed to add 4 and 8 but then gave 12 cm as the final answer. A significant number incorrectly added 4 cm to 6 cm to reach their final answer. Some candidates stated that $\frac{x}{6} = \frac{4}{8}$, which could be a step towards a fully correct solution, but candidates did not realise they needed to add their solution for x to 6 cm to find *DE*.

Question 20

Some candidates used efficient algebraic methods. These candidates usually went on to reach the correct solutions, but some made arithmetical errors. Some attempted elimination methods but did not multiply every term in the equation when equating coefficients; others did not add or subtract consistently when attempting to eliminate a variable. Some gained one mark for giving a pair of solutions that fitted one of the equations.

Question 21

(a) Most realised this was a rotation, but some did not use correct mathematical vocabulary. The word 'rotation' is expected here, using alternate words such as 'turned' will not gain the mark. Many candidates identified the correct angle of rotation, but only a minority were able to identify the centre of rotation as being the origin.

(b) About half of the candidates gave the correct answer and a small number gained one mark for correctly applying one component of the translation vector. Some candidates translated the shape by $\begin{pmatrix} 0 \\ -6 \end{pmatrix}$, which suggests that they were attempting to combine the components of the translation vector.

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Paper 0607/12
Non-calculator (Core)

Key messages

To succeed with this paper, candidates:

- must have completed the full Core syllabus,
- should read the questions carefully, focussing on instructions and key words,
- should be confident with a variety of non-calculator strategies,
- need to check that their answers are accurate, are in the correct form and make sense in the context.

General comments

Candidates need to read the questions carefully, noting the command words and any key information.

Calculators are not permitted on this paper, so candidates need to be familiar with a range of non-calculator methods and strategies. Candidates who used efficient non-calculator methods were more likely to reach the correct answers than those who used longer methods.

Candidates need to know the meaning of mathematical terms, for example, in **Questions 3**, **9**, **10**, **13** and **17.** Workings are vital in multi-step problems, such as **Questions 14**, **16** and **17** as showing workings enables candidates to access method marks.

Comments on specific questions

Question 1

Both parts of this opening question were answered correctly by the majority of candidates. For **part (b)**, the occasional errors were 800 (just the hundreds), 760 (the hundreds unrounded) or 117 (unrounded without the final two zeros). Very occasionally, a candidate rounded to the nearest thousand instead of the nearest hundred.

Question 2

(a) This was answered correctly by virtually all candidates

(b) This part was not handled as well as all the previous questions. The most successful, cancelled the fractions, $\frac{4}{3\times5}$ to give the correct answer. This is a better method than multiplying the numerator and denominator then cancelling as numerical slips can be made in both stages. Some tried a version of cross multiplication getting to $\frac{20}{27}$. Some used a common denominator then added their fractions, $\frac{20}{45}+\frac{12}{45}$.

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Question 3

(a) Most candidates gave the correct answer. Some appeared not to understand the term, 'mode', as the total or the largest value were given as answers.

(b) There were many correct answers seen. Sometimes the answer was 8 (the range) or the total amount of money, 39, even after showing the full method. A few showed no working and gave the answer 40. Some wrote the correct method and then divided by 100 rather than 10.

(c) For 'show that' questions like these, it is best to find the answer from the information given and then check that they have got the value to be shown. Here, the data must be put in order, then the position of the median found and then work out what it is. Some candidates missed out one or two if the $1 amounts, so their median was not the given amount of $3.50

Question 4

(a) The frequent incorrect answer here was –3 instead of just 3. A few candidates gave $\frac{1}{3}$, the reciprocal of the correct answer or – 28 (from –21 – 7) from a misunderstanding of the fraction. The fraction, $\frac{-3}{-1}$, was not acceptable for the answer as the last step of the simplification was expected.

(b) Slightly more candidates were awarded marks with this part than the last. The method here is to work out the value of each term to give 125 and 16 then subtract the 16 from 125. A common mistake seen was in the application of the order of operations, calculating the value of 5 – 3 and then 3 – 4 (for the powers), before attempting to find the value of 3^{-1}.

Question 5

(a) (i) This part was answered well by the majority of candidates.

(ii) For this question**,** candidates needed to state that this sequence has a common difference between adjacent pairs of terms. It was also correct to say that the term-to-term rule is +3.

(iii) Finding the nth term was more challenging for many than the previous parts. Instead of $3n – 2$, many had +3 as the constant term rather than $3n$. Many showed no working as the substitution of $a = 1$ and $d = 3$ into the nth term formula, $a + (n – 1)d$, is often the starting point. Some gave $4n + 3$ which is the nth term for the sequence used in **part (b)**. A few gave answers such as $n^3 + 1$ which is not the nth term of a linear sequence.

(b) Here, candidates had to substitute $n = 1$, then 2 and then 3 into the nth term formula to get the first 3 terms. Alternatively, once the first term, 7, is found, then the next term is 4 more and the 3rd term is 4 more than that. A few substituted $n = 0$, then 1 then 2 to give 3, 7, 11. Some gave 4, 7 and 10 so started with the 4 from the formula then added 3 each time. Others added 3 each time onto various first terms. A few gave an expression rather than a number for each term.

Question 6

(a) Many candidates answered this part correctly. Some did not follow the rule that said the two numbers from the spinners were added to get Jasmine's score. In the first row, some wrote 4, 7, 11 as if they were adding 2 then 3 then 4 rather than 1 more to all the square spinners scores. Similar methods were seen for the other rows.

(b) There were some correct answers seen. Some gave as their answer a number greater than 1 when a probability was required. Others gave a probability but did not use 12, the number of cells, as the denominator and some included the first row or the first column or both giving fractions out of 16, 15 or 19. Some had difficulty identifying the prime numbers or only counted the different primes, i.e. 2, 3 5, 7 is 4 primes. Some omitted the 2 and 3 that were already in the table.

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Question 7

(a) A large majority did well with this question showing clear methods to find the cost of the clothes. Often there was a total for the T-shirts then one for the shorts and then these were added together. Any method to add the costs correctly was acceptable. Mostly the candidates who laid their work out clearly and logically got to the correct answer. Some work was not neat or well laid out so it was hard for the candidate to keep track of their method and errors were made.

(b) Fewer candidates were awarded full marks here. Candidates had to set up calculations that found the cost of two T-shirts then subtracted this from \$115 to get the cost of a pair of jeans. Sometimes correct methods were seen then arithmetic slips meant the final answer was not correct. Again, those who worked logically were the most successful.

(c) This was another 2-step calculation working out the percentage reduction in the T-shirt cost and taking that from the full price. This can be done in one step if candidates worked out $\frac{80}{100} \times 13.50$.

Some gave their answer as the reduced amount rather than calculate the final step. Candidates did have to look back at the beginning of the question to find the full price of a T-shirt and so sometimes used their answer to **part (a)** or other values as the cost of a T-shirt. Some did the calculation incorrectly as an estimate by using \$13 rather than \$13.50

Question 8

Candidates did very well on both parts here.

(a) There was only one step to find x from the algebraic equation, $x = 7 \times 2 = 14$. A few gave the answer 9 from 7 + 2 or made slips with the 2 times table.

(b) This calculation needed two steps, 1 added to both sides of the equation then division by 3 to find x. Sometimes, instead of 12 resulting from the first step, 10 was given as 1 was subtracted instead. A small number multiplied by 3 and then subtracted 1 resulting in 32 for x. Candidates must understand about inverse operations when solving equations as well as the priority order of operations.

Question 9

Here, there was no diagram to aid the understanding of the situation. Candidates should take the information in questions like these and draw their own diagrams. Very few diagrams, correct or otherwise were drawn. Many knew the formula for calculating the sum of the internal angles. Some did not know how many sides a pentagon has so substituted the wrong number into the formula, often 6 or 10 instead of 5. Some knew how to calculate the external angle of a regular polygon and, again, sometimes other numbers of sides were used.

Question 10

The instruction to write each number correct to 1 significant figure was frequently not followed, as candidates tried long multiplication and division of the original expression. Some were awarded one mark for rounding 3 of the numbers correctly or using 4.0, 10.0, 5.0 or 3.0, as leaving extra zeros is not a correct rounding to one significant figure. Other errors included rounding 11.2 to 11 and rounding 2.5 to 2.

Question 11

(a) A common wrong answer was 3, from 9 ÷ 3, or 27 from 9 × 3 rather than the correct process, 9 – 3. An answer of x^6 did not receive the mark as the form of answer required was just the index.

(b) This problem-solving question was answered well by many. Occasionally, 2 pairs of numbers that added to 12 were given. Again, the answers had to be just the indices so, for example, x^4 and x^3 were not awarded any marks. Candidates were asked to find two sets of solutions, and some appeared not to know how to make a start.

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Question 12

(a) Many candidates knew this was a reflection. Fewer candidates were able to give the line of reflection for the second mark. The proper transformation name, reflection, rather than flipped or mirrored must be used.

(b) This was a rotation and the answer needed 2 other pieces of information, the angle and the centre of rotation. Again, the proper name must be used as there is no mark if candidates gave 'turn' or 'spin' as the name.

(c) This was handled better than the previous parts. Candidates had to make sure they translated the correct triangle. Many gave neat, accurate answers, drawing the translated triangle using ruled lines.

Question 13

There are various methods to find the LCM of 2 numbers, either to list multiples of both numbers until the same number appears in both lists or to find the prime factorisation of each number and then work out the smallest number that has all the prime factors of both. Candidates made arithmetic errors in their lists or the factorisation process. Many gave a prime factor in both numbers or the highest common factor, 8.

Question 14

Solving simultaneous equations proved challenging for some. Adding the 2 equations to eliminate y was the most efficient method and was seen in some responses. Other methods were used to reach the right answers, took longer and have more places for arithmetic slips to be made. Candidates need to analyse each simultaneous equations question to choose the most appropriate method.

Question 15

Many candidates find working with the equation of a straight line, picking out the gradient or the intercept with the y-axis, complex.

(a) There were many errors made with the algebraic manipulation of the equation to try and get it into the correct form. There are 2 steps to this manipulation, and many could not see where to start. Some were awarded a method mark for the first step correct.

(b) Candidates had difficulty picking out the gradient of the straight line from their equation as it was often not in the correct form.

Question 16

Candidates should always start with the given data to work towards the answer and show all lines of their method. The approach is to use Pythagoras' theorem to calculate the other side and then check that their answer for x is 12. If the answer was not 12, candidates should be encouraged to check their work for errors. As this is a non-calculator paper, candidates should know that they only will need to square root perfect squares such as 144. A few tried to use trigonometry, or manipulating 5 and 13 to come up with 12 without using Pythagoras' theorem.

Question 17

Candidates did well on this last question. An important point here, was that more data is given than is needed so candidates had to pick out the correct ratios of the sides. The simplest method is to see that the second triangle's base is 3 times the length of the first. This means that $y = 4 \times 3 = 12$. The length of AB is not needed for this calculation. Some candidates add the 3 lengths of triangle ABC to give 15.

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Paper 0607/13
Non-calculator (Core)

Key messages

To succeed with this paper, candidates must

- have completed the full Core syllabus
- read the questions carefully, focussing on instructions and key words
- be confident with a variety of non-calculator strategies
- need to check that their answers are accurate, are in the correct form and make sense in the context.

General comments

Strategies to make working without a calculator easier, such as cancelling and estimating, need to be embedded in classwork for all areas of the syllabus as some candidates' working showed that they made errors with basic number skills and calculating with fractions.

There were a considerable number of questions that were standard processes, and these questions proved to be generally well understood.

Candidates need to read the questions carefully, noting the command words and any key information.

Most candidates showed clear methods; the stronger candidates set their work out clearly and in a logical order.

Comments on specific questions

Question 1

Parts (a) and **(b)** were well answered by the majority of candidates. A few candidates made arithmetic slips with the multiplication and division. For **part (c)**, some tried a version of cross-multiplying giving answers such as $\frac{3}{10}$ or $\frac{10}{3}$. A few gave $\frac{3}{15}$ and this appeared to have come from adding 1 and 2 rather than multiplying for the numerator. For **part (d)**, many did not show any working so could not be awarded a method mark for correct work when the final answer was incorrect. Some added the numerators and denominators without first finding a common denominator.

Question 2

Many tried to use the indices correctly and then do the addition and subtraction. Some made arithmetic slips in the various steps. A few wrote 2^4 as 32 instead of 16. Many gave 4^0 as zero instead of 1. Some combined this expression incorrectly to give $5^6 - 4^0$ then ended getting to 1^5.

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Question 3

(a) Some gave more than 1 number from the list which is acceptable if all values are correct. Sometimes an even number was given as the answer. Other incorrect answers included the decimals.

(b) There is only one factor of 10 in the list, 2. The numbers 0.2 or 0.5 were sometimes given as the factors of 10.

(c) Some candidates were not certain what the term reciprocal meant so often the answer was 0.2

Question 4

(a) A large majority gave the correct next 2 terms in the sequence.

(b) Finding the *n*th term was much more challenging to many than the previous part with some giving the term-to-term rule.

Question 5

Instead of dividing 270 by the sum of 4 and 5, some divided 270 by 4 for one answer and then 5 for the other.

Question 6

For the first 3 parts of this question, most candidates gave the correct answers. A few reversed the coordinates. Many candidates had difficulties with **part (c)**. Many measured the line *AB* instead of using Pythagoras' theorem to calculate its length. A few realised they must use Pythagoras theorem and made errors with the method or the arithmetic.

Question 7

(a) Most candidates gave the correct answer with a few making arithmetic slips. Occasionally, instead of $2a$, the answer was given as a^2.

(b) Some candidates found simplifying algebraic fractions complex. Some squared 5 and did not realise the square only affects x. Some gave just the fraction, $\frac{5}{7}$, as their answer.

Question 8

Some candidates were correct with both answers. Others gave $x = 7$, which is the value of the median given in the question. As this is a list of 6 numbers, the median is not one of the values but is halfway between the third and the fourth numbers i.e. between x and 8 so $x = 6$. Next, the total had to be found ($8 \times 6 = 48$) and then all numbers subtracted to leave the value for y. Some candidates did not consider their value of x when finding y.

Question 9

Some correct, well drawn answers were seen. Some reversed the ending circles with open circle at 2 and the solid circles at –3.

Question 10

Many candidates made a good attempt at finding the value of x, using the fact that angles on a straight line add to 180°.Some candidates recognised that finding y was a 2-step process, finding angle *CFD* and then the fact that vertically opposite angles are equal.

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Question 11

(a) Candidates generally did well, plotting all 3 points correctly by recognising the different scales on the two axes.

(b) For questions about the correlation shown on scatter diagrams, there are only 3 answers to choose from – positive, negative or no correlation. Some tried to describe the correlation in context or used words such as increase or linear.

(c) Fewer candidates were correct here. The better responses recognised that the mean point had to be plotted and then a ruled line drawn through the mean point to follow the correlation.

Question 12

(a) Many did not understand that the notation was asking for the number of elements in set *E*. Some wrote down the integers given in the question.

(b) This part did require listing the factors of 12. Some did not list all 6 factors.

(c) Candidates were required to place all 12 integers of the universal set into the Venn diagram. The most common error seen was to ignore the numbers that were not in sets *E* and *T*.

(d) Many candidates answered this part correctly.

Question 13

Candidates find working with lengths or area expressed in terms of π complex to understand and so difficult to start to solve for *r*. Some gave the answer 32π which is the circumference when they assumed the radius was 16.

Question 14

(a) Some candidates knew this was a reflection. Fewer candidates were able to give the line of reflection for the second mark. The proper transformation name, reflection, rather than flipped or mirrored should be used.

(b) This was the part of the question where candidates were the most successful**.** The proper name for this transformation is a translation. The other piece of information needed was the vector giving the movement. Some confused the direction of the translation.

(c) Many were not certain of the size or the shape of the enlargement of the original shape.

Question 15

Many candidates found working with the equation of a straight line, working out the gradient or finding the intercept with the *y*-axis, complex. The stronger responses used the diagram to find the gradient, *m*, and intercept, *c,* and then found the straight line in the form required, $y = mx + c$.

Question 16

(a) Many candidates were awarded a method mark for correct substation for *x* in either function with some being awarded both marks for finding the final value.

(b) Many candidates understood that the expressions needed to be used rather than a substitution of values. Stronger responses then collected like terms and solved for *x*. Some got as far as $2x + 3 + 5 – 3x$ and collected up like terms but did not put this equal to zero.

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Question 17

Although many did not attempt this question, some were successful in answering this question. Some candidates were able work with just pairs of sides when finding a single variable, for example finding that the scale factor for the first to the second cuboid is one quarter so $x = 2.4 \div 4 = 0.6$ The best responses then used the reciprocal of the scale factor, or that the first cuboid has sides 4 time the length of the second cuboid, to find the value of y.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/21
Non-calculator (Extended)

Key messages

This examination was the first autumn series of the new specification and this paper requires, on some questions, detailed responses as well as some short 'traditional' Paper 2 questions.

Candidates must show all of their working. Incorrect answers without working cannot be given credit, whereas partial credit can be awarded if a correct method is shown.

Candidates should check their working in each question to ensure that they haven't made any careless numerical slips.

If the question requires candidates to show a given result, they must show all of the correct details, including correct notation and language, to score full marks.

General comments

Candidates were prepared for the traditional questions on the paper and were able to demonstrate understanding and knowledge across some of the topics tested. They did struggle with the questions that were of a more problem-solving nature and found it difficult to apply their knowledge and skills in unfamiliar contexts.

The standard of written work was generally good with many candidates attempting to show clearly the methods they were using.

Candidates did not seem to have a problem with the time allowed to complete the paper.

Comments on specific questions

Question 1

Almost all of the candidates could demonstrate some understanding of converting between fractions, decimals and percentages. It was pleasing to see $\frac{7}{20}$ equated to $\frac{35}{100}$ in order to convert correctly from fraction to decimal then percentage. A small number of candidates gave an answer of $\frac{0.9}{10}$ for the fraction equivalent of 0.09 which would not score full marks.

Question 2

Although the majority of candidates were able to carry out a sensible first step of converting the fraction into an improper fraction, it was clear that many did not know how to find the **reciprocal** of a number. Many left their answer as $\frac{8}{5}$ and others gave a negative answer rather than 1 divided by the number.

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Question 3

Candidates generally followed the instructions to estimate by rounding to 1 significant figure. However, it was rare to see all values correctly rounded, and incorrect values of 44 and 1 were common. When all of the correct values were seen, many were unable to compute accurately the decimal division of $\frac{120}{0.6}$.

Question 4

(a) (i) Many candidates were able to identify and isolate triangle *BEC* in order to calculate *x*.

(ii) Few candidates were able to identify which extra angles would be needed to calculate y and hence develop a clear strategy to find a solution.

A common error seen was to give angle *ECF* as 70° as a result of assuming it was an isosceles triangle. Those candidates who showed their working by annotating the diagram were more likely to successfully develop their strategy.

(b) Few responses made clear that the strategy was based on angle facts and went on to use correct angle notation and language.

Corresponding, alternate, co-interior are examples of desired language which would be acceptable in explanations. 3-letter angle notation is essential e.g. angle *EBC* rather than simply angle *B*.

Question 5

Good attempts were made to multiply each vector and then subtract. Errors occurred if only one of the values in the vector was multiplied. There were slips seen, arising from subtraction of negative numbers.

Question 6

(a) Only the minority of candidates could find the relative frequency, that is the number of times an event occurs divided by the total number of trials. The correct answers seen were expressed as a fraction, decimal or percentage.

(b) Most candidates attempted to multiply 5000 by $\frac{40}{200}$ but arithmetic slips often occurred.

Question 7

The full range of quadrilaterals were seen as answers.

Question 8

(a) This was confidently attempted and executed. Most candidates chose to square each side first but a small minority divided by √5a and then squared successfully.

(b) This was more challenging due to the number of steps needed. Nearly everyone attempted to clear the fraction by multiplying both sides by $5a - b$.

The next steps of expanding and rearranging were well attempted but only the strongest candidates then factorised correctly in order to divide and reach a final correct solution.

Question 9

This question was very difficult for some candidates to start. Many did not use Pythagoras' theorem or trigonometry correctly to obtain the length of the side of the isosceles triangle as a first step. Candidates did however demonstrate that they knew how to work out the area of a triangle, and if working was shown, they could gain credit for this.

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Question 10

Candidates found this question challenging and most seemed unsure of how to deal with changing ratios. Algebraic approaches were rare and many worked with an unstructured trial and improvement approach.

The better responses worked with the original lengths in the ratio of $5x : 3x$. This then resulted in the ratio $5x - 4 : 3x - 4$, which was cancelled down to the ratio 2 : 1 giving $5x - 4 = 2(3x - 4)$. The solution of $x = 4$ was then substituted back into the first ratio to give the original lengths of 20 cm and 12 cm.

Question 11

(a) Although many candidates seemed to understand that they were looking for the intersection of sets *A* and *B*, a common error was to miss out 3 and 9.

(b) (i) Few candidates answered this part well. Some candidates listed the elements, rather than writing down the number of elements in the list.

(ii) Many candidates found this part challenging.

(c) (i) Candidates found this part difficult. The common error was to calculate with, rather than without, replacement.

(ii) Only the strongest candidates were able to write the correct product and multiply by 2.

Question 12

Many candidates struggled to determine a suitable strategy here. Most successful attempts came from using the cosine rule. Unfortunately, arithmetic slips often occurred here and it was rare to see the correct negative value alongside the knowledge that a negative value implies the angle is obtuse.

Question 13

(a) This question was well answered with candidates demonstrating a good understanding of the rules of indices.

(b) The majority of candidates made a good attempt to find the reciprocal of the cube root of 64 and square the result. Candidates who didn't have the correct final answer were able to score the method mark for one correct index interpretation.

Question 14

This question proved to be challenging for many candidates. Writing an inequality to describe a region using the correct notation was rarely seen.

Question 15

(a) Nearly every candidate managed to substitute $x = 3$ into the correct function.

(b) This part was very well executed by many, with correct substitution of 10 into $\frac{x+1}{3}$ seen.

(c) Most candidates started this part correctly and gained one mark but slips were often seen in expanding the bracket and tidying up negative terms.

(d) Very good attempts to find the inverse function were seen. Most candidates started with swapping *x* and *y*, and if mistakes were seen they usually involved missing, or not dealing with, –2.

(e) Most candidates were able to equate the two functions but not many got far enough to rearrange the quadratic expression equal to zero. Of those who did, some factorised and others used the quadratic formula to obtain the correct solutions.

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Question 16

(a) Responses showed two possible approaches to this part; either substituting $n = 6$ into the correct formula for the interior angle of a polygon or demonstrating that the exterior angle is $\frac{360}{6}$.

(b) This part proved to be a very difficult for many candidates. Few identified the correct right-angled triangle in the prism and then went on to determine the length of the diagonal base using trigonometry.

Question 17

Few candidates showed all four products from multiplying out the brackets. There was often an error in dealing with $-2\sqrt{3} \times -2\sqrt{3}$, leaving this as a product of $\sqrt{3}$.

Question 18

(a) Few candidates showed that three corresponding angles (AAA) are equal, or that two corresponding angles are equal and hence the third one is. Some candidates stated that *BEC* = *ECF* due to alternate angles and *EFC* = *BCE* alternate segment. Some candidates incorrectly concluded that *BEFC* was a parallelogram.

(b) Very few candidates used the scale factor to determine length of *CE*. Many tried to use Pythagoras' theorem on a triangle that is not right angled.

(c) Very few candidates used the scale factor for the lengths of sides and squared this for the area scale factor. A number of candidates tried to use $1/2ab \sin\theta$ in this part without success.

Question 19

This final question required candidates to factorise two separate expressions using different skills. The numerator is a 3-term quadratic expression. It was very rare to see candidates attempt to look for a pair of numbers multiplying to –60 and adding to 4 in order to rewrite the numerator as $4a^2 – 6ab + 10ab – 15b^2$. Few candidates were therefore able to correctly factorise this as $(2a + 5b)(2a – 3b)$.

There was considerably more success in factorising the denominator by factorising each pair of terms and combining these to get $(2a – 3b)(a + c)$.

It was very rare to see a completely correct factorised expression that could be simplified by cancelling.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/22
Non-calculator (Extended)

Key messages

This examination was the first October/November series of the new specification and this paper requires, on some questions, detailed responses as well as some short response questions.

Candidates must show all of their working. Partial credit can be awarded if a correct method is shown.

Candidates should check their working in each question to ensure that they have not made any numerical slips and that the question asked of them has been answered.

If the question requires candidates to show a given result, they are expected to show all of the correct details of their working to gain full marks.

General comments

Candidates were very well prepared for the paper and were able to demonstrate understanding and knowledge across many of the topics tested.

The standard of written work was generally good with many candidates clearly showing the methods they were using.

In some cases, responses which reached a correct expression then included incorrect simplification. These slips meant that not all marks could be gained.

Comments on specific questions

Question 1

(a) Almost all of the candidates were able to answer this question correctly.

(b) The place value of the answer was incorrect in some responses, but most candidates knew that $3^4 = 81$.

(c) The majority of candidates correctly converted to an improper fraction and then found the square root of the resulting improper fraction.

Question 2

This question was very well answered by most candidates. Some candidates did not fully factorise, but most then gained one mark for partial factorising.

Question 3

In general, candidates used the correct conversion factor and divided by 1000.

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Question 4

Many candidates gave the incorrect answer of 10. This suggests that, as the third significant figure here is 0, candidates did not appreciate the importance of retaining this digit when reporting a number to the required accuracy. Some candidates confused significant figures with decimal places giving an answer of 10.028.

Question 5

(a) This part was correctly answered by nearly all of the candidates.

(b) Most candidates realised that relative frequency needed to be a fraction (or decimal). Some candidates gave an answer of 8, which is the frequency rather than the relative frequency.

(c) This part was very well answered. There were some occasional numerical slips, but candidates who had shown working were able to score a method mark.

Question 6

Good arithmetic was seen in this question. Some candidates gave their answer as a fraction, which was not appropriate in the context of money.

Question 7

(a) Nearly all candidates were able to find the next term of the sequence.

(b) Candidates are very well versed in finding the *n*th term of a sequence and nearly all candidates scored both marks.

Question 8

Candidates were able to make an attempt at this question and many found at least one solution. Some candidates did not simplify their surd answer(s) to the simplest form.

Question 9

Candidates realised that they had to divide their total distance by their total time. Candidates who worked with fractions and used $14 \div \frac{7}{4}$ were usually more successful than candidates who tried the decimal division of $14 \div 1.75$.

Question 10

(a) Most were able to accurately reflect the triangle in the correct line but a few candidates reflected in the line $y = -1$.

(b) Nearly all candidates were able to correctly draw the translated triangle.

(c) The majority of candidates recognised that the transformation was a rotation, and attempted to give the required properties. Some candidates gave more than one transformation rather than the single transformation requested.

Question 11

This question was very well answered, showing that candidates have a good understanding of standard form.

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Question 12

(a) The plotting of points and drawing of the cumulative frequency diagram was accurate.

(b) The majority of candidates scored full marks on this part. Many candidates illustrated their lower quartile and upper quartile before subtracting. This is a practice to be commended.

(c) Nearly all candidates realised they needed to find the value corresponding to 172 students.

Question 13

Candidates confidently solved the pair of simultaneous equations using either the elimination method or the substitution method.

Working out was clear and enabled candidates to gain method marks if they made a numerical or sign error. Some candidates checked their solutions worked in both equations. This is highly recommended.

Question 14

(a) This question was well answered with candidates demonstrating a good understanding of circle theorems.

(b) Candidates were familiar with the concept of congruence and many candidates having identified a pair of congruent triangles were able to give detailed reasons for the congruency.

Question 15

Many candidates answered this question well. The common incorrect answer was $h = -3$.

Question 16

There was excellent work seen and most candidates started correctly by multiplying both the numerator and the denominator by $\sqrt{7} - 2$. There were some sign errors seen in the denominator.

A number of candidates struggled to leave their answer in its simplest form and did not cancel correctly by 3.

Question 17

There was good knowledge of the values of special angles but $\sqrt{0.81}$ caused the most difficulty, often appearing as the smallest number, as candidates wrote the value as 0.09.

Question 18

The majority of candidates made good attempts on this coordinate geometry question. Working out was clearly shown which enabled candidates to score method marks if they had made numerical slips when finding the midpoint or the gradient.

Question 19

Most candidates knew $4^\circ = 1$ and so reached the correct solution.

Question 20

(a) This part was very well answered by many candidates.

(b) Some candidates did not use their factorisation in **part (a)**. These candidates started again often using the quadratic formula but they were usually successful.

(c) The candidates who made the link with **parts (a)** and **(b)** were successful in solving the equation. The majority of candidates gave at least one correct value within the correct range.

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Question 21

The majority of candidates scored the first two marks by correctly factorising both parts of the fraction.

There were a significant number of candidates who were unable to simplify their fraction to the correct answer.

Question 22

This proved to be a very demanding final question for many candidates. Some candidates isolated *A* rather than *r,* or rearranged the equation to equal zero.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/23
Non-calculator (Extended)

Key messages

This examination was the first autumn series of the new specification and this paper requires, on some questions, detailed responses as well as some short 'traditional' Paper 2 questions.

Candidates must show all of their working. Incorrect answers without working cannot be given credit, whereas partial credit can be awarded if a correct method is shown.

Candidates should check their working in each question to ensure that they have not made any careless numerical slips.

If the question requires candidates to show a given result, they must show all of the correct details of their working to score full marks.

General comments

Candidates were generally well prepared for the paper and were able to demonstrate good understanding and knowledge across many of the topics tested.

The standard of written work was generally good with many candidates clearly showing the methods they were using.

Candidates did not seem to have a problem with the time allowed to complete the paper.

Some candidates lost marks through incorrect simplification of a correct expression.

Comments on specific questions

Question 1

(a) Nearly 50 per cent of candidates could correctly name the quadrilateral. The most common answer was rhombus.

(b) The majority of candidates were able to draw the correct line of symmetry.

Question 2

Candidates were able to solve this simple 2-step equation, but many candidates left their answer as 0/7.

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Question 3

(a) Candidates were able to add the journey time to the start time and write their answer correctly in 24 hr notation.

(b) Nearly all attempted to divide their total distance by their total time. Some candidates incorrectly wrote 2.3 for 2 hrs 30 mins. A few candidates struggled with evaluating 200 divided by the decimal 2.5.

Candidates who used equivalent fractions were, in general, successful.

Question 4

This question was very well answered with candidates realising that 5*t* was a common factor.

Question 5

Candidates were able to correctly convert the mixed numbers to improper fractions before multiplying. However very few candidates cancelled before multiplying and this resulted in numerical slips when evaluating 11×12. A significant number of candidates did not simplify their answer correctly to 6.

Question 6

(a) Almost all candidates were able to find the next term correctly

(b) This part was well answered with candidates able to find the *n*th term of the arithmetic sequence correctly.

Question 7

(a) Although candidates appeared to understand the set notation and realised that they were looking for the intersection of *A* and *B*, they often only gave the answer as 9 and did not recognise that 1 is a square number.

(b) This part proved to be challenging. Candidates did not understand the notation and were unable to give the **number** of elements that were not in set *B*, although many did write a list of them.

Question 8

There were many good attempts at this question, with both methods being used. The most efficient approaches worked out the exterior angle (180 – 168) and then divided 360 by their answer.

Question 9

The majority of candidates made a good attempt to find the reciprocal of the fourth root of 81 and cube the result. Candidates who did not have the correct final answer were able to score the method mark for one correct index interpretation.

Question 10

(a) Candidates that realised *ABCD* was a cyclic quadrilateral, usually worked out angle *BCD* correctly and were able to find the angle of 22 in the isosceles triangle. The common mistake was to assume *AB* as a diameter and then to use angle *ADB* as 90°.

(b) There were very few correct responses to this question. The best responses used angle theorems to show that angle *CAD* or angle *BAD* was equal to 22°, and then concluded that the angle had been bisected.

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Question 11

(a) Candidates found this part challenging and correct answers, not in standard form, were rarely seen.

(b) Many candidates scored full marks on this test of adding numbers in standard form.

Question 12

(a) Nearly all candidates were able to use the basic rules of indices correctly.

(b) Only the better candidates were able to write 4^{3-y} as $2^{2(3-y)}$ in order to equate powers, and to find an equation in y.

Question 13

(a) The majority of candidates scored full marks for this part.

(b) Candidates mostly gave the correct transformation alongside the correct two properties. A small number of candidates are giving two transformations, rotate and translate, contrary to the instructions in the question.

Question 14

(a) Many candidates started the question correctly by finding the difference between the coordinates. However, they did not use Pythagoras' theorem to find the length of the line, but simply wrote 6 and 8 as a coordinate, vector or fraction.

(b) There were very good attempts to this part, with candidates finding the midpoint of BC and then using this to find the gradient of line L, before substituting their values into $y = mx + c$. Candidates who made numerical mistakes but who showed clear working were able to score method marks.

Question 15

(a) Nearly all candidates were able to equate the expressions for the areas and rearrange their equation correctly to the required equation. It is essential that in any 'Show that' question, candidates must show all of their working to be able to score full marks.

(b) The majority of candidates were able to factorise this quadratic expression.

(c) This part was more challenging for candidates, and many gave their answer as an algebraic expression, not realising that they needed to use $x = 6$ from the factorisation found in the previous part. Of those candidates who attempted to find the difference between their expressions, many made a slip in subtracting a negative term.

Question 16

(a) Nearly all candidates were able to multiply the numerator and the denominator by $\sqrt{7}$ correctly.

(b) Although many candidates started the question correctly, errors were seen when multiplying the surds. A significant number of candidates found the correct answer but then spoilt it by incorrect cancelling.

Question 17

Candidates found this question was very demanding and there were only a small number of them who were able to find a correct value for either b or c.

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Question 18

(a) Nearly all candidates scored this mark.

(b) Candidates generally used a correct method to find the inverse function but some incorrectly dealt with the negative sign in their answer.

(c) Many candidates knew the order in which to substitute into the functions, reaching $\mathrm{gf}\left(-\frac{5}{3}\right) = \log 10$. Fewer candidates went on to write down the value of log 10 as equal to 1.

Question 19

The majority of candidates attempted to use a common denominator but errors were seen in the numerator, as they had to subtract a negative term.

Question 20

(a) This part was well answered.

(b) Candidates found this part very difficult. Candidates who attempted this question often did not score method marks as they were writing $\left(\frac{4}{5}\right)\mathrm{n} \times \frac{1}{5}$ rather than $\left(\frac{4}{5}\right)^{\mathrm{n}} \times \frac{1}{5}$.

(c) There was more success with this part of the question. The common error was to omit multiplying the product by 5.

(d) The majority of candidates scored full marks although a number did not multiply 1/4 by 1/5 correctly.

Question 21

Candidates found the final question challenging although most were able to make an attempt at the question and some excellent answers were seen. The unfamiliar diagonal in the cube caused a problem and some candidates who tried to use Pythagoras' theorem made errors in squaring $2x$, writing this as $2x^2$ rather than $4x^2$.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/31
Calculator (Core)

Key messages

To succeed in this paper, it is essential for candidates to have completed the full syllabus coverage. Sufficient working must be shown and full use made of all the functions of the graphics calculator that are listed in the syllabus.

Teachers should ensure that the candidates are familiar with command terms.

Candidates should bring the correct mathematical instruments to the exam.

General comments

Presentation of work continues to improve although some candidates are still reluctant to show their working, writing down answers without the supporting methods.

Not all candidates appeared to have mathematical instruments with them. Diagrams were drawn carefully though some were sketching graphs in pen; this should be avoided. Straight lines on a graph should be drawn with a ruler.

In general, calculators were used efficiently and accurately though there were instances where candidates used 'pencil and paper' methods when a calculator method was more appropriate. When sketching graphs, candidates should practice transferring what is on their calculator screen to paper.

Candidates should be careful when writing their answers. If no specific accuracy is asked for in the question, then all answers should be given exactly or correct to 3 significant figures, unless otherwise stated in the question.

Comments on specific questions

Question 1

Most candidates worked out the correct answer for **part (a)**. Some candidates had problems with working out the cube root in **part (b)**. They should be aware of how to use this function on their graphing calculator.

Question 2

Many candidates knew how to work out the percentage. However, they did not all give their answer correct to 2 decimal places. It is very important to show all the working out and, in the working out space, write down an answer to more decimal places (or significant figures) than is asked for in the question.

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Question 3

In **part (a)** many candidates managed to put the three numbers in the correct order. Some candidates put 0.44 and 43.9 per cent the wrong way round. In **part (b)** most candidates could write down a number between 0.6 and 0.7, with 0.65 being the most common answer.

Question 4

Some candidates had problems writing the number in words. Some put thirty thousand instead of thirteen thousand and some wrote seventy hundreds instead of seven hundred. More candidates had difficulties writing the number in figures with the seven hundred and forty thousand causing the most problem.

Question 5

In **part (a)** very few candidates knew that the first angle was a reflex angle. The majority of candidates wrote 'obtuse' for this angle. Most knew that the other angle was an acute angle. In **part (b)** many candidates added up the angles correctly to get 179° and then correctly compared this with the sum of the angles on a straight line which is 180°. A few candidates did not compare their answer to 180°. Some candidates stated that the sum of the angles was less than 180° without working out the sum.

Question 6

This question proved difficult for many candidates. Some confused the 2 types of circles drawing an open circle at –3 and a closed one at 1. Some drew circles that were either both open or both closed. Some candidates did not draw any circles at all. Some did not draw a straight line between their circles but shaded the space in between.

Question 7

Nearly all candidates managed to draw the correct line of symmetry in **part (a)**. They were less successful in shading the six triangles in **part (b)** to make a pattern with rotational symmetry of order 6.

Question 8

Many candidates found the correct area of the rectangle in **part (a)** but not all gave the correct units with 'cm' being the most common incorrect answer. In **part (b)** there were many correct answers for the length of a side of the triangle. Only a few candidates multiplied by 3 instead of dividing by 3.

Question 9

Nearly all the candidates found the correct answer for **part (a)**. **Part (b)** was also well answered with many candidates finding the correct probability.

Question 10

Candidates were awarded 1 mark for expanding at least one of the brackets correctly. Some candidates made an error when expanding one of the brackets and so did not reach the correct answer. Some candidates did expand the brackets correctly but made slips when simplifying their answer.

Question 11

Many candidates had some problem with finding the coordinates of the midpoint. Some tried to use the formula for the gradient, while others did not divide by 2 and gave an answer of (–1, 14). Some candidates tried to make a sketch of the points and were able to find the *y*-coordinate correctly, but not the *x*-coordinate.

Question 12

In **part (a)(i)** a good number of candidates put the correct numbers in the correct space in the Venn diagram. The most common error was to write 16 in F only and 43 in G only. In **part (ii)** few candidates were awarded the mark because most of them put the number that was in G only but then did not add the number that was in the intersection. In **part (b)** many candidates shaded the intersection correctly but fewer shaded $(C \cup D)'$ correctly.

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Question 13

Most candidates knew that the total probability had to be 1 and correctly put 0.27. Only a few candidates wrote 0.5 or a different decimal.

Question 14

Most of the candidates who used trigonometry found the correct answer. Only a few tried to use sine or tangent, with most recognising that the cosine ratio was required. Some candidates did not use trigonometry to try and find the angle. Often Pythagoras' theorem was applied, but most of the time this was not correctly attempted.

Question 15

Many candidates found this very difficult. Few candidates recognised that they had to divide the triangle into two right-angled triangles before using Pythagoras' theorem. Most of the candidates that did use Pythagoras theorem used it incorrectly by adding the squares of 8 and 5.

Question 16

In **part (a)** a lot of candidates managed to find the correct answer. Some candidates omitted this question.. In **part (b)** there were also many correct answers. The most common wrong answer here was 61 with the candidates using 19 as the input rather than the output. **Part (c)(i)** was well answered with a good many candidates finding the correct formula. **Part (c)(ii)** was not so well answered. Many candidates did not realise that they had to put their answer to **part (c)** equal to x and then solve the equation to find x.

Question 17

This question proved difficult for some candidates. Some candidates confused 'volume' with 'surface area' and found it difficult to find an answer for 'w'. Other candidates did write $90 = 5 \times 2.5 \times w$ but then went on to subtract 12.5 from 90 instead of dividing.

Question 18

In **part (a)** there were many correct answers. The most common wrong answer was to write 0.9×10^{-4}. In **part (b)** many candidates managed to work out the product but then had problems putting their answer into standard form. The most common answer for this part was 15.17×10^{8}.

Question 19

Most candidates appeared to have a graphing calculator and could sketch the graph well. Some graphs did not cross the y-axis as requested in the specified domain. Those candidates who drew the graph correctly could then find the intersection with the x-axis in **part (b)**, the intersection with the y-axis in **part (c)** and the coordinates of the minimum in **part (d)**.

Question 20

There were some correct answers in **part (a)**. Many candidates used the formula for simple interest here rather than compound interest. In **part (b)**, a few candidates tried to use the compound interest formula rather than the one for simple interest. Some candidates realised that they had to find the interest only before using the simple interest formula and most of these candidates went on to find the correct answer. Some candidates knew how to find the interest but used 1939 rather than 189.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/32
Calculator (Core)

Key messages

To succeed in this paper, it is essential for candidates to have completed the full syllabus coverage. Sufficient working must be shown and full use made of all the functions of the graphics calculator that are listed in the syllabus.

General comments

Candidates continue to perform well on this paper. They were well prepared and, in general, showed a sound understanding of the syllabus content. Presentation of work continues to improve though some candidates are still reluctant to show their working, writing down answers without the supporting methods. Calculators were used with confidence though it does appear that some do not have a graphical calculator as the syllabus requires. Most candidates attempted every question.

Diagrams were drawn carefully though some were sketching graphs in pen; this should be avoided. Straight lines on a graph should be drawn with a ruler. In general, calculators were used efficiently and accurately though there were instances where candidates used 'pencil and paper' methods when a calculator method was more appropriate. Unless otherwise stated in the question, answers should be given to 3 significant figures.

Comments on specific questions

Question 1

Candidates had a good grasp of the three different aspects of time in this question. In **part (b)**, a number forgot to include 'pm' with their answer of 2.25. In **part (c)**, some gave the answer as 84 this being the base 10 subtraction of 1609 and 1525 rather than the time subtraction.

Question 2

(a) Many did not know the meaning of faces, edges and vertices with relation to the cuboid. A common wrong answer was 6 faces, 8 edges and 12 vertices rather than the correct answer of 6 faces, 12 edges and 8 vertices.

(b) Most could find the volume of the cuboid correctly though some incorrectly found the surface area instead. A correct answer for the volume usually meant that the units were identified correctly.

Question 3

There were many completely correct answers to each part of this question. Some gave all the even numbers and all the square numbers in the range rather than just one of them, as required. In **part (c)**, a few failed to give all six factors of 20.

Question 4

This was usually answered correctly though often with no working shown. For a small number, this meant that part marks could not be awarded when an incorrect answer was given.

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Question 5

Many candidates correctly found the two amounts of money. Very few failed to use the exchange rate in the correct way. Two decimal place answers for money should be encouraged.

Question 6

It was common to see the properties of 'angles on a straight line', 'alternate angles' and 'angles in an isosceles triangle' being applied correctly to the angles in the diagram. Many provided three correct answers.

Question 7

Though a large number of candidates found the correct answer for the radius here, some misread the question. Of these, some thought the diameter was 15 cm and others thought the radius was 15 cm and went on to find the area or circumference. When candidates followed the correct method, the answer was sometimes spoilt by giving it to an inappropriate degree of accuracy. Candidates should always use either their calculator value for pi or 3.142.

Question 8

There were many fully correct answers to all three parts of this question. Some errors did occur in the two parts of **part (a)** when candidates misread the information given. In a few cases, 177 was written as 117 or 18 as 8. A few got the order of operations wrong when rearranging their equation in **part (a)(ii)**. Finding the formula in **part (b)**, though often correct, was sometimes marred by the omission of the subject, C, or by misplacing one of the elements of the formula.

Question 9

Again, there were many fully correct answers to both parts. Mistakes were: not cancelling far enough in **part (a)**, misreading the total mass in **part (b)** as 540 g and making rounding errors in the answers to **part (b)** after using $\frac{560}{42}$ as 13.3.

Question 10

The expression was found correctly by many candidates. By far the most common error was not combining the y terms correctly giving an answer of $15x^7y$. Occasionally, one of the other two terms was wrong with 8 instead of 15 and x^{12} instead of x^7 being the common errors.

Question 11

Candidates performed well on this question. Few misread the scale, with the majority plotting the points accurately.

Most knew the correlation was negative though a few thought it was positive and some described the correlation rather than using the appropriate mathematical terms. Many drew a line of best fit through the mean point, in tolerance and with a ruler. Some did not do one or more of these three requirements. Most used their line of best fit and an inflation rate of 3.0 per cent correctly for an answer in **part (d)**, though a few misread the question and used 4.0 per cent.

Question 12

Most listed all four elements of R in **part (a)** though some omitted 2 and 7. In **part (b)**, many correctly wrote $P \cap Q$ to describe the first diagram. Some thought the answer to the second diagram had to contain A and B though in fact it was just A'.

Question 13

Those that had a graphical calculator used it well and could answer each part successfully. It is important to remember that, even though it is a sketch, it is expected that a straight line should be drawn with a ruler.

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Question 14

Most candidates could not identify the right angled triangle required to answer this question. Some thought that the given triangle *OAB* was right angled. The clue in the question to 'use trigonometry' was overlooked by many. It was common to see Pythagoras' theorem being used.

Question 15

Many interpreted the formula correctly and gave correct answers to the first two parts of the question. A few put $T = 1$ in the formula and gave 5400 as the answer to **part (a)** and a small number put 1.08 for the value of R in **part (b)**. Invariably, the given formula was used correctly in **part (c)** though it was common to see candidates finding the value of the investment and not the amount of interest gained.

Question 16

A significant number of candidates used the appropriate formulae, combined their answer to each and successfully showed that their total, to more than 3 significant figures, would round to the required value. A few rounded their intermediate answers, leading to an inaccurate total. A small number used incorrect formulae. All candidates should be made aware of the list of formulae given on page 2 of the exam booklet.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/33
Calculator (Core)

Key messages

To succeed in this paper, it is essential for candidates to have completed the full syllabus coverage. Sufficient working must be shown and full use made of all the functions of the graphics calculator that are listed in the syllabus.

General comments

Candidates were well prepared and, in general, showed a sound understanding of the syllabus content. Presentation of work continues to improve though some candidates are still reluctant to show their working, writing down answers without the supporting methods. Calculators were used with confidence though it does appear that some do not have a graphical calculator as the syllabus requires. Candidates had sufficient time to complete the paper. Most attempted every question.

Diagrams were drawn carefully though some were sketching graphs in pen; this should be avoided. Straight lines on a graph should be drawn with a ruler. In general, calculators were used efficiently and accurately though there were instances where candidates used 'pencil and paper' methods when a calculator method was more appropriate. Unless otherwise stated in the question, answers should be given to 3 significant figures. Care must be taken so that the figures used in a calculation are the ones quoted in the question.

Comments on specific questions

Question 1

Most candidates answered all parts of the question correctly. Most interpreted the diagram accurately though, in **part (b)**, a number found the difference between the number of eggs on Thursday and Friday instead of Tuesday and Friday. In **part (d)**, a few misread $3.35 as $3.55, $3.25 or $3.315.

Question 2

Few candidates showed working for this question. This meant that when the answer was incorrect, no part marks could be awarded. Often a truncated 3 decimal place answer was given rather than a rounded 3 decimal place answer. Some confused decimal places with significant figures. With questions like this, candidates should write down their unrounded answer first before giving their rounded answer.

Question 3

In **part (a)**, 'triangle' and 'pentagon' were well known names for the shapes drawn but the kite was often labelled as diamond or rhombus. Drawing the lines of symmetry caused problems for many. Though the line of symmetry for the kite was usually correct, many drew one on the triangle and the pentagon rarely had the full 5 lines.

Question 4

Most candidates found at least one of the values in the code. Few found all four. The digit causing most difficulty was the cube number greater than 1 and the digit causing least difficulty was the highest common factor (HCF) of 12 and 8.

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Question 5

Few candidates had problems calculating the mean and the range of the boys' and the girls' data. However, some did not know what was required to compare the values calculated.

Question 6

The rules for solving equations are well understood. Very few candidates did not score full marks in both parts of the question.

Question 7

Part (a) posed a problem for many with $\frac{12}{6}$ or 2.4 being very common wrong answers. **Part (b)** was answered more successfully though some gave the reciprocal, $\frac{13}{1}$, as their answer. The majority of candidates gave the correct answer to the percentage in **part (c)**.

Question 8

Most knew of the simple interest formula though a number forgot the ÷100 part. Many found the value of the investment correctly but a similar number just found the interest and forgot to add the amount invested. A few incorrectly used the compound interest formula.

Question 9

Few found the height of the pyramid correctly. Many thought the area of the base was 23 or 4 × 23 rather than 23^2, 23 cm being the length of the side of the square base. However, candidates did show that they could set up an equation and rearrange it correctly.

Question 10

Very few candidates reached a correct answer in either part of this question. A number made no attempt at the question. Some managed to partly rearrange the equation but then gave –6 as their answer for the gradient in **part (a)**. **Part (b)** was found equally challenging. Few candidates recognised that an efficient approach was to substitute $y = 0$ into the equation and solve for x.

Question 11

Most used their calculator correctly and found the answer 23700 with some able to change this into standard form.

Question 12

Some found the required formula from the formula list on page 2, used an appropriate value for pi (the calculator value or 3.142) and evaluated the expression correctly. A number of these candidates did not change their answer to litres while others used an incorrect conversion factor. An incorrect formula was often seen with $\pi \times 160^2 \times 9$, $\pi \times 160 \times 9$ and $\pi \times 80 \times 9$ being the most common.

Question 13

Candidates did start this question by multiplying out the brackets on the left side of the equation. However, very few candidates knew how to proceed after that.

Question 14

Many knew the mathematical name for the line AB and that a tangent makes an angle of 90° with the radius of the circle. Applying trigonometry to the right angled triangle in the diagram was challenging for some though a good number evaluated the length successfully.

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Question 15

It was clear that candidates knew that there were 1000 m in 1 km and 3600s in 1 hour. The difficulty came when deciding to multiply or divide by these factors. Some divided by 60 instead of 3600 and others multiplied by 100 instead of 1000.

Question 16

Candidates found this difficult. Most knew the shaded area had something to do with the complement of the sets but were unsure of how to put that in the required notation. A few missed the brackets out of an otherwise ‘correct’ answer.

Question 17

Many coped well solving the equation, taking the square root of 64 and then the cube root of 8. A number found the cube root of 64 and gave the answer 4.

Question 18

It was clear that a number of candidates did not have access to a graphical calculator. Those that did performed very well on all parts of this question. Some candidates did not give their answers to **part (c)** to a correct level of accuracy. Where answers are not exact, they should be given to 3 significant figures.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/41
Calculator (Extended)

Key message

Candidates are expected to answer all questions on the paper, so full coverage of the syllabus is vital. The recall and application of formulae and mathematical facts to apply in familiar and unfamiliar situations is required, as well as the ability to interpret mathematically and problem solve with unstructured questions.

Communication and suitable accuracy are also important aspects of this examination and candidates should be encouraged to show clear methods, full working and to give answers to 3 significant figures or to the required degree of accuracy specified in the question. Candidates are strongly advised not to round off during their working and to work at a minimum of 4 significant figures to avoid losing accuracy marks. Candidates should be aware that it is inappropriate to leave an answer as a multiple of π or as a surd in a practical context, unless requested to do so.

The graphics calculator is an important aid, and candidates are expected to be fully experienced in its appropriate use. It is anticipated that the calculator has been used as a teaching and learning aid throughout the course. There is a list of functions of the calculator that are expected to be used and candidates should be aware that the more advanced functions will usually remove the opportunity to show working. There are often questions where a graphical approach can replace the need for complicated algebra and candidates need to be aware of such opportunities.

General comments

The candidates were well prepared for this paper and there were many good scripts, showing all necessary working and a suitable level of accuracy. Candidates were able to attempt all the questions and complete the paper in the allotted time. The overall standard of work was good and most candidates showed clear working together with appropriate rounding.

A few candidates needed more awareness of the need to show working, either when answers alone may not earn full marks or when a small error could lose several marks in the absence of any method seen. This is particularly noticeable in ‘show that’ style questions, when working to a given accuracy.

There could be some improvements in the following areas:

- Care in handwriting, particularly with numbers.
- Candidates should not overwrite answers as they do not scan well.
- Care in copying values from one line to the next.
- Care in reading the question:
    - noticeable in transformation questions where the requirement is usually for a single transformation only,
    - ensure use of the correct formula in calculations involving circles,
    - check whether interest or total investment is required in savings problems,
    - check whether it is the equation of a line that is required; do not assume that is the equation of the perpendicular bisector.
- Care in reading scales on graphs.
- Wherever possible, consider use of simple sketches to aid solutions, this usually gains credit where seen.

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The sketching of graphs does continue to improve and there was more evidence of the use of a graphics calculator supported by working. Candidates need to be aware that in drawing graphs, points should be plotted within $\frac{1}{2}$ square (1 mm) of the correct position. There was, however, evidence of use of facilities in the calculator that are not listed in the syllabus. These facilities often lead to answers given by candidates without any working and this must be seen as a high-risk strategy. Candidates must take care to ensure that their calculator is in the correct mode when calculating angles, i.e., degrees not radians.

The most accessible topics were those on transformations, currency conversion, solving linear inequalities, scatter diagrams, curve sketching, percentages and compound interest.

The most challenging topics were inequalities within graphs, bearings, mensuration, direct and inverse proportionality, simple interest, ratio and circle formulae.

The candidates' overall responses to all specific questions will be detailed in the following comments.

Comments on specific questions:

Question 1

(a) A well-answered, straightforward opening to the paper. The usual tolerance of $\frac{1}{2}$ square (1 mm) was applied and it was necessary to plot at least 2 points correctly to gain the first mark. A few candidates incorrectly reversed their x and y coordinates whilst several omitted this part completely.

(b) Most answered this part correctly, although an occasional negative or linear response was given, Comments on the strength of the correlation were ignored.

(c) The majority of candidates were able to use their graphical calculators efficiently to obtain at least one mark for either value seen correctly to at least 3 significant figures, however, many dropped a mark for rounding or truncating prematurely. Credit was strictly only given in their working for more accurate values if seen in an expression or an equation in x. A small number gained no marks for omitting the 'x' in their final equation.

(d) Most were able to use their answer from the previous part to gain the mark, but some solved their $y = ax + b$ by substituting for $y = 57$ instead of x.

Question 2

This was the most accessible question and was answered well, with the overall majority gaining the mark. Any errors seen were usually the result of premature rounding of the numerator.

Question 3

Another straightforward part with most candidates awarded both marks, some worked in Dirhams and gave their final answer as 39.5, earning a special case mark. However, some incorrectly multiplied 1185 by 3.95 as their first step.

Question 4

There were many correct answers seen in this question. Common errors resulting in marks being dropped were for only giving the answer to 2 significant figures, a ratio approach whereby the calculation was implied and not explicitly shown, expressing the new rate as a percentage of the old (answering 110.3, earning M1) and the increase in pay given as a percentage of the new rate. Many candidates incorrectly used 19.3 as the denominator in their calculations.

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Question 5

Most candidates were able to gain at least one mark for the sight of $-\frac{2}{5}$ or – 0.4, either in their working or on the answer line but often with the given final inequality incorrect. Many others gained a method mark for a correct first step shown in the form $ax > b$.

Question 6

(a) The most common answer seen was $2560 which scored the method mark for having found the correct amount of simple interest of $560, but this had then been incorrectly added on to find the total amount of the investment. A few candidates incorrectly used compound interest in this part.

(b) Similarly to the previous part, the total value of the investment was often submitted as the final answer, rather than just the interest earned and many were awarded the method mark for $2636 seen. The compound interest formula was confidently applied by most candidates, with only a handful resorting to year-by-year calculations.

(c) A pleasingly high success rate was achieved here with the preferred approach being to use either logarithms or trial and improvement; very few instances of graphical solutions were seen. Most candidates were able to set up the required equation, usually getting as far as the second method mark before struggling to solve the equation to find the exponential value. A few answers of 15 were seen, following on from their n value of e.g. 14.0000118… losing the final mark.

Question 7

(a) Most candidates were able to calculate the crucial missing length of, e.g., AD of 13 cm using their understanding of perimeter, then going on to find the base of triangle as 5 cm. These candidate were sometimes uncertain of how to calculate the perpendicular height. Many successfully used the preferred implicit method of Pythagoras but some used trigonometry and calculated the height to be greater than 13. All of the first three marks were often awarded for being seen on the diagram.

Two alternative methods were then used, with the standard approach being to use the area of a trapezium formula, leading to the correct solution. Others broke the shape down into a rectangle and two triangles; however, this often led to an incorrect solution. Several candidates joined the mid-point of AB to C and D assuming that they were dealing with 3 equilateral triangles, this usually only gained one mark. Those candidates that proceeded using a perpendicular height greater than 13 were unable to gain further credit.

(b) Many fully correct solutions were seen with candidates able to apply trigonometry to their ‘triangle’, others scored the method mark using their values but were again restricted to the perpendicular height being less than 13.

Question 8

(a) The overall standard of graph sketching continues to be high, with candidates showing good use of their graphical calculators and accurate sketching. Occasionally, marks were lost for an excessive overlap or a large gap around the asymptote at $x = -2$. Excessive feathering or curlbacks were rarely seen.

(b) The correct coordinates were not always given to the required 3 significant figure accuracy and the negative sign was frequently omitted from the x-coordinate.

(c) Similar to the previous part, the accuracy was often lost here and the common incorrect answer of 1.6 was seen on many responses.

(d) Candidates had limited success with this part, with many misunderstanding what was required. Any negative value or their y-coordinate from the previous part would have gained the mark; 0 was condoned here.

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(e) A discriminating part with only a small minority of candidates gaining both marks. Some found the correct values, but the inequalities had to be fully correct. Inequalities in y instead of k were condoned but not for those in x.

Question 9

(a) Another challenging part in which candidates had to use their knowledge of bearings to find the correct angles in triangle ABC; many struggled with this aspect and could only gain the two method marks available for correctly applying the sine rule. A few candidates only picked up one mark for the correct identification of any of the 3 acute angles, often seen on the diagram.

(b) Most were able to pick up the method mark for correctly applying the area formula to the triangle using, e.g., their BC and AB, or acceptable equivalence, with many gaining full marks due to a large range of acceptable answers. However, several assumed the triangle was right-angled and did not multiply their lengths (AB and BC) by sin (their 33).

Question 10

(a) Most candidates had a good grasp of this topic, correctly applying the inverse relationship and gaining both marks but some used direct proportionality here.

(b) Many correct solutions were seen, however, rearranging $20\,000 = \frac{20}{x^3}$ proved challenging for a significant number of candidates, often incorrectly leading to $x^3 = \frac{20000}{20}$ or $x^3 = 20000 \times 20$. Some candidates gained the method mark for correctly rearranging their equation to make x^3 the subject but then incorrectly square rooted to find their final answer.

(c) Another difficult part in which the majority of candidates gained the first method mark for correctly setting up $p = cy^2$, however, only a small number then successfully continued to gain both marks for their final answer in a fully simplified form. Many substituted the given x value into their equation instead of finding y by using their answer from **part (a)**.

Question 11

Few candidates achieved full marks in this question. Most candidates were able to identify the median point at (48, 60) but then did not plot the maximum point, others found the lower quartile point correctly but not the upper quartile point at (60, 90). Some responses showed all 4 points plotted correctly but then not joined up with a straight line or curve, whilst others used the origin as the starting point instead of the given point at (12, 0). The usual tolerance of $\frac{1}{2}$ square (1 mm) was applied to the candidates' plots.

Question 12

Responses with full marks awarded were rarely seen, however, many gained the first two available marks for simply repeating the information given in the first line of the question, but marks were not awarded if the translation was also added. The need to supply a single transformation was not always fully noted by candidates; more than one transformation meant that no marks could be awarded. The lack of axes on the supplied grid caused additional issues.

Question 13

(a) Most candidates initially made a strong start to this part, correctly calculating the required gradient by dividing the change in y-values by the change in x-values, although some inverted these whilst others struggled with two of the given values being negative. Many then correctly substituted the coordinates of A or B or the mid-point at $(2, -\frac{1}{2})$ into $y =$ (their m) $x + c$ to calculate the y-intercept before providing a three-term equation for full marks. Several omitted the '$y =$' on the final answer line.

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Several candidates found the mid-point of *A* and *B* and then proceeded to find the equation of the perpendicular bisector.

(b) Mixed responses were seen in this part with many candidates unsure how to divide the line AB into the given ratio to find the coordinates of *C*, several started off using Pythagoras to try to calculate the length of *AB* but this approach was usually unsuccessful. Similar to the previous part, some did not resolve the issue of the two points having negative coordinates. Candidates who sketched a diagram to aid their solutions were generally successful.

Question 14

This was the most challenging and discriminating question on the paper, with many candidates unfortunately confusing the formulae for the area and the circumference of a circle which led to many responses scoring zero marks.

(a) The majority of candidates realised that they needed to calculate a fraction of the whole circle and used the correct formula with the radius as 15m or 25m, however several others incorrectly used 10m as their radius or found the areas of whole circles. The alternative approach of dividing 360 by 35, approximating to, e.g., 10.3, then dividing this into the two full circle areas usually led to the final accuracy mark being lost. Final answers with π left in were awarded full marks, if when evaluated they were in the given range.

(b) Many gained the first method mark for correctly finding the length of either arc; however, the necessity to add the two arcs together was not always applied, with many using the difference again. Several candidates were awarded two method marks for adding the lengths together but then omitted the lengths of *AB* and *CD*, or simply added them incorrectly. Similarly, the alternative method seen in the previous part also led to inaccurate final answers. It was rare to see answers with π left in the final answer as 20 should also have been added.

Question 15

(a) Several correct solutions were seen in this challenging part, usually in the expanded form of $f(x) = 2x^2 - 4x - 6$. Sometimes, the correct factors of $(x + 1)$ and $(x - 3)$ were seen in the working but were not multiplied together to gain credit. A single method mark was often awarded for a quadratic function which passed through $(0, -6)$. The alternative method mark for the substitution of all 3 given points into $y = ax^2 + bx + c$ was rarely completed successfully.

(b) This part discriminated well, with the factorised final answer of $2x(x - 4)$ rarely seen, many candidates were aware that they needed to replace x in their $f(x)$ to represent the translation but unfortunately this was usually seen as $(x + 1)$ instead of the required $(x - 1)$. No responses were awarded a mark for a correct sketch seen.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/42
Calculator (Extended)

Key message

Candidates are expected to answer all questions on the paper, so it is essential that the whole syllabus is covered.

The efficient and accurate use of a graphics calculator is fundamental to the success of candidates in this syllabus. It is anticipated that the calculator has been used throughout the course. There are often questions where a graphical approach can replace the need for complicated algebra and candidates need to be aware of such opportunities. For example, better use of the calculator could be made in solving compound interest problems and the calculator should always be used when a purely algebraic approach to solving equations involving cubic or higher powers may be beyond the scope of the syllabus. There is a list of functions of the calculator which can be used but candidates should be aware that the use of some more advanced functions may lead to the candidate showing no working. If a slight error is made, this could result in no marks being awarded. Candidates should always show at least an outline of their method.

Communication and suitable accuracy are also important aspects of this examination and candidates should be encouraged to show clear methods, full working and to give answers to at least 3 significant figures when necessary. Candidates are strongly advised not to round off during their working but to work at a minimum of 4 significant figures accuracy. Most candidates followed the rubric instructions carefully but there continues to be a number of candidates of all abilities who lose accuracy marks either by making premature approximations in the middle of a calculation or by not giving answers correct to the specified degree of accuracy.

General comments

Compared to the examination in November 2024, the number of marks available had changed from 120 to 75 and the style of the questions had also changed as there were fewer multi-part questions and more simple one-part questions. The candidates were very well prepared for this change and there were many excellent scripts. Candidates were able to attempt all the questions and to complete the paper in the allotted time. The overall standard of work was very good and most candidates showed clear working together with appropriate rounding.

Some candidates needed a greater awareness of the need to show working, either when answers alone may not earn full marks or when a small error could lose several marks in the absence of any method shown. This is particularly noticeable in ‘show that’ style questions where candidates are required to reach an answer correct to a given degree of accuracy. Here, it is important that detailed working leads towards a value more accurate than that stated in the question. In order to gain the accuracy mark, the value obtained before the value given in the question must be written down.

The sketching of graphs continues to improve, especially in the drawing of asymptotes to aid correct placement, and there was more evidence of the use of a graphics calculator supported by working. However, there is still some evidence of use of functions in the calculator that are not listed in the syllabus. These functions often lead to answers given by candidates without any working and their use must be seen as a high-risk strategy.

Topics on which questions were well answered included ratios, trigonometry, regression analysis, and solving algebraic equations involving fractions.

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Difficult topics included estimating numbers to 1 significant figure accuracy, factorisation involving a non-linear common factor, dealing with inequalities involving functions with asymptotes, converting an annual interest rate to a monthly one, and correctly using Pythagoras' theorem with lengths expressed algebraically.

Question 1

(a) Many candidates approximated each number to one significant figure as required and gave the correct value for the estimate. However, a significant number of candidates made a mistake, usually estimating 44.9 as 50 or failing to give the correct estimate for the square root, and only scored one method mark. Some candidates gave $\sqrt{140}$ as 11.8 first and this was not given credit as the question required the 140 to be estimated correctly to one significant figure, $\sqrt{100}$.

(b) Most candidates gave the correct answer to this part.

Question 2

(a) Most candidates gave the correct answer to this part.

(b) Most candidates gave the correct answer to this part.

(c) Most candidates gave the correct answer of 60.8 but a substantial number gave an answer of 60.3, resulting from using midpoints all 0.5 less than the correct values. These candidates were credited with a Special Case award of 1 mark. Of the remainder, most showed some working with at least 5 correct midpoints to earn the method mark. However, there are still some candidates who show no working. As a minimum, the mid-points should be written down.

Question 3

This was a very simple piece of algebra and almost all candidates gave the correct answer. However, a small number of candidates went on to give $\left(2\sqrt{x}+3\sqrt{y}\right)\left(2\sqrt{x}-3\sqrt{y}\right)$ as their final answer and this was not awarded the second mark.

Question 4

Almost all candidates gave the correct answer and most wrote down the equation showing the sum of the angles equal to 360° so that, on the rare occasion when a slip was made in solving the equation, a method mark could be obtained.

Question 5

Almost all candidates realised that, in order to find the area of the circle, the diameter had to first to be divided by 2 to find the radius.

Question 6

Most candidates gave the correct answer but sometimes a final answer of 263 and 368 was seen. This was not accepted for full marks as the sum of these values is not 630. The error was in giving the actual values to 3 significant figures, but this was not appropriate here as both values were exact.

Question 7

This was a fairly straightforward factorisation; the only difficulty was in ensuring that the common factor, whichever was chosen, did not have its signs reversed, for example, $3a(x-y)+4b(y-x)$. Some candidates were unable to deal with this and gave an answer with at least one incorrect sign, this example often leading to $(3a+4b)(x-y)$. A method mark was only available to candidates who successfully dealt with this issue.

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Question 8

(a) (i) Many good sketches were seen. This was helped by the increasing number of candidates who drew the asymptotes first in order to better guide their placement of the three branches of the graph. As a result, there were fewer examples of overlaps between the branches. The two outer branches were almost always correctly placed but the inner branch was sometimes incorrectly placed. The calculator display would have shown that the x-coordinate of this local maximum point was negative and therefore the turning point should have been to the left of the y-axis.

(ii) Most candidates gave both intercepts correctly, but some gave the 0.781 answer as 0.78. As the values are inexact, it is required that answers are given to 3 significant figures.

(iii) Most candidates gave the equations of the two required asymptotes correctly. Some, however, omitted the '$x =$'or gave '$y =$'.

(b) Almost all candidates drew the required straight line graph correctly.

(c) As is usually the case with this type of question, there are many candidates who try to answer the question using purely algebraic methods, when the entire setup of the question directs them to use a graphical approach.

Most candidates did realise that the x-coordinates of the intersections of f(x) and g(x) were required. However, only a few then went on to give all 3 inequalities correctly. Very few candidates make full use of their sketches; for example, the parts of f(x) which are greater than g(x) could be outlined by using bolder shading. By doing so, candidates would immediately see that there are 3 inequalities and that the x values of the asymptotes play an important part. It is important for candidates to understand that x cannot take the x value at an asymptote. The incorrect inequality $-1.33 \leq x \leq -1$ was often seen.

Question 9

For almost all candidates, this was an extremely simple probability question and the correct answer was usually given. A very small number of candidates did not read the question carefully enough and gave a calculation involving probabilities with replacement.

Question 10

(a) This was a standard regression question and most candidates found the correct equation. There were some errors in the precision of the coefficients which were not always given correctly to 3 significant figures as required.

(b) The regression equation was used correctly by most candidates to give an acceptable answer.

(c) The answer estimated in the previous part was not reliable because of extrapolation and this answer was given by many candidates. Many candidates gave convincing explanations that the French value used was not within the range of the original data. Some stated that the estimate was not reliable because of anomalous data within the data set or because the data set was too small, both of which were unacceptable reasons. Among those who believed the estimate was reliable, several cited a high correlation coefficient, which was also not a valid justification.

Question 11

This was a question designed to test the candidates' ability to correctly put the given information onto the diagram and use simple trigonometry to calculate the required length and almost all candidates were able to do so. A few candidates placed the acute angle incorrectly and this was the most common error seen.

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Question 12

This algebraic equation with fractions was solved correctly by most candidates, many of whom set out their working in an exemplary manner. When some candidates did make an error, it was relatively easy to award method marks when working was clearly set out. It is worth pointing out that when the answer is exact, as was the case here, it should not be rounded to 3 significant figures. A final answer of 1.13 was often seen, but it was not penalised provided the exact answer of 1.125 or $\frac{9}{8}$ or $1\frac{1}{8}$ was seen as the answer in working.

Question 13

This was a more difficult question which many candidates attempted by expanding the brackets and then trying to cope with the resulting algebra, which did not lead to a successful outcome. Dealing with a common term such as $(2x-y)^2$ was probably unfamiliar to some, but many candidates dealt with it correctly and arrived at the final answer.

Question 14

(a) This was a question which required an application of the cosine rule to obtain the answer and most candidates were able to do so correctly. A very small number of candidates used the information given in the next part, that $DAC = 41.6^{\circ}$ instead. This was not allowed as the information given later in a question cannot be used in a preceding part. In this case, these candidates did not realise that they were using a circular argument, i.e., using the result of **part (b)** to calculate the answer to **part (a)** which is then used to calculate the result in **part (b)**.

(b) This was a difficult question for many candidates as it required them to show the result, an angle, correct to 1 decimal place. As the given angle was 41.6^{o}, in order to obtain this level of accuracy candidates had to work to at least 4 significant figures throughout. Those who did so obtained a value between 41.58 and 41.59 and were awarded the accuracy mark. Those who used the result from **part (a)** rounded to 3 significant figures, 14.6, usually obtained a value of 41.65… and this did not score the accuracy mark. The candidates who kept their result from **part (a)** in their calculator's memory and then used it in **part (b)** demonstrated the best technique.

(c) Although the shape appeared complex at first sight, finding its area simply required candidates to apply the correct formula for the area of each triangle and then subtract the smaller area from the bigger area, which most candidates did this successfully. Occasionally, some candidates obtained a final result outside the acceptable range of accuracy; this was inevitably because of premature rounding of the lengths of sides or of one of the areas calculated.

Question 15

(a) (i) This was another 'show that' question so it was important that a correct initial equation was written down, followed by each step required to find the given answer. Most candidates showed full working and obtained full marks. A small number of candidates did not gain any credit because they did not write down an acceptable first step; writing down $x(1+7.5\%)^5 = 11485$ was not sufficient as the 7.5 per cent had to be correctly converted to a fraction or decimal. Another error commonly seen was for the $(1.075)^5$ term to be approximated prematurely to 1.436 or 1.44. As the question required candidates to show that $x = 8000$ correct to the nearest dollar, it was essential to work to at least 5 significant figure accuracy.

(ii) This was a standard question and most candidates gained full marks, although some took a risk in showing either minimal working or no working at all. Many demonstrated a proficient use of logs to solve their equation. Very few candidates chose a graphical approach to show their method.

(b) There were some very good answers but, for many candidates, this part proved to be very difficult. It was crucial that candidates understood that turning an annual interest rate into a monthly rate required the use of compound interest techniques. Those who did not understand this often gave the incorrect answer of 0.625 per cent, obtained by dividing the annual rate of interest, 7.5 per cent, by 12.

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Question 16

This was an unstructured probability question which required candidates to set up an equation and then solve it to find the two answers. There were many good solutions with work set out clearly and easy to follow. However, some candidates did not attempt to write down an equation and tried to find values which worked out to match the stated facts; this method led to little or no success.

Candidates were expected to write down $\text{p(red)} = \frac{x}{24}$ and deduce that $\text{p}(\text{blue}) = \frac{24 - x}{24}$. This second probability was awarded 1 mark if no further progress was made. They were then expected to write down the equation $2 \times \frac{x}{24} \times \frac{24 - x}{24} = \frac{4}{9}$. However, as is often the case in this type of probability question, some candidates omitted the 2.

In either case, this equation simplified to a quadratic which then had to be solved to give the answers. Those who had the 2 in their equation were usually successful, but those who omitted it could still gain up to 3 method marks.

Question 17

(a) This was a very difficult question for many candidates, and the modal score was 0 marks out of 4. The first difficulty arose from working out the curved surface area of the cone. The formula was given in the list of formulas at the beginning of the question paper. However, some candidates used the vertical height of the cone, given in the question, as the slant height and no further progress could be made. Others realised that the slant height had to be found using Pythagoras' theorem and an attempt was made to do this. The correct $l^2 = r^2 + (3r)^2$ was seldom seen; more common was $l^2 = r^2 + 3r^2$ leading to $l = 2r$. This did not meet the criterion for a method mark to be awarded. Only those who had a correct statement were awarded the first method mark. To gain the second method mark, it was then necessary to add the surface area of the base of the cone to find the total surface area and set this equal to 209.22, but many candidates omitted this addition. Finally, r had to be made the subject of the equation and then the answer followed.

(b) This was a relatively easy question and most candidates realised that the square root of the ratio of the surface areas would give the required linear scale factor to find the radius of the larger cone. Although the correct answer could not be obtained by those who had not solved the previous part correctly, most were able to score the two method marks available here.

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Paper 0607/43
Calculator (Extended)

Key message

Candidates are expected to answer all questions on the paper so it is essential that the whole syllabus is covered.

The efficient and accurate use of a graphics calculator is fundamental to the success of candidates in this syllabus. It is anticipated that the calculator will have been used throughout the course. The use of the graphics calculator is essential for the sketching of algebraic functions where questions may ask for equations of asymptotes or for values satisfying given inequalities. There are often questions where a graphical approach can replace the need for complicated algebra and candidates need to be aware of such opportunities. For example, more use could be made of the calculator in solving compound interest problems. There is a list of functions of the calculator which are expected to be used.

Communication and suitable accuracy are also important aspects of this examination and candidates should be encouraged to show clear methods, full working and to give answers to at least 3 significant figures when necessary. Candidates are strongly advised not to round off during their working but to work at a minimum of 4 significant figures accuracy. Most candidates followed the rubric instructions carefully but there continues to be a number of candidates of all abilities who cannot be awarded accuracy marks as they make premature approximations in the middle of a calculation or they do not give answers correct to the specified degree of accuracy.

General comments

Compared to the examination in November 2024, the number of marks available has changed from 120 to 75 and the style of the questions has also changed as there were fewer multi-part questions and more simple one-part questions. The candidates were well prepared for this change and there were some very good scripts. Most candidates were able to attempt all questions and to complete the paper in the allotted time, although some may not have had access to a graphics calculator. The overall standard of work was good and many candidates showed clear working together with appropriate rounding.

Many candidates needed a greater awareness of the need to show working, either when answers alone may not earn full marks or when a small error could lose a number of marks in the absence of any method seen. This is particularly noticeable in ‘show that’ style questions where candidates are required to reach an answer correct to a given degree of accuracy. Here it is important that working is shown which leads towards a value more accurate than that stated in the question.

The sketching of graphs continues to improve, and many candidates showed evidence of the use of a graphics calculator supported by working. However, there is still some evidence of use of functions in the calculator that are not listed in the syllabus. When using these functions, candidates often give answers without any working and the use of such functions must be seen as a high-risk strategy.

Topics on which questions were well answered included currency conversion, simultaneous equations, changing the subject of an equation, and compound interest.

Difficult topics include sketching to interpret algebraic equations and to show regions defined by algebraic inequalities, the magnitude of a vector, and working with the sector of a circle.

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Question 1

Most candidates gave the correct answer to this question. A small number reversed the answers.

Question 2

Most candidates gave the correct answer to this question. A small number gave the answer to only 3 decimal places.

Question 3

Most candidates gave the correct answer to this question.

Question 4

(a) Many good sketches were seen, with almost all candidates showing the minimum point clearly and ensuring that the function passed through the origin.

(b) Most candidates gave both zeros, but some lost a mark by including the *y*-coordinates.

(c) Most candidates gave the correct answer to this part. A small number of candidates omitted one of the negative signs.

(d) There were very few correct answers to this part, and many candidates gave no response at all.

(e) Many candidates gave both values to the required degree of accuracy, but some only gave one of the values. The candidates were not instructed to add the straight line to their sketch, but it should be the natural thing to do in order to solve the equation. Those who added the straight line to their sketch were more likely to see that there were two solutions. Some candidates who attempted a purely algebraic approach should have realised that solving an equation involving the fourth power of *x* is well outside the demands of the syllabus.

(f) (i) Most candidates added the correct vertical line to their sketch, but a small number added the line $y = -2$.

(ii) Only a small number of candidates showed the correct region. Those candidates who had not added the straight line to their sketch in **part (e)** were at a great disadvantage here.

Question 5

There were many completely correct solutions with working shown as required. Most candidates chose to eliminate a variable by adding or subtracting two equations, but some chose to use a substitution method, usually using $y = 3x - 1$ to obtain an equation in *x*. It is very important that when a question says, 'You must show all your working', that this instruction is followed. Some candidates showed no working and were only able to score 1 mark out of the 3 available for two answers which satisfied at least one of the equations.

Question 6

Many candidates gave the correct calculation of 0.9 × 0.85 to obtain the value of 0.765. The majority then went on to give the correct answer of 23.5 but some gave a final answer of 76.5 which was awarded the method mark. Several candidates simply added the two percentages together to give an answer of 25.

Question 7

(a) (i) The majority of candidates plotted all the points correctly and went on to draw an acceptable cumulative frequency curve or polygon, but there are still many candidates who draw multiple lines or lines which omit a point.

(ii)(a) Most candidates gave the correct answer to this part.

(b) Most candidates gave the correct answer to this part but some read off the number of plants with a height less than 30 cm and then omitted to subtract this from 100.

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(b) (i) Almost all candidates gave the correct answer to this part.

(ii) There were many correct answers but this question, which was standard in estimating a mean from a frequency table, produced a variety of incorrect methods. The most common of these was adding the 5 mid-points and then dividing by 5. Some candidates gave only an answer with no working shown when at least the mid-points should have been written down.

Question 8

Only a small number of candidates were able to give the correct answer to this question. The majority showed little understanding of the magnitude of a vector and made little progress or, in most cases, no progress at all.

Question 9

This was a standard mensuration question. In most cases, candidates showed their working clearly and it was easy to allocate method marks if the final answer was incorrect. However, some candidates were more disorganised with their calculations appearing at random in the working space. A minimum requirement was that each calculation should have been linked to the shape to which it related by some form of labelling.

There were 2 major issues in finding the answer. The first issue was in finding the surface area of the cone for which the slant height was required. Many candidates simply used the vertical height, 15, and others, although realising that Pythagoras was needed chose to evaluate $\sqrt{15^2 - 12^2}$ instead of the correct $\sqrt{15^2 + 12^2}$.

The second issue seen was when candidates did not consider the shape as a whole and worked out the surface area of each component shape and then added these together. This resulted in a final answer inflated by the addition of the areas of one or more circles. When this happened at most 3 method marks could be gained, even if the individual surface areas of the 3 shapes were all correct

Question 10

This proved to be a very difficult question for which very few candidates gave the correct answer. It was an unstructured question so that candidates had to first work out that a two step approach was necessary. In order to find the area of the sector, the radius was needed and this had to be calculated in the first step using the given perimeter. Some made an attempt but $\frac{100}{360} \times 2 \times \pi \times r$ = 48.4 was seen more often than the correct equation $r + r + \frac{100}{360} \times 2 \times \pi \times r$ = 48.4.

However, a method mark was awarded for an attempt at the first equation, and the method mark for the second step, finding the area, was dependent on at least 1 mark being scored for the first step. Those candidates who omitted the two *r* terms were therefore still able to score up to 2 marks out of the 4 available.

Question 11

Most candidates gave the correct answer for this question. The most common error was the use of an incorrect sign.

Question 12

In this type of question, the type of variation is often given in words but here it was given as an expression. This seemed to confuse many candidates who omitted the first step of writing down an equation using a constant, k, giving $y = \frac{k}{\sqrt{x+1}}$. Those candidates who did so usually found the correct answer after finding k by substituting the given values.

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Question 13

(a) Most candidates gave the correct answer but some chose to use compound interest in their method. Other errors included failing to divide by 100 to find the interest. Other candidates found the interest correctly but then failed to add it to the principal to obtain the final value.

(b) (i) This was a standard compound interest question and almost all candidates gave a correct response.

(ii) Again, a standard question answered correctly by most candidates. It was good to see the correct use of logarithms but few candidates chose to show their method by drawing an appropriate sketch with relevant points indicated. Many candidates still use a trial and improvement method, but some showed no working at all. This is a high-risk strategy as a small error could result in 0 marks out of the 4 available. As a minimum, candidates should write down an initial equation, and, if using the trial and improvement method, at least the two values on either side of the target value.

Question 14

(a) This was a standard sine rule question after candidates had found the third angle of the triangle and most gave the correct answer.

(b) This required the use of the cosine rule, and, although fewer candidates were successful than in the previous part, there were still many correct answers.

(c) This part proved to be more difficult with some candidates seeming to be uncomfortable with the fact that the triangle *ABC* was not drawn in as a triangle on the diagram. There were relatively few correct answers as most candidates did not realise that the angle *CBD*, found in the previous part, had to be added to 45 to give the angle *ABC* which was needed to enable the evaluation of the area of the triangle.

Question 15

This question involved the use of both algebra and trigonometry. Many candidates set up a correct equation and solved it to give the correct answer, but many others were unable to rearrange the equation in order to make *w* the subject. Instead of writing down the obvious equation using cos 55, some candidates chose to use the sine rule, which was more complicated but could still lead to the correct answer. However, others introduced another letter, *x*, to stand for the third side of the triangle and attempted to use Pythagoras Theorem, ignoring the $55°$ angle.

Question 16

This was a much more difficult algebraic simplification and there were very few correct answers. Although some candidates attempted to factorise the denominator, most did not realise that a common factor needed to be found and most failed to make any progress beyond $ab(1-2x)+2x-1$. Some candidates did factorise correctly as $ab(1-2x)-1(1-2x)$ and then $(ab-1)(1-2x)$ but then gave this as the final answer.

Question 17

There were some very good solutions with most candidates taking the square root of the ratio of the surface areas to find the linear scale factor, cubing this to find the ratio of the volumes and then applying this to find the volume of solid A.

However, there were also many candidates who did not evaluate any square roots or cubes and simply used the ratio of the given surface areas to find the volume and 875… was a commonly seen incorrect answer.

Question 18

Most of the candidates who attempted this question made some progress, but only a small number gave an acceptable answer. Some candidates gave sketches to help visualise the situation but answers of –63.4 (not

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in range) and 63.4 (giving a positive tangent) were often seen. These answers did show some progress towards the solution and were awarded a Special Case mark.

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Paper 0607/51
Investigation (Core)

Key messages

Candidates should learn the difference between an expression **in** *n* and an expression **for *n*.**

Some started by writing *n* = when an expression in terms of *n* was the demand.

There was a small but significant number of candidates who produced near perfect responses to this paper. They were particularly strong in skills dealing with the algebra for expressions and equations. Some candidates needed to appreciate that using an algebraic generalisation saves much work.

Candidates should show the method for solving a linear equation. Just substituting the answer in the equation is not enough communication.

General comments

Algebra was often done well and candidates showed willingness to communicate throughout the paper. There is still a reluctance to show working or communication within a table. This can be done neatly and is often worth marks. Algebra was often easier than calculating from first principles, for instance adding 20 terms (for the 6 by 6 square ring) and subtracting 12 terms (4 by 4 square ring). Those who saw the benefit of using the formulas often did well, while those who continued to add up strings of numbers could not access the last three questions.

Comments on specific questions

Question 1

(a) Nearly all candidates correctly calculated the ring value for the 4 by 4 square ring given in the example. The most common numerical mistake was in calculating the value of *L*. Most showed the totals for *L* and *S* and a subtraction, which was awarded a communication mark. There were some who omitted the subtraction in their working.

(b) The majority of candidates correctly calculated the square ring that started at 1 and usually filled in the 4 by 4 grid as communication of their method. Several candidates went further and gave the calculations, showing they understood the need for communication throughout this paper. The most common error was entering the consecutive numbers 1 to 16 in the grid, not understanding that the square is only part of the large grid.

(c) From those candidates who had the correct ring values in **part (a)** and **part (b)**, very few errors were seen in completing the table for square rings with different starting numbers

(d) Most candidates found the value of $g = 8$. However, this only accounted for one of the two marks. The other mark was for communicating how the value was found. Since the ring value of 148 was given for $n = 2$, these were useful values to use with the given expression. Trying out $g = 8$ in the expression did not explain how *g* was found in the first place.

The question asked for the expression, so the final answer was $8n + 132$.

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A few candidates put the given expression equal to 0 and so wrote $g = -\frac{132}{n}$.

$4n - 132$ was also seen quite often.

(e) Candidates, who had the correct expression in **part (d)**, usually found the correct ring value by substituting 67. However, this was not a popular method.

Most candidates, some of whom either did not have an expression or were unsure about it, preferred to work from first principles. Totals and the minus sign were expected for this lengthier method.

Question 2

(a) Nearly all candidates gave the correct total for *S* and the corresponding ring value for the given 6 by 6 square.

(b) As in **Question 1(c)**, there were few errors in completing the table and only very occasionally was a numerical mistake was seen.

(c) Most candidates found the expression for the ring value of a 6 by 6 square. Very many of those candidates assumed the expression was linear. For a communication mark, there needed to be a reason why that was a correct assumption. Three differences of 8 next to the last column in the table for **part (b)** was a straightforward way to show this, and candidates are encouraged to show patterns and relationships in such tables. Describing a difference of 8 was insufficient for the communication mark. A frequent incorrect answer was to involve the expression $L - S$ in their answer.

(d) Candidates had more difficulty explaining why an increase in ring value of 20 happened when the square was moved one space to the right.

There were two parts to this. Firstly, each square ring has 20 numbers in it and, secondly, moving a single square to the right increases each number by 1. Only a small minority of candidates covered both ideas in their answer.

Some candidates wrote that it was the column *L*, rather than the square ring, that had 20 numbers.

Several candidates were not specific and only wrote about numbers getting larger.

A few candidates repeated the question and said that moving the square one to the right increased the values by 20.

(e) Many candidates preferred to calculate the ring value from first principles instead of using the expression they found in **part (c)**. Those candidates with the correct answer for the expression for a 6 by 6 square ring usually had the correct answer here. Many of those candidates also gained the communication mark for substituting 45 into that expression. A common error was to subtract the whole square inside rather than just the ring along the inside edge. Several candidates also calculated the ring value for a 4 by 4 square ring instead of for the 6 by 6 square ring. Candidates who used the general expression from later in the paper were not awarded communication of this method for calculating the ring value.

(f) This question required skill in solving an equation to find the starting number of the square ring followed by an understanding of the geometry of the large grid. While there were several correct answers seen, some candidates went no further than finding the starting number. A common source of a missed mark was in not writing the initial equation but going straight into numerical work. By this stage in the paper, candidates should be using relationships observed to complete questions.

Question 3

While most successful candidates made use of what was given in the question to form a relevant equation, there were others who looked back and used the expression for a 4 by 4 or a 6 by 6 square ring.

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With three variables in the expression for a w by w square ring, some candidates were confused regarding what to substitute and did not get far in their attempt at a solution. Despite this, the correct value for $k = 44$ was seen often. Writing the correct final expression was essential and this had to be in terms of n and w. Several candidates included L or S in the final answer.

Question 4

(a) There were two methods for solving this more complex problem.

Many candidates substituted $n = 71$ into the general expression found in **Question 3**. Some of those candidates equated the answer to 832 and so gained two marks for communication. It was also possible to gain these marks by substituting for an 8 by 8 square ring ($w = 8$) and using the answer from **Question 2(c)**, with $w = 6$, for a 6 by 6 square ring.

As the algebra was quite extensive, many candidates got lost in their working and left the question largely unanswered.

(b) This answer, 0, is in fact true for all 6 by 6 rings surrounding a 4 by 4 ring. In this question, candidates had to bring together ideas, both algebraic and geometric, from what they had found in the investigation. Although this was a more challenging question, several good responses were seen, though most responses did not progress far enough.

Since most candidates had the correct expression for the 4 by 4 square ring from **Question 1(d)**, they could equate it to 1300 and solve the equation, and so many candidates correctly found 146 as the starting number for the 4 by 4 ring.

Only a few candidates were able to deduce the starting number for the 6 by 6 square ring and substitute it into the expression for a 6 by 6 ring, found in **Question 2(e)**.

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Paper 0607/52
Investigation (Core)

Key messages

Candidates need to understand what an expression in a given variable means, namely that only the variable, with perhaps some numerical values, appears. Using other variables or writing equations is not correct. *Find an expression* saw weaker candidates give a numerical answer.

The term-to term rule was often improperly understood.

Candidates should learn how to check the correctness of a formula, for a particular value of the variable, by comparison with first principles.

General comments

Many candidates had little difficulty in extending a quadratic sequence and work on formulas for linear sequences was done well.

Most of the communication marks were gained by many candidates. This can also be done in any given tables, by looking for patterns and giving appropriate indications.

The ability to set down a linear equation at the start of a question was an important communication skill.

Candidates should note that substitution of the solution into the equation does not show how the solution was found in the first instance.

Comments on specific questions

Question 1

(a) All candidates correctly counted the number of vertical, horizontal and total lines in the diagram.

(b) (i) Almost all candidates drew the correct pattern, some more accurately than others.

(ii) The correct number of vertical, horizontal and total lines was given by nearly every candidate.

(c) There were practically no errors in the table for the correct number of vertical, horizontal and total lines.

(d) (i) The large majority of candidates gave the correct expression for the number of vertical lines in Pattern *n*. A small number did not give an expression in *n* and gave an expression for *n*, and answers that started *n* = received no credit.

(ii) Most candidates could see from the table that 47 was the correct pattern number. A few candidates added 1 to the number of vertical lines and gave 49 as their answer.

(e) (i) The large majority of candidates correctly found the number of horizontal lines in Pattern 8 and, for communication, most of those candidates also showed how that was worked out, the preferred method being to double 8.

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(ii) As in **part (d)(i)**, most candidates gave the correct expression, here $2n$**.** A few candidates wrote $n + 2$.

(iii) As in **part (d)(ii)**, most candidates found the correct pattern number and showed how that was calculated. A few candidates could have improved their mark by showing this communication.

(f) (i) The term-to-term rule is a recent addition to this syllabus and did not seem to be well understood.

Several candidates left the question unanswered. There were quite a few candidates who introduced a variable into the term-to-term rule. Answers of $n + 3$ did not receive credit since this is the format for the nth term.

(ii) This question required candidates to add together their expressions for the vertical and the horizontal lines. Most candidates understood this and communicated the method. The question also expected the simplest form of the answer. It seemed that many candidates did not read this second demand. For simplest form, terms such as $n3$ and $3 \times n$ were not accepted.

(g) This question required putting together what had been seen in **part (e)** and **part (f)**. Therefore, it was important to communicate the starting point by writing an equation with their answer to **part (f)(ii)** equated to 754. Many could have improved their mark by doing so. Of those who wrote the equation, most were able to solve it correctly to find a pattern number of 251. Some candidates did not realise that it was the number of horizontal lines that was required and so did not double this answer. This was the most common source of error.

Question 2

(a) As in **Questions 1(a)** and **1(b)(ii)**, there were very few errors in counting the numbers of lines.

(b) Most candidates completed Tower 4 correctly. A common error was to draw six squares instead of four underneath Tower 3. Those candidates may have thought that all the given dots should be joined.

(c) Those who drew six squares in **part (b)** usually had the wrong completion for the table of vertical, horizontal and total lines. Candidates generally answered this question well, however, in the table, very few candidates indicated where their numbers came from and so did not gain a communication mark. A straightforward indication would have been to show differences of 3, 4, 5, 6 for vertical lines or 4, 6, 8, 10 for horizontal lines.

(d) The quadratic expression in this more challenging question was found correctly by many candidates. Of the successful candidates, many needed to show some communication in order to gain full marks. This communication could have been an indication in the table of the relationship, between the pattern number and the number of horizontal lines as a sequence of operations such as ×2, ×3, ×4 or +1, +4, +9, etc. Substituting a value of t to check their formula was insufficient communication.

As in previous questions, answers that started $t =$ could not be given credit as this showed a basic misunderstanding of an expression in t and an expression for t.

(e) Most candidates knew that adding 19 to 50, the total lines in Tower 5, would give the correct total. Few candidates gained the communication mark for showing that +19 came from continuation of the sequence of previous additions, +7, +10, +13, +16. Candidates could have written this down on the right side of the table in **part (c)**. Some candidates did not read that use had to be made of the total number of lines (50) for Tower 5. An answer of just 69, which was seen a few times, did not answer this question.

(f) In this question, full marks could only be awarded when the total of 69 was calculated in two different ways: (1) using the given formula and (2) from the explanation in **part (e)**. Checking that a formula is correct often requires looking back to see how the result was previously calculated and making a comparison. Most candidates were precise in using the given formula though they are advised not to use short-cuts but to show the substitution of 6 clearly. By contrast, few candidates were clear enough in giving the previous calculation of 50 + 19. This was often implied in their answer to **part (e)**, but details were missing and 19 or 69 seen on its own in **part (e)** was insufficient.

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(g) The number of vertical lines is the difference between the total and the horizontal number of lines. The subtraction of the two expression was therefore required for a communication mark. Many candidates did not attempt this question, often because they had not previously found both expressions.

A number of candidates gave numerical answers.

Several candidates wrote the subtraction the wrong way round.

Very few candidates were able to simplify the subtraction. Some gained a mark for correctly expanding the expression given in **part (f)**.

Some candidates intended to subtract, but instead of writing $-(t^2 + t)$, they omitted the essential brackets.

(h) In this more challenging question, the successful candidates used the sequences that they had seen in the table in **part (c)** and, from that table, continued the sequence 2, 5, 9, 14, 20 for the number of vertical lines by writing 27, 35, 44, 54, 56, 77. Others continued the calculation 2 + 3 + 4 + 5 + ….. until it totalled 77. Both approaches showed good communication. Furthermore, successful candidates noted that the sequence to 77 had 11 terms, which was also credited for communication. Without such reasoning, substitution of 11 into the expression from **part (g)** was insufficient as it does not communicate how 11 was found in the first place.

Knowing there were 11 terms, various methods were seen in finding the total number of lines, such as drawing the final row of the Tower and showing how the total number of lines could be counted. Several successful candidates used their formula from **Question 1(f)(ii)** or continued the sequence of line totals up to 11 terms: 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34.

Candidates, who drew a complete Tower 11, still needed to show numerical reasons for the total.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/53
Investigation (Core)

Key messages

Show that means that full reasons must be given and the final result must be reached.

The difference between 'expression' and 'equation' was not properly understood and the use of the equals sign was often ambiguous.

To show that a general expression is true in a particular case requires **(a)** work from first principles and **(b)** relevant substitution into that general expression.

It is likely that part of a question depends on the answer to a previous part of the same question, so candidates should always consider if a previous answer will help them.

General comments

Algebra was often done well and candidates showed a willingness to communicate throughout the paper. There is still though a reluctance to show working or communication within a table. This can be done neatly and is often worth marks.

Comments on specific questions

Question 1

(a) Candidates had little difficulty in completing the table to find answers to STEP 2 (multiplying the outside terms of the sequence) and STEP 3 (squaring the middle term).

A few candidates omitted the index 2 in 6^2 and 15^2.

(b) Candidates had to notice that the answer to STEP 2 was 1 less than the answer to STEP 3. While 'STEP 2' appeared in the given statement, it was important that candidates made a link to 'STEP 3' in their response. Several candidates wrote something like 'STEP 2 increases by 1' and could not receive credit.

(c) Most candidates gave the correct sequence. While many communicated how to find the middle term from the given 484, a few more could have gained this communication mark.

Question 2

(a) (i) Nearly all candidates gave the correct sequence. A few did not read that the numbers increased by 2 each time.

(ii) There were very few errors seen in calculating the answers to STEP 2 and STEP 3.

A few could have improved their mark by remembering to show the calculation of these answers.

(b) To find the connection between STEP 2 and STEP 3, candidates produced a great variety of linear sequences to investigate. Most candidates chose simple numbers, which is advisable in reducing

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the chance of error, but there were several who were interested in what happened with larger numbers.

Nearly all candidates gave three suitable sequences, and this question was done well by many.

A few candidates gave only one sequence, indicating they had only read 3 as applying to the difference and not to the number of sequences.

Candidates need to be aware that full communication of the calculations was expected as some only gave the final answers to STEP 2 and STEP 3.

Similar comments apply here as in **Question 1(b)**, with there being a requirement to link STEP 2 and STEP 3 in their response regarding the connection.

Question 3

(a) Most candidates completed the table correctly. This only gave 3 of the 4 marks since it was expected that candidates would communicate how to complete the bottom row, where only 324 was given. There were very few candidates who did so and the numbers 18 and then 15 and 21 often appeared without reason.

(b) Candidates usually used a similar formulation to that in **Question 2(b)** and the same comments apply here.

Question 4

Most candidates could continue the values 1, 4, 9, correctly. Several candidates only showed subtractions without referring to their answers in **Questions 1(b)**, **2(b)** and **3(b)**, as stated in the question. Those candidates could not then answer the general case of an increase by k.

Another error, seen a few times, was when candidates replaced k by a number, usually 6 or 15, not understanding that k implies a general result.

A few candidates did not understand what the heading in the answer column meant and left it unanswered.

Question 5

This challenging question brought together the previous ideas in one problem. Very few candidates were successful in finding both sequences that fitted the four pieces of information given.

Half of the marks were for communication and most candidates gained at least one mark for that. They either showed that the sequence difference was calculated as the square root of 225, or that the answer to STEP 3 had to be 100, or how 25 and 5 were useful factors of 125. Two of these facts were sufficient to find the sequences. Using these facts, the sequence –5, 10, 25 was seen more often than –25, –10, 5.

Despite –125 in the given information, some candidates did not think there should be negative integers and so tried to avoid them.

Several candidates read that the answer to STEP 2 was 225 and so incorrectly deduced that the middle term was 15.

Question 6

Many candidates correctly expanded the brackets.

By contrast, there were very few who then subtracted these expansions. The question told candidates where to find the final result, and it was important that, in this *Show that* question, this final result was reached and stated, even if it might seem obvious.

The most common error in expanding $(10 + k)(10 + k)$ was to omit the middle term(s). Occasionally $2k$ for k^2 was seen.

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Some candidates wanted to turn the individual expressions into equations and added '= 0', for instance, to their expansion. The equals sign in this question does not mean that an equation is expected.

Several candidates tried to show the result by using numerical examples instead of algebra.

Question 7

(a) Nearly all candidates found the next term in the algebraic sequence correctly.

(b) While many candidates knew to expand $(10 + 2k)(10 + 2k)$, very few managed this correctly. As in **Question 6**, candidates did not bring this question to the correct conclusion that the difference simplifies to $4k^2$.

(c) Most candidates did not understand that working out the answer to STEP 3 minus the answer to STEP 2 from first principles was insufficient. There is a second part required, namely substitution of the sequence difference of $k = 4$ into the given $4k^2$, to show its correctness.

(d) This final question proved the most challenging and very few candidates found the two correct sequences that satisfied the given information. Many candidates did not know how to proceed as they did not link this part to the previous parts.

The key to solving the problem is to realise that $4k^2$, given in **part (b)**, should equal 144. Some candidates wrote k correctly as 6. This approach gave candidates communication marks. Other candidates took the square root of 144, without first dividing it by 4.

A few candidates calculated STEP 2 and STEP 3 (and their difference) for various values of k. This approach could have led to the correct sequences if those sequences had started or ended with 41. This could also have gained marks for communication.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/61
Investigation & Modelling (Extended)

Key messages

It is very important for candidates to be able to use a graphical calculator efficiently to draw graphs for models, as well as being able to sketch accurately on paper. To do well candidates needed to complete neat, accurate sketches and use their graphs to determine values, ranges and validity.

Secondly, a variety of algebraic skills are needed to complete many of the questions. Candidates should be able to rearrange, substitute and solve, and communicate their working-out clearly.

General comments

Candidates should practise drawing curves, using sensible drawing techniques and equipment, especially a pencil and eraser.

Candidates should also make sure they understand the language of the questions, for example – the difference between an expression and an equation and the meaning of 'in terms of n'. They should also read the questions very carefully and make use of any directions within that question, such as 'use these values …'

Comments on specific questions

Section A Investigation Square Rings

Question 1

(a) Most candidates showed that they had read and understood the introduction to this investigation by answering this question correctly. Most also communicated their working as the subtraction of $L - S$.

(b) This continuation of the $L - S$ calculations was also answered well with most candidates able to show that they could work backwards given the Ring Value to find L or S.

(c) Candidates should be encouraged to use a method of differences and to show at least 3 differences in the sequence. The most acceptable way of doing this is to write the differences down the edge of the Ring Value column in the table of **part (b)**. Alternatively, writing the sequence horizontally in the answer section and noting a minimum of three differences is required to show good communication. Candidates should be clear on the terms of a question. Here, an expression was asked for and not an equation. The meaning of 'in terms of n' tells the candidates to include n in the expression. Interpreting these instructions correctly will help the candidate to write their answer in the form requested (and not as an equation with n as the subject).

(d) The intention of this question is to use the expression found in **part (c)**. This provided a quick and easy calculation to find the required Ring Value. Candidates should be encouraged to look for links between parts of questions. Those who reverted back to the method of **part (a)** made a fairly simple question more complicated.

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Question 2

(a) Most candidates answered this correctly, some with working shown for the Ring Value.

(b) The objective of this second table was for candidates to gather information. The calculations were straightforward. Candidates should be encouraged to check their answers on their calculators, even when calculations appear to be easy.

(c) This second expression could also be found by using the difference method and finding common differences of 8 in the Ring Value column of the table in **part (b)**. Some candidates found expressions for the *L* and *S* columns and subtracted them. This took more time, and, with more steps, there was more opportunity for error.

(d) Candidates need to be familiar with the difference between the question in this part, where the Ring Value was given, and that in **Question 1(d)**. Most candidates did realise they needed to put their expression equal to 1028 and not that the value of *n* was 1028. Most also realised that the value they found of 101 gave them the answer to the top left square and that they needed to add 5 and 50 to move to the bottom right square. Candidates should be encouraged to read questions very carefully no matter how straightforward they may seem.

Question 3

The positioning of the expressions in the explanation gave a quick and easy start to this question, in that $8n + kw - k$ was above $8n + 308$ so $kw - k$ is equal to 308 when w is 8. Candidates should practise their algebraic skills, for example, when using the expressions with $8n$ included, it is important to realise that the $8n$ terms will equate to 0, leaving the key equation $8k - k = 308$. Some candidates used a trial and improvement method to try to find the value of k. When successful, this meant they achieved the answer marks without the communication mark.

Question 4

The instructions told the candidate to use algebra so using numerical examples did not achieve communication marks. A diagram had been drawn, and candidates should be encouraged to use such a diagram, writing on it anything they find that might be useful. This should help candidates to visualise what the question is asking. It should have been more obvious to many candidates that the top left corner of the inner ring became $n + 11$ and that the width is 2 less than w. Common errors were to write this as $w - 2n$ or $w - 1$, and common answers were a difference of 44 or 88.

***Section B* Modelling Lift**

Question 5

(a) Candidates should be encouraged to check that they are reading the scales correctly and to plot accurately with a fine pencil.

(b) (i) Sketching a graph means drawing its general shape with key features. A curve should not be ruled or made up of several rough lines as an artist might do for a sketch of an object. Candidates should be clear that one freehand line shows the trend of the model with precision at certain points. Apart from the general shape the key points for this model were that it reached the full length of the *h*-axis and that it intercepted the *d*-axis at 1.2. Candidates were asked to label their sketch so that it could be identified from the one to be drawn in **part (c)(i)**.

(ii)(a) The question asked for a range which indicates that an inequality should be used and that a single value would not be correct as an answer. Reading from the plotted points in **part (a)** and the sketch in **part (b)(i)** should have indicated a value between 10 and 20, with the answer to this part indicating *h* would be less than the value.

(b) In this part, the answer should now be indicating more than their chosen value in **part (a)**.

(c) (i) The rules for sketching as outlined in **part (b)(i)** apply here as well as for all sketches. The key points for this sketch were that it intersected the *h*-axis between 40 and 50 and showed the intention of intersecting the *d*-axis above 1.3. The idea of a sketch is not to plot points, so it is important that candidates know the difference between the two. On their calculator, candidates

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need to be sure of how to set up the given ranges for the axes so that they do not think the curve is a straight line.

(ii)(a) Candidates should know about the validity of models and how to compare models with real data to judge when a model would be reasonable for the given situation.

(b) If asked to comment on a model, it is necessary to find out and state what the model predicts for the given value, as well as to comment on the validity of the model.

Question 6

(a) Algebraic and numeric slips were often seen in the answers to this question. The question stated that two certain values of a should be used. Candidates should realise that there will be a reason for this and to follow these instructions. Values for both a and C had to be substituted. Often C was not replaced by 0.55 or 1.66. To simplify the equations candidates often found the result of $(0 – 17)^2$ to be –289. Practice on rearranging and simplifying equations is also necessary to help candidates to avoid sign errors and such steps as, for example, $m + n = \frac{1.66}{9}$ following from $m + 9n = 1.66$.

(b) Many candidates tried to solve their two simultaneous equations with three variables, C, m and n, in them. Most realised that they needed to make use of the equations they had found in **part (a)** and there was some very good communication of good methods used to solve them. Many of those who did find answers were able to write them correctly to 2 significant figures as requested.

(c) To maximise the lift coefficient candidates needed to reason as to how they could use their model to find the largest C. With a negative value for n, this meant minimising the subtraction of 0.0040 $(a – 17)^2$, in other words this part needed to be 0. To obtain 0, a needed to be 17. The ability to answer this question correctly showed a good level of understanding of the modelling task.

Question 7

This question needed to be tackled step by step. Many candidates who looked at the model for L first realised that they needed to calculate both C and d. Good candidates then showed their substitution and working for these calculations before substituting their answers into the model for L and correcting their final answer to 2 significant figures.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/62
Investigation & Modelling (Extended)

Key messages

Candidates who did well on this paper read the questions carefully and made sure they answered the questions fully. They communicated their methods in detail, showed some very good algebraic skills and a good understanding of both scenarios.

General comments

Reading the question very carefully was key to a good score on this paper. Several questions had final extra steps which could have easily been missed. If they were asked for an expression, they wrote an expression and if they were asked to use certain parts or answers then they did this. Candidates who achieved the higher marks showed every step in their calculations including, for example, how they solved the quadratic equation.

Comments on specific questions

Section A Investigation Square Patterns

Question 1

(a) This question was very well answered. The table was completed accurately showing that the candidates had read the introduction carefully.

(b) Candidates also answered this question well. Some candidates should be reminded of the difference between an expression, as asked for here, and an equation as they confused 'in terms of n' with 'n ='. Many candidates assumed this was linear and jumped straight to using the $a + (n - 1)d$ formula. They needed to show at least three common differences of 3 before making this assumption. These differences could have been written at the side of the 'Total' column in **part (a)** or with the sequence rewritten in the **part (b)** answer space. Some candidates chose to find the expressions for the vertical and horizontal lines and then to add them together. For this method, the communication was adjusted to need three common differences of 1 in the vertical column and three differences of 2 in the horizontal column.

(c) Most candidates realised that they needed to equate their expression in **part (b)** to 754 as opposed to those few who replaced n by 754. It is a good idea to check the question when an answer is reached. In this case, the value of 251 was the pattern number and not the answer because the question asked for the number of horizontal lines. From the table, candidates could see that the horizontal lines total was double the pattern number.

Question 2

(a) Again, the table was completed well. Three differences in any one of the columns was sufficient to show communication as looking for patterns. There were many good attempts at drawing the next rows to make Tower 3 into Tower 4 or Tower 5. Candidates need to be careful with their drawing. Although ruled lines were not required, the lines should be in the correct position and clear. Some candidates drew 2 vertical lines between each square instead of one.

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(b) This question was also well answered, with most candidates realising that the pattern of common differences meant this expression was a quadratic.

(c) Most candidates realised that they needed to subtract the horizontal lines (their **part (b)** answer) from the total (given in this part), to find the expression for the number of vertical lines. Practice in writing and calculating algebraic expressions would be useful. A common error was to write what should have been $-(t^2 + t)$ without the bracket, so that much of the time it became $-t^2 + t$. This was more common than incorrectly expanding $-(t^2 + t)$.

(d) There were several steps to this answer, the first being to equate their answer to **part (c)** to 902 and the second being to solve this equation. There were very few sketches seen, indicating that candidates were not using their graphical calculator to draw the graph or set up a table in order to read off the solutions. This was the most efficient method. Other candidates used the quadratic formula or factor brackets to find the solutions. Candidates need to make sure that they write their working out correctly and in full. This means the formula should be written with all the values for a, b and c correctly in place. Also, the factor brackets should be equated to 0 before the solutions are written down. Checking that their answer was what was asked for was, again, important here. Having found n, candidates still needed to substitute this into their $3n + 1$ expression to find the number of lines in the bottom row.

(e) The standard of algebra was good, once candidates had managed to write the first line using the expression for the total number of lines given in **part (c)**. Many candidates expanded the brackets and rearranged well. Very few candidates realised they could put their $3n + 1$ expression equal to 175 for a much simpler method.

Section B Modelling Waste Plastic

Question 3

(a) (i) Most candidates completed the table correctly.

(ii) The question indicated this model was a straight line, so of the form $y = mx + c$. The 'c' was given in the table, and the 'm' was given in **part (a)(i)**, so most candidates were able to write down their answer without calculation. Candidates should be reminded that an equation needs a subject, in this case '$y =$'.

(b) All the information required was given in the introduction to this part, so candidates were again able to write down this equation without calculation.

(c) Many candidates seemed unfamiliar with the correct language of transformations. The word 'translation' was often omitted and an answer of 'shift/move up 6' or similar was given. Vector notation to describe the translation was often not used or was incorrect.

(d) (i) This question asked the candidates to show how a model was obtained. Candidates should, therefore, work from the start using information/answers that they already have and not start from the answer given. Many candidates tried various ways of arriving at the figures of –1.4 and 92.8. Candidates frequently used values of 91.4 and 90 without showing where they came from. These figures give a –1.4 change, but there is nothing to show that this change remains constant.

(ii) Many candidates thought that $x = 70$ was 'out of range' or that the value was 0.

(e) Most candidates answered well by equating the given model in **part (d)(i)** to 49.4 and were able to show isolation of the x term for good communication.

(f) Many candidates equated the two equations and isolated the x term successfully. Those who provided sketches often showed the algebraic calculations as well. The sketches needed to be labelled for good communication. Candidates who had incorrect equations at the start often managed to pick up two of the three answer marks by solving their equation successfully and adding their answer to 1988.

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Question 4

(a) This question was well answered. Candidates need to be reminded that if they change the units, for example, here to kilograms, that they should put the units in their answer.

(b) The sketching of this model was done well with mostly one freehand line drawn with a continuously increasing positive gradient. Points to look out for are to make sure that there are no horizontal or ruled parts. The curve needed to start on the m-axis above (2020, 0) and reach to $t = 2050$. For communication, a correct vertical scale needed to be indicated. The easiest way to do this was to label the m-axis intersection point at 1.258.

(c) The most efficient method of answering this question was to look on the graph or use a table on the candidate's graphical calculator to find the t value when m was 2.516. Communication for this technique is to draw the horizontal line at $m = 2.516$ on their sketch in **part (b)**. Most candidates solved the model equal to 2 × their 1.258 algebraically. When reaching the answer of 2037, some candidates should have checked the question again because if they had they would have seen that it asked for the number of years, so they needed to subtract 2020 from their answer.

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CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/63
Investigation & Modelling (Extended)

Key messages

It is very important for candidates to be able to use a graphical calculator efficiently to draw graphs for models, as well as being able to sketch accurately on paper. To do well candidates needed to complete neat, accurate sketches and use their graphs both on the calculator and on paper to answer questions efficiently.

Secondly, a variety of algebraic skills, especially with algebraic fractions, are needed to complete many of the questions. Candidates should be able to rearrange, substitute and solve, and communicate their working-out clearly.

General comments

Candidates should practise drawing curves, using sensible drawing techniques and equipment, especially a pencil and eraser. They need to communicate their working-out clearly, making sure that they cross out mistakes or unwanted parts of their final answer and that they do not try to write over previous work when correcting mistakes. Candidates should practise working with algebraic fractions, in particular, with signs and enclosing terms in brackets, as well as isolating e.g. x, when x occurs in more than one term.

Comments on specific questions

Section A Investigation The Vertex of the Quadratic Function

Question 1

(a) (i) Sketching a graph means drawing its general shape with key features. A curve should not be ruled or made up of several rough lines. Candidates should be clear that sketching implies one freehand curve showing the trend with precision at certain points.

(ii) Candidates could work from their sketch or using points to find the gradient of the line. The y-intercept of 4 could be seen on the sketch. Candidates who use 'rise/run' should communicate clearly how they have found the rise/run values, either by drawing and labelling a triangle on the graph or showing their calculations for rise and run. Most candidates remembered to write '$y =$' before their $mx + c$.

(iii) A variety of methods were used to answer this problem. Most candidates found the vertex correctly and proceeded to use substitution into their equation from **part (a)(ii)**. The substitution of $x = 6$ into the equation of the line should have given a value of -14 for y, which was the y-coordinate of the vertex. Others substituted $(6, -14)$ into $y = -3x + c$ to find $c = 4$, or $(6, -14)$ into $y = -mx + 4$ to find $m = -3$, or substituted $y = 14$ into $y = -3x + 4$ to find $x = 6$. Candidates should note that equating the curve with the line only showed that they intersected at $(6, -14)$ which is insufficient evidence unless $(6, -14)$ is identified as the vertex. Similarly, substitution into the parabola instead of the straight line did not lead anywhere. Sketches can be used and, to earn full marks, they must be clearly labelled.

(b) Most candidates used the same method to find the equation of this line as they had in **part (a)(ii)** with much success.

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(c) (i) Candidates need to be careful about what they write down, especially if they feel the answers are easy or obvious. The + in front of the 10x and the x after the 10 and the 6 were easy to leave out, particularly if rushing.

(ii) Some candidates gave numerical values even though the general equation of the function was in the first line of the question. Most others spotted the pattern to get at least c correct.

Question 2

(a) (i) The same rules for sketching as in **Question 1(a)(i)** apply here. For complete correctness, this sketch needed to be U-shaped, symmetrical about the y-axis and pass through (3, –9) and (–3, –9). Most candidates scored the mark for the shape. Candidates need to make sure that their sketches are careful and accurate so that they can achieve the symmetry mark and do not miss the vertices.

(ii) Candidates needed to draw a smooth curve through the vertices of these graphs. They need to be careful to draw one smooth curve and to be accurate when drawing through the vertices.

(iii) Candidates should remember that, when asked for an equation, their answer must include a subject, in this case, '$y =$'. It is also necessary to show at least three pairs of coordinates of vertices as good communication.

(b) This answer was similar to **part (a)(ii)** in that the equation needed a subject, and three vertices needed to be shown. A set of three fully labelled sketches was acceptable for communication, the key point here being 'fully labelled'.

(c) Some candidates found the complete correct equation, whilst others scored a mark for $-ax^2$. It was necessary to set up sets of equations on the graphical calculator and then notice the patterns that would lead to the answer.

Section B Modelling Club Fees

Question 3

(a) As usual it was necessary to use the information to reach the answer of \$20 000 rather than to start with the \$20 000 and work backwards. Most candidates achieved this.

(b) (i) Reading the question carefully is very important. In this question, most candidates found the increased total fees by multiplying 160 by 200. Many therefore gave \$19 200 as their answer. The question asked for 'the change in total fees' so it was important to then find this change by subtracting \$19 200 from \$20 000.

(ii) Most candidates took the most efficient route and calculated 20 000 ÷ 160. Other methods were possible and were used by some.

Question 4

(a) The phrase 'Write down' implies that the answer can be written without any detailed calculation and that no calculation needs to be shown. Some candidates managed to get close to the answer by writing an equation, e.g., $y(200 - x) = 20\,000$, when the question asked for an expression. Numerical examples also offered as answers are not applicable in this case.

(b) The question asked the candidates to 'Show that …'. This means that candidates should work towards the given expression rather than starting with it. It would be useful to practise the algebraic method of using a common denominator, especially in cases like this, with a value to be subtracted, i.e., $\frac{20000}{200-x} - 100$. It is important to write a bracket around the multiplied term and to be careful with the signs when the bracket is removed, i.e., $\frac{20\,000 - 100(200-x)}{(200-x)}$ leading to

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$\frac{20000 - 20000 + 100x}{200 - x}$. Candidates should start their answer at the top left corner of the space and work downwards, in two columns if necessary, crossing out mistakes and restarting, rather than trying to write over the corrected mistake. Candidates should also note that numerical examples only show a result for each particular number and do not show a general case.

(c) The wording of this question was asking for a range of values rather than a single figure. The denominator of an expression is often the place to look for validity values.

(d) Most candidates sketched the correct shape well, remembering this is a curve and not a straight line, and most correctly shaped curves started from the origin and continued to the end of the *x*-axis.

(e) Candidates should be encouraged to use the graph on their calculator to answer this type of question. This could have been written down by looking for the *x* value when *y* is 13. Good communication is to draw a horizontal line at $y = 13$ on their sketch on their paper. Most candidates equated the given expression to 13 to calculate x. This is perfectly correct, takes a bit longer and does not make use of the graphics calculator.

Question 5

(a) (i) This was well answered. Some candidates interpreted the information in a particular way and wrote the expression as $F(N - x)$. This was allowed here and followed through for **parts (b)** and **(c)**.

(ii) Again, this was well answered by most candidates.

(b) The expansion of the brackets from **part (a)(ii)** was completed accurately by many candidates. Some omitted to set the expansion equal to their answer to **part (a)(i)** which meant the NF term remained in the expression. Isolating the *x* terms was the next step for most, apart from those who had divided by the $(F + y)$ bracket at the beginning. It would be useful to practise these steps, especially where there is more than one *x* term. As in **Question 4(b)**, candidates should practise writing their answers neatly and in order, clearly crossing out and rewriting any mistakes.

(c) Some candidates went back to **part (a)** to substitute the values for *x* and *y*, whilst others used the model they had found in **part (b)**. Good algebraic skills were needed to manipulate the equation to give a model for *N* in terms of *F*.

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