CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/11
Non-calculator (Core)

Key messages

To succeed with this paper, candidates need to have completed the full Core syllabus, be able to apply formulae, clearly show all necessary workings and check their answers for suitability. As calculators are not permitted, it is vital that candidates carry out their calculations accurately. Candidates should be reminded of the need to read all questions carefully, focussing on key words and instructions.

General comments

This is the first June examination paper for the new syllabus. Compared to previous sessions, this has an increase in number of marks and available time. So, when candidates prepare for this paper using previous papers, they should take this into consideration.

The questions that presented least difficulty were **Questions 1(a), 1(b), 3, 4(a), 7** and **11(c)**. Those that proved to be the most challenging were **Question 9** problem solving using perimeter of a triangle, **Question 19** simplifying algebraic fractions, **Question 20(b)** describing a transformation, and **Question 22** solving simultaneous equations.

In the majority of cases, it could be seen that candidates attempted virtually all questions as there were very few questions left blank. Those that were occasionally left blank were mainly later questions such as **Questions 15(b)**, **19**, **20(b)**, **21(b)**, and **22**; these were also amongst those that proved to be the most challenging.

Comments on specific questions

Question 1

Candidates did very well indeed with various parts of this opening question.

(a) The vast majority of candidates gave the correct answer. A few rounded to the wrong accuracy giving 54 700 or writing the original number in words.

(b) Many chose a correct prime in the given range. There were some who gave a prime outside the given range. Sometimes 15 or another composite number was seen as the answer. Those that gave 16 might have been confusing prime with square.

(c) Again, this was answered well by many candidates who were awarded one or two marks. Sometimes 2 or 4 were incorrectly given as factors.

(d) If candidates were incorrect here, they most often circled $\sqrt{64}$ or $\frac{1}{3}$.

Question 2

Candidates were often correct here after using the space around the calculation to try out positions for the brackets. This is a sensible approach to save multiple crossings out on the calculation itself. As the question included the instruction to insert one pair of brackets, if candidates used more brackets, the mark was not awarded. Some did not attempt this early question.

Question 3

This was well answered by the vast majority of candidates. If a candidate was incorrect with **part (a)**, by reversing the coordinates, for example, they were likely to be wrong with **part (b)** as well.

Question 4

(a) Candidates did very well here. The most common wrong answer was 0.47 or an attempt to calculate 100 – 47.

(b) This part was not as well answered as **part (a)**, with answers such as 0.05, 1.05, 1.5 and 1.2 given.

Question 5

Many were correct here or were awarded a mark for the correct method to find an area. Those that calculated a volume in stages, giving a surface area then multiplying by the last dimension were not awarded the mark. A few gave the total length of all the edges.

Question 6

The correct lines of symmetry were frequently shown. Some candidates were confused with the symmetry lines of a square as often the diagonals were also present; this was awarded no marks. Only occasionally was just one line shown.

Question 7

Candidates did very well in this question. Occasionally, answers such as 0.3, 30 or 3000 were given. Length conversions are one of the most straightforward type. Candidates remembered that the digits do not change when converting in the metric system.

Question 8

(a) Measuring this angle caused some problems as many candidates either read the wrong scale on their protractors (giving answers around 48°) or were not accurate enough with their measuring. Some gave 90° as their answer – the diagram clearly shows this is larger than a right angle. Besides 90°, 60° and 180° were seen as answers.

(b) A very large majority wrote obtuse here. Some gave acute, reflex, 90°, wide or large.

Question 9

For both marks, candidates needed to give equilateral triangle. Many only gave triangle which gained them one mark. A large number wrote rectangle.

Question 10

This is a familiar type of question, and many did very well, gaining at least one mark. There was some confusion about the meaning of the symbols so often the –3 was omitted and 2 added to the list.

Question 11

(a) Many answers were correct. Some candidates did not understand the square root symbol and gave 72 as their answer as if it meant division by 2. Other answers such as 22 and 7 were seen.

(b) Many thought 7^0 was 7 or 0.

(c) Here the common incorrect answers were 3^3, 9^3, 4^3, 27, 36 or 81. The answer of just the power, 4, was not correct. This is another example that the instruction in the question needs to be followed.

(d) Some gave 2^{12} which did not gain a mark as, in this part, the index alone was required. An answer of 7 came from a confusion of the rules of indices as, in this situation, the indices multiply not add.

Question 12

Some candidates did not understand the correct way of writing numbers in standard form with only one digit being in front of the decimal point. Incorrect answers such as 1.25^5 or 125 were seen, with occasionally some candidates writing out the number in words.

Question 13

This algebra question needed two steps to find the solution. Candidates should show one step at a time and not do both together in case they make errors. There were many correct solutions and also a good number that gained the method mark. Some performed the first step correctly to form $4x = 10$ and then gave $\frac{4}{10}$ or $\frac{2}{5}$ as their answer. Some had problems with signs as they made the right-hand side, 9 – 1, instead of, 9 + 1.

Question 14

(a) The vast majority completed the statement correctly. The part was structured to aid the candidates in **part (b)**.

(b) Some candidates ignored their answer to **part (a)** and did not proceed correctly. Most chose to list the times the two bells rang. This work gained one mark or two marks for one or both bells. Those that chose to do two lists, rather than one timeline for both bells, were the most successful. Some appeared to get confused with what time they had got up to, so instead gave an answer of 09 30 the next day.

Question 15

(a) Most realised the need to add 0.6 and 0.15 and as they did not set this out as a column addition, this led to the common error that 0.6 + 0.15 = 0.21. Some performed the addition correctly then omitted to subtract their answer from 1. Another common error was to think that all the probabilities totalled 40 (which was the total number of balls in the box) or 40% which led to calculations such as 40 − 21 being seen quite frequently.

(b) Often an incorrect answer was given without any working so the method could not be seen. This was only a single mark question but that does not mean that workings are not needed to get to the answer. Candidates needed to work out the total number of balls multiplied by the probability of getting a white ball, 40 × 0.6 = 24.

Question 16

(a) Some candidates were correct with both diagrams. For the first, some shaded the part of *B* that is not in the intersection. For the second, some only shaded the intersection of *A* and *B* or the space outside *A* and *B*.

(b) This problem-solving question was handled well with many candidates being awarded at least 1 mark. The given information needed to be added into the Venn diagram and only then the calculation, of those that only like lemon ice cream, needed to be done, 80 – (5 + 12 + 43) = 20. Sometimes the information was placed in the wrong place within the diagram.

Question 17

(a) This question was found to contain an error and so all candidates were awarded the mark. The question did not state that the polygon was regular. The question has been corrected in the published version of the paper.

(b) This type of problem-solving question, combining geometry and algebra, is a familiar context. Candidates were given the sum of the interior angles of a pentagon. Once candidates have a value for x, they should check what is actually needed for the final answer. In this case, the answer is the value they have just found, but it could easily be the largest angle or some other instruction. Apart from the correct algebraic approach, another common one was to use trial and improvement which rarely led to the correct answer. Often this work was not logically laid out and would not have helped the candidates to get to the right answer.

Question 18

(a) Sometimes candidates found one term correctly or found both terms and then combined them to give, for example, $12\,\text{m}^3$.

(b) Candidates were, in general, more successful in this part. However, many candidates only multiplied the first part of each bracket giving answers such as $10x + 6x = 16x$. This was given a mark as this x term was correct. Some candidates got as far as $(10x – 5) + (6x + 8)$ but then unlike terms were combined. Some did not handle the subtraction correctly.

Question 19

Most candidates found this question difficult. Some had problems with cancelling to just f on the numerator and others did not realise that the denominator of 2 does not change.

Question 20

For questions on single transformations, candidates must use the correct term i.e. reflection, translation, rotation or enlargement. Translocation is not a transformation name. Candidates must only give one transformation as the question says **single** transformation. A good indication to what transformation is required, is that one piece of information is needed for each mark.

(a) Many gave the correct answer of reflection in the line of $x = 5$. Some spoiled a correct answer by also saying the reflection was in the y-axis or mentioned a second transformation. Some did not use the correct term but instead gave mirrored or flipped.

(b) This was the question that many found the most complex on the paper. This was due to two main reasons. First, the transformation is still called an enlargement even though the image is smaller than the original shape. Some called this a reduction, delargement or disenlargement or used shrink. Some incorrectly stated that this was the 'opposite of enlargement'. The second area of misunderstanding was that the scale factor is not 3 but rather, $\frac{1}{3}$ as the lengths in the image are a third the length of the original's lengths. Many said that the scale factor was -3 or a division by 3. The centre of the origin was the simplest part of the description, but this property was often missed by candidates.

Question 21

(a) As the answer has got to be one of the three choices, candidates should not leave this blank. Random was the most frequent choice by candidates. Candidates should associate examples with each type of data. Types of continuous data include time (used in the question), height, mass, speed and capacity. Discrete data examples include the number of candidates in a class, number of siblings or number of books. A helpful idea is that if data includes, 'number of' then it is discrete data.

(b) Many were correct here being awarded 1 or 2 marks for all angles correct. There were a few starting points here, either working out the angle representing one candidate by using $360 \div 120$ or $15 \div 5$. The other method was by realising that all the angles are multiples of 15° so the angles are those multiples of 5 candidates. This means for the last group, there is an angle 3 times the size of the first group, so the frequency is $3 \times 5 = 15$. This way all frequencies can be found and a check performed to make sure that they added to 120. Quite a few candidates gave no response.

Question 22

Solving simultaneous equations is a familiar exercise. This question was perceived as challenging by many, but this might have been caused by the need to sustain their method through all the stages. It is well worth studying the equations to work out which method is the simplest one to use as there are various methods to eliminate one variable and, here, both equations had to be multiplied by different numbers to equate coefficients. Some only multiplied one equation. Some candidates got confused within their methods. It is perfectly correct to use other methods, for example, to rearrange either equation and then substitute that into the second equation. Candidates must be careful they do not substitute back into the equation that they had just rearranged – this error was seen a few times. When one value is found, candidates must still be careful with directed numbers when they substitute their answer back into an equation to find the second – this was also a place where errors were seen. Candidates should check their answers in both equations – this step was rarely seen.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/12
Non-calculator (Core)

Key messages

To succeed with this paper, candidates need to have completed the full Core syllabus.

Key formulae are provided, but some candidates did not use these, for example a significant number of candidates were unable to find the area of a triangle. Candidates should understand how to use and apply the formulas that are provided. Candidates need to learn other formulas, such as $\text{speed}=\dfrac{\text{distance}}{\text{time}}$ and simple interest.

Candidates need to read the questions carefully, noting any key information, such as the format of the answer required. Candidates are expected to be familiar with the command words used on this syllabus. They also need to be familiar with subject-specific vocabulary, including, in this paper, tangent, perimeter, simple interest, investment, reflection and translation.

Calculators are not permitted on this paper, so candidates need to be familiar with a range of non-calculator methods and strategies. Candidates are advised to check their working carefully for arithmetical errors.

General comments

The paper was accessible to all candidates; most attempted every question and reached the end of the paper. A few candidates omitted **Question 3(a)(ii)** (identifying a tangent), **Question 13** (finding the reciprocal of a decimal) and **Question 14(b)** (simplifying an algebraic fraction).

The questions that presented the least difficulty were **Questions 1**, **5**, **8(a)**, **12(a)**, **12(b)**, **16(b)** and **16(c)**. Those that proved to be the most challenging were **Question 8(b)** (finding the expression for the *n*th term of a quadratic sequence), **Question 9** (finding an estimate by rounding numbers to 1 significant figure), **Question 13** (finding the reciprocal of a decimal), **Question 14(b)** (simplifying an algebraic fraction) and **Question 17** (matching equations to graphs).

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

Comments on specific questions

Question 1

(a) Almost all candidates gave the correct answer.

(b) Most gave the correct answer. A few gave the answer 14 (the number of males who chose the meat pizza). A very small number misinterpreted the scale on the bar chart and gave the answer 4.

(c) Most candidates reached the answer $\frac{10}{60}$ and many went on to simplify this correctly. Some candidates started with the answer $\frac{5}{30}$, possibly from the alternate approach of counting squares on the bar chart. Some put 10 as their final answer.

(d) There were many fully correct answers. A significant number did not follow the instruction to write the numbers in order and instead listed the types of pizza in order.

Question 2

(a) Most gave the correct answer. Some candidates used the word 'lakh' for one hundred thousand, this did not gain the mark. The most common error was to give an answer in millions.

(b) There were some excellent answers here, with most of the highest achieving candidates reaching the correct answer.

A variety of errors were seen. Some spoiled good work by giving a rounded answer of 1.5×10^5. Some candidates gave answers such as 15.5×10^4 that were in index form, but not standard form. Answers such as 155×10^3, 155^3 and 1.55×10^3 were common, suggesting that candidates were counting zeros in the given number. A few candidates thought the question was asking for the number to be written with a thousands separator, leading to the answer 155,000.

Question 3

In all three parts, the majority of candidates gave the correct answer. However, a significant number had difficulty with this question, and many did not take note of the information given. Candidates are advised to read the information in the question carefully and take note of the command words used.

(a) (i) The majority were able to identify the diameter. 'Radius' was a common wrong answer. Some candidates gave descriptions instead of the mathematical name of the line, for example, 'straight line' or 'linear'. The question stated that line *POQ* was a straight line, so candidates should have realised that repeating this information would not be sufficient for the mark to be awarded.

(ii) More than half of the candidates gave the correct answer. A variety of incorrect names were seen in this part, including diameter, chord and sector. The most common wrong answer was 'straight line'. As in **part (a)(i)**, the question stated that the line was straight, so this will not gain a mark.

(b) The majority of candidates gave the correct answer. The diagram is clearly labelled as 'not to scale' and the question used the command words 'write down', but the most common error was to measure the angle using a protractor. Another common error was to give the answer 180°. A few candidates gave a description of the angle, such as acute or right angle, instead of giving the size.

Question 4

Most candidates realised they needed to divide 1100 by 55. Some were able to do this mentally, but many candidates had difficulty performing the division, with a lot of rough working shown. Some evaluated the division incorrectly, often reaching an answer 2 or 200. Some candidates reached the stage of writing $\frac{1100}{55}$, gaining 1 mark, but were unable to make further progress. A few candidates spoiled their work by completing further calculations using the number 60 (the number of minutes in an hour). Some candidates used an incorrect formula or method, often leading to the calculations $\frac{55}{1100}$ or 1100 × 55.

Question 5

Most candidates did well here, with the majority showing clear calculations and reaching the correct answer. A few made arithmetical errors.

Question 6

Most candidates gained at least 1 mark here. The highest achieving candidates usually reached the correct answer of 22 and many others gained 1 mark, usually for evaluating 2^3 as 8. A significant number had difficulty evaluating $\sqrt{196}$, with many showing trials to reach the correct answer. Some of the lower achieving candidates thought that $\sqrt{196}$ could be found by dividing 196 by 2.

Question 7

Most candidates were able to perform the required calculations correctly. Some made calculation errors, usually when multiplying by 3. A few divided 85 by 5 but were unable to continue. The weakest candidates often did not know how to start this question; they frequently divided 85 by 2 and then divided 85 by 3, leading to the common wrong answers 42.5, 28.(…).

Question 8

(a) Most candidates found the next two terms correctly. A few candidates made arithmetical errors but were able to find one term correctly. Some identified the differences between terms, but then gave the next two differences, not the next two terms, as their final answer.

(b) This part was challenging, with only a few candidates reaching the correct answer. Many candidates calculated the differences between terms in the sequence, and some went on to show the second differences, gaining 1 mark. Most did not realise the sequence was quadratic, and most of those who offered an *n*th term wrote a linear expression. Some had realised the second difference was 2 and gave answers of $n + 2$ or in the form $2n + k$. Some used the difference of 3 between the first two terms in the sequence to arrive at an answer in the form $3n + k$.

Question 9

This question instructed candidates to write each number correct to 1 significant figure. Most candidates who followed this instruction showed very clear working and many reached the correct final answer, gaining both marks. A few did not show sufficient working here, the question requires all four correctly rounded values to be shown. A few candidates misread the calculation, writing $\frac{3\times5}{2\times3}$ and not $\frac{3\times5}{2+3}$. A small number spoiled their rounding by incorrectly including trailing zeros, for example writing $\frac{3.00\times5.00}{2.00+3.00}$. This was condoned in the working on this occasion, but candidates should be aware that these trailing zeros should not be included. Trailing zeros were not accepted for the final answer.

Many candidates did not follow the instructions in the question. Some tried to find an exact answer using long multiplication and division; in some cases, this answer was then rounded. This approach does not answer the question and so does not gain any marks. Some candidates rounded the given numbers but did not round them all to 1 significant figure, leading to very challenging calculations.

Question 10

Most candidates did well here, with many reaching the correct answer. Successful candidates often used the diagram effectively, writing in the missing angles as they worked towards a solution. 50 was a common wrong answer, implying that candidates had found angle *ACB* and not *BAC* as the question required. Some of the lowest achieving candidates did not realise that *ACB* and *ACD* had an angle sum of 180° and so they were unable to make any progress towards the correct answer.

Question 11

Most candidates showed a good understanding of the methods for solving equations. Some made sign errors. A few used incorrect inverse operations or made calculation errors.

(a) Most candidates recognised that they needed to multiply 7 and 5 and went on to reach the correct answer. The most common errors were to add 7 and 5 or to divide 7 by 5.

(b) Most candidates did well on this question. The most common errors were sign errors. Some made errors in their first step, for example rearranging $8x - 3 = -11$ to $8x = -11 - 3$. Some reached $8x = -8$ or $x = \frac{-8}{8}$, gaining 1 mark, but then gave an incorrect final answer of 1.

(c) Most started by multiplying out the brackets, with the majority able to do this correctly. Many went on to collect the terms in x on one side of the equation and the constant terms on the other. However, a number made sign errors at this stage. Some made arithmetic errors when working out $-29 + 32$. A number reached $6x = 3$ but were unable to complete the final step correctly, with 2 being a common wrong answer.

Question 12

(a) Almost all candidates gave the correct answer. A small number reversed the coordinates or gave the coordinates of point *C*.

(b) Most candidates drew the correct line of symmetry. Some incorrectly assumed that the triangle was equilateral and spoiled their answer by drawing in extra lines.

(c) There were some excellent answers with very clear working. Some candidates used the correct formula but thought that the base of the triangle was 7, or the height of the triangle was 5. The lowest achieving often did not know how to find the area of a triangle; errors included finding perimeter, multiplying base and height without dividing by two, and multiplying the lengths of two or three of the sides. A few gave incorrect answers, such as 24, but did not show any working at all, so it was not possible to give any credit to what may have been a partially correct method.

(d) (i) Most candidates gave the correct answer of 5 cm. However, some did not understand the command word 'measure' and attempted to find the length of *AB* without measuring. The most common wrong answer was 4. This may result from candidates measuring the height, but some showed $5 - 1$ in the working, suggesting that they were using the coordinates of points *A* and *B* to calculate the required measurement. There were numerous attempts to use Pythagoras' theorem. A few of these reached the correct answer and were awarded the mark, but most made errors, with working such as $3 + 4$ or $3^2 + 4^2$ often leading to the wrong answer of 7.

(ii) Just over half of the candidates were able to use their measurement from the previous part to calculate the perimeter of the triangle. There was a significant difference in performance here, with most of the highest achieving candidates able to calculate the perimeter correctly for their measurement, but very few of the lowest achieving candidates were able to do so. A wide variety of errors were seen. These included using a length of 7 for the base of the triangle, attempts at area, attempts at Pythagoras' theorem, and multiplying the lengths of two or three measurements.

Question 13

There were some correct solutions with efficient methods, but this proved to be the most challenging question on the paper, with only a minority of candidates reaching the correct final answer and a significant number leaving the question blank.

A number of candidates reached the stage of writing 0.4 as $\frac{4}{10}$, but were unable to make any further progress. Some wrote $\frac{1}{0.4}$, gaining 1 mark, but were unable to evaluate this. A variety of incorrect methods were seen, with multiplying or dividing 0.4 by 10 being the most common. Some thought the final answer should be a negative number.

Question 14

(a) Most candidates could collect the terms in x, but many made sign errors when working with the terms in y. The most common wrong answer was $5x - y$. A few candidates thought that collecting terms in x and y resulted in terms in x^2 and y^2.

(b) More than half the candidates reached the correct answer, but many had difficulty here. The most common wrong answer was $\frac{3x}{2x}$. Some thought that $\frac{3}{2}$ simplified to 6. A few did not follow the instruction to give the answer as a fraction.

Question 15

There was some excellent working seen, usually leading to the correct answer. Some candidates offered working that was unclear, for example, some wrote a correct step, such as $\pi r^2 = 16\pi$, but then spoiled it by writing in extra operations or crossing out one of the πs. Candidates are advised to write each step on a new line and not to cross out or add to the previous step. The most common wrong answer was 8, with many showing 16 ÷ 2 = 8, $\sqrt{16}$ = 8, or 8^2 = 16.

Question 16

Most candidates attempted to complete the diagram in **part (a)** and then used it to answer **parts (b)** and **(c)**.

(a) There were some excellent responses seen, usually from the highest achieving candidates. Many did not know how to calculate the number of candidates in the intersection. A significant number wrote the given values 11, 13 and 8 in three of the spaces on the Venn diagram and wrote 1 in the intersection. Some gave an incorrect value for the intersection but showed some understanding by giving three values such that n(E) was 11 and n(C) was 13, gaining 1 mark.

(b) Most candidates used their diagram correctly to reach the answer. Some gave the value from the intersection. A few gave values that did not appear in their Venn diagram.

(c) Many candidates used their Venn diagrams correctly to identify the required number of candidates and most used this value to write a probability. A few did not use the value 25 as the denominator. A few gave answers greater than 1, which they should know is not possible for a probability.

Question 17

Most candidates attempted both parts, but this proved to be a challenging question. Significantly more candidates were able to identify the correct equation in **part (b)** than in **part (a)**.

(a) The most common wrong answers were B, which showed some understanding of the form of the equation of a straight line, and C, which implied a fundamental misunderstanding of this topic.

(b) The full range of answers was seen, but the most common wrong answer was C, showing that most candidates could link a quadratic equation to a parabola.

Question 18

Successful candidates showed their methods clearly and worked through the required steps carefully. A large number calculated the interest correctly, gaining 2 marks, but did not go on to find the total value of the investment.

A significant number knew the formula for simple interest but were unable to work with the value of 2%. Many of these candidates calculated with 2, not $\frac{2}{100}$ or 0.02, meaning they did not gain any marks on this question. Some did not know the formula for simple interest and so were unable to make any progress.

Only a very small number of candidates attempted to use the method for compound interest.

Question 19

Most candidates attempted this question, and some excellent responses were seen. However, many candidates had difficulty here, with only the highest achieving candidates doing well in all three parts. Correct mathematical terminology is expected when describing transformations; words such as flip or move will not gain marks.

(a) Most recognised that this was a reflection. However, a significant number used incorrect terminology such as mirror, flip, or inverted. The question asked for a single transformation, but some thought that the shape had been both reflected and translated.

A significant number had difficulty describing the line of symmetry. Many gave a pair of coordinates instead of describing a line. A few thought the line of symmetry was $y = -1$.

(b) There were some fully correct responses seen. However, again, many used incorrect terminology such as move or translocation; a few wrote transformation instead of translation.

A considerable number had difficulty identifying the two components of the translation vector. Errors included reversing the components, sign errors, and components with the wrong magnitudes. Some candidates gave coordinates instead of a vector. A few spoiled their work by including a fraction line between the components. Some gave a correct description in words instead of writing a translation vector.

(c) There were some good answers here, but some did not use the correct centre of rotation. A common error was to draw a reflection of the given shape, or a combined reflection and translation.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/13
Non-calculator (Core)

Key messages

To succeed with this paper, candidates need to have completed the full Core syllabus, be able to apply formulae, clearly show all necessary workings and check their answers for suitability. As calculators are not permitted, it is vital that candidates carry out their calculations accurately. Candidates should be reminded of the need to read all questions carefully, focussing on key words and instructions.

General comments

This is the first June examination paper for the new syllabus. Compared to previous sessions, this has an increase in number of marks and available time. So, when candidates prepare for this paper using past papers, they should take this into consideration.

The questions that presented least difficulty were **Questions 3(b)**, **4(a)**, **5(b)**, **6(a)** and **9(a)**. Those that proved to be the most challenging were **Question 2(b)** write a number in standard form, **Question 4(b)** the *n*th term of a sequence, **Question 9(d)** find the equation of a line, **Question 10(a)** describe a transformation and **Question 14(b)** find a probability from a tree diagram.

Those questions that were the most likely to be left blank by a significant number of candidates were **Question 2(b)**, parts of **Questions 9** and **10**.

Comments on specific questions

Question 1

Candidates did well with parts of this opening question.

(a) Candidates were often correct with the smallest and largest numbers and made errors with the other three values.

(b) Slightly more candidates were correct here. Frequently, the incorrect answers of 6% and 0.6% were seen.

(c) Some gave $\frac{56}{10}$ for 0.56, instead of $\frac{56}{100}$. Others gave $\frac{5}{6}$ by using the digits in the question. Some wrote $\frac{0.56}{1}$, which was a repetition of the question and is not a fraction as the numerator and denominator should be whole numbers.

Question 2

(a) Here many candidates successfully rounded to the nearest 100. Sometimes the answer was given as 278 or 278.0 which is the given number divided by 10.

(b) Many candidates were unsure of how a standard form number is written with many changing the place of the decimal point to have no digit in front or more than one and omitting to multiplying by a power of 10. Some wrote, 278×10^1, which although it does multiply to give 2780 it is not in standard form and so the mark was not awarded. Candidates must learn the correct way to express a number in standard form and to practise converting numbers to and from standard form.

Question 3

Candidates need to understand the terms mean, mode, median and range and how to find or calculate each. It is also important that candidates know what each measure says about the data and when to use each one.

(a) Many were correct here. It is not sufficient to give 13 – 4 or even 4 – 13 as if they were writing 4 to 13 for the range; it must be a single value, 9 in this case. The mode, 6, was seen as the answer as well as 13, the highest temperature. Occasionally all the different temperatures were listed, so only included one 6, showing a misunderstanding as range is not all the possible values.

(b) This was one of the best answered questions. The seven temperatures were already in order so candidates had to pick out the middle value of 7. Again, some gave the mode.

(c) Candidates were more successful here than with **part (a)**. A few gave the total of the temperatures which was only one step away from the answer, as the total needed dividing by 7 (pieces of data) to give the mean of 8. If the method was correct, a mark was awarded. Sometimes the method used was not clear or unfinished so could not be awarded the method mark. Again, mode was seen here as well.

Question 4

(a) Virtually all candidates could give the next term in the sequence.

(b) Finding the nth term should have been familiar to candidates. Some candidates used the formula, nth term = $a + (n - 1)d$, and had problems substituting for a and d or during rearrangement. Some were awarded a mark for $4n$ in their answer. More often, the 4 was a constant term in answers such as $n = 4$. A few gave the term-to-term rule, add 4. A small number thought this was a quadratic sequence.

Question 5

On the whole, this was a well attempted question. Candidates will have come across buying items and receiving change and so this is a familiar context for them.

(a) Candidates had to work in a logical way to find the cost of the adult tickets and the cost of the child tickets and then take the total away from \$50. Some had the correct method but got an incorrect answer as they had made arithmetic errors, particularly with the subtraction to find the final answer. Some took each cost in turn from \$50 so there were up to 5 separate subtractions. This method has plenty of places for slips to be made. A few rounded the costs before subtracting. Calculations should not be rounded in the midst of the method and only at the end, if it is appropriate to the question. For actual money calculations of this type, it is not appropriate to round at all.

(b) This reverse calculation was a problem-solving question. Candidates had to look back at the start of the question to see the cost of each type of ticket then subtract 4 × 6.50 from 66 to give the total paid for the adult tickets. The last stage is to divide by \$8, the cost of an adult ticket. There are many stages to the method so candidates must set out their work clearly so they can check they have performed the calculation correctly. It might have helped candidates if they labelled some of the calculations, for example, 'total for children's tickets is …', 'total for adult tickets is…'.

Question 6

This was another problem-solving question that relied on different concepts and skills. This was well handled over all three parts.

(a) Candidates did very well, either using algebra to form and solve an equation where $x + 3 + 4 = 12$ or writing 12 – 3 – 4 = 5. This could be done in stages. Candidates can find 'show that' questions difficult as they sometimes do not know where to start or what method needs to be shown; here, there was very little hesitation shown in the methods.

(b) Even if candidates did not attempt **part (a)**, they could answer this, as all relevant lengths were given. The quick method is to realise that the tops of the rectangles add to 12 and the widths on the right-hand side add to 8, so the perimeter is 2(12 + 8) = 40 cm. Candidates also added all the lengths together, but this allowed plenty of places where they could make arithmetic slips and so not earn the mark. Some confused perimeter with area. Incorrect answers included 96 (12 × 8) or 60 (the perimeter as if all the rectangles were separate).

(c) This area calculation was answered better than **part (b)**. Most found the area of each rectangle then added. Another way is to find the area of a containing rectangle (12 × 8) and subtract the missing parts so 96 – 22 = 74. Many did not show workings so if the answer was wrong, they could not have picked up either of the two method marks. Some gave the same answer to each of these last two parts.

Question 7

(a) Candidates did well here. Method marks were available for showing the substitution or part calculations.

(b) Candidates did less well rearranging the formula to make *x* the subject. When using a horizontal line for division, candidates must be careful that their line is long enough, for example, neither $x = T + \frac{4y}{3}$ or $x = T + 4\frac{y}{3}$ is correct.

Question 8

This question was found difficult and only a minority of candidates gave the correct answer. There was one very common error seen as candidates divided 135 by 5 then divided 135 by 4 so gave answers as 27 and 33.75. Sometimes candidates gave 27 then the other answer was 108 (135 – 27). Candidates should then check their two answers add to the amount stated in the question and appear sensible.

Question 9

This question had parts that candidates found accessible and other that were complex. This question also had some of the highest number of 'no response' answers.

(a) A very large majority were correct with the coordinates of *A* and *B*. A few reversed both and a smaller number just reversed one pair. Candidates must only write numbers in the coordinates brackets and not give their answers in the form (x = 3, y = 5).

(b) Here some candidates seemed to think that the midpoint must be a vertex on the grid so their answers only used whole numbers. Some gave (0, –1) as the midpoint. Others gave coordinates for points that were not on the line. Some subtracted their coordinates in **part (a)** and then divided by 2 to give (2.5, 5). Wrong notation, as described above, was also used here.

(c) In general, candidates found this part very difficult. There were many pairs of points that could be used to find the gradient. Candidates did use the gradient formula and then made errors with the directed numbers. Others had the formula inverted, with the *x*-distance as the numerator and the *y*-distance as the denominator.

(d) Candidates often find this section of syllabus complex and there were many 'no response' answers as said before. This needed the previous answer of the gradient to find the equation of the line.

Question 10

(a) For questions on single transformations, candidates must use the correct term i.e. reflection, translation, rotation or enlargement. Translocation is not a transformation name. Candidates must only give one transformation as the question says **single** transformation. A good indication to what transformation is required, is that one piece of information is needed for each mark.

(b) Some candidates drew their answer in the space below the question. Under translations, shapes do not change size or orientation; both of these errors were seen. Candidates should draw transformations with a pencil and ruler.

Question 11

This question was set up so that **part (a)** would help candidates with **part (b)**.

(a) This was another ‘show that’ question. There is a technique to approach these questions. Candidates must start with finding the time from the distance and speed, process that and end up with $\frac{1}{2}$ hour. It was necessary to show $\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{10}{20} = \frac{1}{2}$ hour. The answer is required in hours, so an answer of 30 min needed to be written as a fraction of an hour. This formula for time was not as well known by candidates as, $\text{speed} = \frac{\text{distance}}{\text{time}}$. Some did set out the full process clearly.

(b) This is the question with the most marks on the paper, so it was vital to show all workings. Some candidates found the average of 20 and 80, 50 km/h, which is the wrong method. Average speed is total distance divided by total time. The question gives the two distances. One time is given in **part (a)** and the time for the 200 km has to be found using the same technique that was required in the previous part. Then, the total distance and total time calculated, the final calculation of 210 ÷ 3 = 70 km/h can be completed.

Question 12

This question was well handled by many candidates.

(a) The vast majority were correct here. Occasionally, the answer was left as 1 rather than x.

(b) The first step is to multiply out the brackets and then to collect like terms. Occasionally, candidates did not multiply each term in the brackets. Sometimes the answer was spoilt by the correct terms being incorrectly combined to give, for example, $14x$. Some made arithmetic slips with, in particular, the constant term.

(c) Some candidates did not realise that $15x^6$ is divided by all parts of $3x^2$ not just the 3 alone. Many subtracted the indices and then went on to subtract 3 from 15, instead of dividing, to produce 5 as the coefficient.

Question 13

Finding prime factors of numbers then working the lowest common multiple (LCM,) should be a familiar exercise. Neither of these parts were handled well by a large number of candidates. This might have been because the questions are near the end of the paper.

(a) Many candidates gave a product that equalled 60 but was not made up of prime factors, for example, 6 × 10 or 60 × 1. For the method mark, this was not far enough as all prime factors had to be found. These could be listed or shown on a factor tree, table or ladder.

(b) For one method, the answer to **part (a)** was needed as well as the product of prime numbers for 24, then the prime factors that make up the LCM can be seen; if the answer was given as a product of primes, $2^3 \times 3 \times 5$, this was awarded one mark. Another, more popular method was to list the multiples of 60 and 24 to see what number is first to appear in both lists. There was a mark available for a higher number that later appears in both lists, for example, 240 or 360.

Question 14

Again, this should have been a familiar question on probability trees. Whether Pari’s phone has a fault or not is independent to whether Siya’s phone has a fault or not, so the probabilities stay the same.

(a) The probabilities on each pair of branches add to 1 so the probability for Pari not having a fault is 0.8. For the branches for Pari, the probability of her phone having a fault is also 0.2 and so the probability of her phone not having a fault is, similarly, 0.8. Some candidates thought that 0.2 was a percentage so their probability for no fault was 99.8. Others put 0.2 on all branches or put a different probability on the no fault branches which was not 0.8. A few gave probabilities that were greater than 1.

(b) In this part, candidates had to use their tree diagram to work out the probability that both phones had no faults in the first year. To do this, candidates should have multiplied along the lowest branches to obtain 0.64 or 64%. Candidates were not as successful here, compared to the last part, and quite a few did not attempt this calculation. Candidates had to use correctly formatted probabilities from their tree diagram in **part (a)** in order for them to gain follow through marks here.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/21
Non-calculator (Extended)

Key messages

Candidates should take care with simple arithmetic, making sure they know the required multiplication tables. They should also be careful when performing arithmetic involving negative signs.

Candidates should also use correct mathematical language when giving reasons in geometrical questions.

Candidates need to understand relevant mathematical terms.

General Comments

This paper tests a wide range of skills and mathematical understanding across the syllabus. Many candidates were able to demonstrate knowledge and competency across each of number, algebra, shape and space, and probability and statistics, and achieved very good marks on this paper. Candidates had enough time to complete the paper with very few questions left unanswered. Working was usually well set out with numbers and words clearly written.

Some of the higher scoring candidates demonstrated excellent knowledge when performing procedures needed for the harder, later questions, but lost marks on the early basic number work questions.

It is important to be able to deal carefully with negative signs. Errors with negative signs occurred in **Questions 11**, **15**, **16**, **18(a)**, and **19**.

Candidates should check their answers to see if they seem sensible. For example, in **Question 5** the answer should be between $1 \times 4 = 4$ and $2 \times 5 = 10$. In **Question 10**, the answer should be less than $2 \times 4 \times 10^{18}$ so an answer of $K \times 10^{35}$ would be too large. In **Question 9**, a factorised expression can be checked by expanding the brackets. In **Question 14**, the *n*th term can be checked by checking it works for one or more of the given terms in the sequence. In **Question 15**, solutions can be checked by substituting back into the given equation.

Candidates should use correct mathematical language when answering questions requiring words. In **Question 6**, candidates should describe transformations accurately and use the word translation, rather than, for example move, and enlarge rather than, for example magnify. In **Question 13(c)**, candidates should state the geometrical wording from the syllabus: namely, ‘angle at the centre is twice the angle at the circumference’ and not describe the theorem using non-mathematical words such as middle and edge and nor should they refer to points on the diagram.

Candidates should make sure they understand the meaning of mathematical words and read questions carefully to ensure they have answered the question as required. For example, **Question 1(b)**, irrational number, **Question 5**, mixed number, **Question 13(c)**, reflex angle and **Question 16**, perpendicular bisector.

Candidates should learn principal trigonometry values for sine, cosine and tangent, as required for **Question 20**. They should also learn the shapes of the graphs so that they can find other connected values from the principal values.

Comments on specific questions

Question 1

(a) Almost all candidates answered this part correctly. The most common incorrect answer was 81.

(b) Around half of all candidates gave the correct answer. A common incorrect answer was 3.142, perhaps thinking this was π, whereas in this question it was merely a number with 3 decimal places. Others incorrectly gave the mixed number $7\frac{2}{3}$ which is not irrational as it is written in fraction form.

Question 2

(a) Around half of all candidates answered this part correctly. The most common incorrect answer was 0.003, giving the answer to 3 decimal places rather than to 3 significant figures. Other common incorrect answers included 0.003 095, 0.003 10 and 0.0031. Others gave the number in standard form as 3.0948×10^{-3}, perhaps not reading the demand of the question carefully.

(b) The majority of candidates answered this part correctly. The most common errors included rounding to the nearest 100 000 as 579 600 000 or truncating the millions to 579 000 000 or rounding to 1 significant figure giving the answer 600 000 000 or making a slip with the number of zeros.

Question 3

This part was answered very well. Those candidates not scoring full marks almost always earned one mark for showing 68 on the diagram. The most common errors arose from arithmetic slips with 68 ÷ 2 = 39 or 180 – 68 = 122 seen. Others, after recognising triangle *ACD* as isosceles did not recognise triangle *ACB* as isosceles.

Question 4

(a) Many candidates drew all five of the lines of symmetry accurately on the regular pentagon. The most common errors seen were to only draw one vertical line of symmetry or to draw only 3 or 4 lines of symmetry. Some also drew a 6^{th} horizontal line of symmetry through the furthest left and furthest right vertices. Some candidates did not draw lines of symmetry but marked lines on the sides to show they were of equal length. This question also had a number of no responses.

(b) Around half of all candidates were correctly able to name the shape as parallelogram. A wide range of other quadrilaterals were named including rhombus, rectangle, square, kite and trapezium. A significant number of candidates gave pentagon as their answer and a few gave other polygons such as hexagon and octagon despite being told the shape was a quadrilateral. Others attempted to draw the shape but, to be awarded the mark, the mathematical name was required.

Question 5

This part was answered well with many candidates gaining full marks. Whilst the majority used a concise method with denominators of 3 and 7, it was not uncommon for candidates to earn 3 marks by unnecessarily using the common denominator of 21 and successfully cancelling down from $\frac{30}{21} \times \frac{98}{21} = \frac{2940}{441}$. Some earned 2 marks for getting as far as $\frac{20}{3}$ or $\frac{140}{21}$ or $6\frac{14}{21}$ and others earned one mark for $\frac{10}{7}$ and $\frac{14}{3}$. The most common errors were slips with cancelling and arithmetic. A number of misconceptions were seen and these included incorrect methods to convert the mixed numbers to top heavy fractions and multiplying the fractions without converting with $1\frac{3}{7} \times 4\frac{2}{3}$ seen equal to $1 \times 4 + \frac{3}{7} \times \frac{2}{3}$.

Question 6

(a) This part was answered well. The word translate, or translation, was required with words such as translocation, shift and move not accepted. A vector was also required, with answers given in coordinate form not accepted. Other common errors included slips with signs or miscounting or finding the transformation from *B* to *A*.

(b) This part was answered less well with many candidates not giving a **single** transformation but combining an enlargement with either a translation or a rotation. These candidates were not awarded any marks. The most common other errors included missing out part of the description, giving the scale factor as 3 rather than –3 or having an incorrect centre or using an incorrect word for the type of transformation, such as magnification or increased.

(c) This part was answered very well with the majority of candidates transforming the triangle correctly. Most other candidates earned one mark for rotating the triangle through the correct angle but using the wrong centre, usually the origin or (1, 1) or for rotating the triangle clockwise rather than anticlockwise. A minority of candidates rotated the triangle through 180°.

Question 7

A good proportion of candidates who recognised that the first step was to find a common multiple of 8 and 12 were usually successful in finding a correct ratio, although not all gave a simplified ratio as their final answer. However, most other candidates did not know how to approach this question and common errors included multiplying or dividing by the sum of the parts, that is 19 or 13 or just adding or subtracting the 8 and the 12 to give 7 : 20 : 5 or 7 : 4 : 5.

Question 8

This question was answered well with many candidates correctly finding the extra number. Others were able to earn a mark for 9×8 or 10×7.7. Common errors included arithmetic slips or not recognising that the extra number gave ten numbers with a mean of 7.7. A common misconception was to use the difference of the means without taking into account the change in frequency and calculate $10 \times (8 - 7.7) = 3$.

Question 9

(a) The majority of candidates answered this correctly. Most of the other candidates earned one mark for a correct partial factorisation, taking out at least two of 2, x and y^3. The most common errors included slips with powers. The most common misconception was to give an answer such as $2x - 3y$ after cancelling the common factors.

(b) A fair number of candidates factorised completely the given expression. Others were awarded one mark for partially factorising with many reaching either $2\left(9p^2 - 1\right)$, but not recognising this as the difference of two squares or, for example, $(6p + 2)(3p - 1)$ and not recognising that a factor of 2 could be taken out of the first bracket. Some candidates again had a common misconception that they could divide by 2 and gave the answer $9p^2 - 1$. Others made arithmetic errors when dividing 18 by 2, made slips with signs or they offered no response.

Question 10

A good number of candidates answered this correctly but there were a wide range of incorrect methods seen. These included adding the powers, multiplying the 4 and 3.2 and incorrectly converting 3.2×10^{17} to 32×10^{18} with answers such as 7.2×10^{35}, 12.2×10^{35} and 36×10^{18} frequently seen. A number of candidates also wrote 4×10^{18} as 4.10^{18} and then used 4.1 + 0.32. Some candidates attempted to write the numbers out in full with all the zeros, and whilst some gave the correct answer, others made slips with the number of zeros. This is not an efficient method nor the intended approach.

Question 11

Most candidates answered this correctly. Those candidates who reached $15 > 5x$ were more successful in reaching the correct answer than those who reached $-5x > -15$. The latter often forgot to reverse the inequality when dividing by a negative number. A minority of candidates did not earn any marks as they did not correctly add or subtract the elements when collecting like terms.

Question 12

Many candidates earned full marks on this question and were able to give the answer by analysing the given prime factor products without writing anything down. Others used a Venn diagram to help them work out the values. The candidates who attempted to multiply out both the highest common factor and the lowest common multiple were usually unsuccessful as they struggled with the arithmetic, the large numbers and hence large divisions.

Question 13

(a) Almost all candidates answered this correctly. Occasionally a candidate gave the answer 90, incorrectly believing *BE* was the diameter and hence *BFE* was an angle in a semi-circle. Others gave the answer 67, incorrectly using opposite angles in a cyclic quadrilateral when in fact *BCDEF* is a pentagon.

(b) Most candidates answered this part correctly. There were a few candidates who offered no response.

(c) This question required the reflex angle at the centre to be found, but only a minority of candidates gave the required value of 210° as their answer. The majority of candidates gave the answer 150°, the obtuse angle *BOE*, or showed it correctly on the diagram. A small number of candidates gave the answer 226° by doubling 113° not realising the importance that 113° is angle *BCD* and not angle *BCE*. Whilst some candidates gave correct geometrical reasons using the required language, many gave reasons using alternative wording or only providing calculations. Some used descriptions referencing angles on the diagram, rather than using the required words, namely angle at the centre or angle at the circumference. Words and phrases such as perimeter, edge, top of the circle, middle, origin or triangle were not accepted for circumference, centre or angle.

Question 14

(a) Almost all candidates answered this correctly. Where candidates did not gain marks it was usually clear they had made an arithmetic slip rather than a conceptual error. A very small number of candidates offered no response.

(b) Many candidates were able to give a correct expression for the *n*th term. The majority of these candidates evidenced their knowledge that a constant second difference of 4 led directly to $2n^2 + bn + c$. Some extended the sequence to the left to find the term when $n = 0$ as –1 to reach $2n^2 + bn - 1$. By testing a term in the sequence this led them to $b = 0$. Other candidates recognised a constant second difference of 4 was a quadratic but did not know how to find the coefficients of that quadratic, other than by trial and error. Some thought the quadratic was of the form $4n^2 + bn + c$ but could not find consistent values for *b* and *c*. Some candidates did not know what form the *n*th term took and a common error was to try to find *n*th terms of the form $a \times 4^n$ or $4n + c$.

Question 15

The majority of candidates earned full marks on this question. Most used the method of factorisation, but others substituted into the quadratic formula. Common errors included factorisations which only multiplied out to give some of the terms, and slips with signs, arithmetic and inaccurate substitution when using the quadratic formula.

Question 16

A good number of candidates were awarded full marks on this question. Most others earned some of the marks for showing a correct method for some parts of the process. That is, finding the gradient of *AB*, or for finding the negative reciprocal gradient for the perpendicular, or finding the midpoint of *AB* or for substituting their midpoint into $y = mx + c$. Most working was clear and easy to follow. The most common errors came from slips with arithmetic, signs and cancelling, finding the equation of the line *AB*, using point *A* or *B* instead of the midpoint and errors in finding the midpoint. Some candidates tried to find the equation by drawing a grid and the graphs but this was not the intended method and it was rare for anyone to earn any marks from this approach.

Question 17

(a) This part was answered correctly by a fair majority of candidates. Those who did not get full marks often earned a mark for showing 18 or 11.5. A common arithmetic error was to evaluate 18 – 11.5 as 7.5 . A common conceptual error was to first subtract the cumulative frequencies rather than find the heights and then subtract. So, a solution of 90 – 30 = 60 and then a height as 14.5 cm from a cumulative frequency of 60 was commonly seen.

(b) This part was also answered correctly by a large majority of candidates. Some gained one mark for finding 104, the number of plants less than 20 cm, but not going on to subtract this from 120. The most common other errors arose from a misreading of the cumulative frequency scale, usually as 102.

Question 18

(a) (i) Almost all candidates answered this correctly. The few mistakes were predominantly arithmetic or sign error slips, the most common being 3 × (–4) – 2 = –10 or + 10.

(ii) Around half of all candidates answered this part correctly. The most common errors included slips with rearranging or conceptual errors such as 5 + *x* or $\frac{1}{5-x}$. Answers were expected to be simplified and not left as, for example, $\frac{x-5}{-1}$.

(iii) A minority of candidates answered this part correctly. With those understanding composite functions, the most common errors arose from either lack of brackets or incorrect removal of brackets with gf(*x*) often set up as, or becoming, 5 – 3*x* – 2, as well as slips with signs when collecting like terms. Most other candidates made conceptual errors that included substituting g(*x*) into f(*x*) and finding fg(*x*) or finding the product of the functions, namely gf(*x*) = g(*x*) × f(*x*) or finding the sum of the functions, namely gf(*x*) = g(*x*) + f(*x*) and none of these earned any marks.

(b) Around a quarter of all candidates answered this part correctly. A wide range of incorrect answers were seen including: 0, 1, $h(x)$, $h^{-1}(x^2)$, $h^{-2}(x)$, and $h(h^{-1})$. This part had the most noticeable number of candidates who did not offer any answer.

Question 19

A good proportion of candidates earned full marks on this question. Others earned some of the marks for evidencing a correct approach using, for example, [(*x* – 4)(2*x* + 1)] × (*x* + 2) with only a slip, usually a sign or an arithmetic error. The most common misconceptions were to see the three brackets multiplied out as three pairs of brackets in one step, resulting in (*x* – 4)(2*x* + 1) + (*x* – 4)(*x* + 2) + (2*x* + 1)(*x* + 2) which gave 12 terms but no cubic terms, or (*x* – 4)(2*x* + 1 + *x* + 2) resulting in 8 terms and no cubic.

Question 20

(a) The starting point for this question was knowing that $\tan 60 = \sqrt{3}$. Using knowledge of the tan graph, candidates should be expecting two solutions to the given equation. Whilst some candidates earned full marks for the two correct values and some earned one mark for 60, many gave multiple answers which came from $\tan x = \pm\sqrt{3}$ or from the wrong principal value such as 30 or 45. Some candidates were awarded a mark for recognition that there are two solutions $180°$ apart.

(b) A minority of candidates earned full marks on this question. The starting point was being able to rearrange the equation correctly and to know that sin30 = 0.5 or sin (–30) = –0.5. Errors were seen with the equation when a first step was to divide by 4 and the 3 on the left was not changed to $\frac{3}{4}$ or, when the first step was to subtract 3 from both sides and 1 – 3 became + 2. Others made errors with principal values using $45°$ or $60°$ rather than $30°$. From the drawn graph candidates should have expected two solutions, when again often more than two were given on the answer line. A few candidates earned a mark for using the symmetry of the graph to give two solutions that totalled $180°$ or $540°$.

Question 21

(a) Most candidates gave the correct equation. The few errors that were seen came from setting up the equation incorrectly, usually as $y \propto \frac{k}{x^3}$ or $y = -kx^3$ or $y = kx$ or $y = -kx$ or $y = \frac{k}{x}$.

(b) Most candidates who had answered the previous part correctly showed $27 = \frac{8}{x^3}$. However, a significant number were unable to rearrange this to find the value of *x*. Incorrect next steps included $x^3 = 8 \times 27$, $x^3 = 8 - 27$, $x^3 = \frac{27}{8}$ and $\sqrt[3]{27} = \frac{8}{x}$. Others rearranged correctly but did not simplify $\sqrt[3]{\frac{8}{27}}$.

Question 22

(a) A minority of candidates were able to completely simplify the surds. The majority were awarded one mark for evidencing some simplification, such as $\sqrt{27} = 3\sqrt{3}$ or $\sqrt{120} = 2\sqrt{30}$ or giving a final answer, for example of $9\sqrt{40}$ or $6\sqrt{90}$. The most common errors came from candidates using incorrect rules of surds. The most common examples included incorrectly simplifying $\sqrt{a^2b}$ to $b\sqrt{a}$ *or* $\sqrt{cd}$ *to* $c\sqrt{d}$. Candidates who combined $\sqrt{120} \times \sqrt{27}$ to give $\sqrt{3240}$ were not awarded any marks unless they went on and correctly completed some simplification of the surd.

(b) A good proportion of candidates answered this part correctly. The majority of other candidates were able to show a correct multiplication by $\frac{5+2\sqrt{3}}{5+2\sqrt{3}}$ but there were a variety of slips with signs, arithmetic and in finding $\left(2\sqrt{3}\right)^2$. Others simply cancelled the multiplier and ended up back at the original expression.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/22
Non-calculator (Extended)

Key messages

This examination was the first summer series of the new specification and this paper now 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 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) The majority of candidates scored this mark. The common mistake was with an incorrect place value. A small number of candidates worked in fractions and gave their answer as a fraction which was an acceptable method.

(b) Candidates showed a good understanding of standard form and candidates who made an error in **part (a)** could still score this mark.

Question 2

Candidates clearly recognised prime numbers but sometimes did not identify all of the numbers in the given list. A common error was to include 39.

Question 3

This question was correctly answered by nearly all of the candidates.

Question 4

This question proved to be more challenging. Candidates attempted to divide by a power of 10, with many dividing by 100.

Question 5

Although many candidates gave the correct answer of trapezium, there was a wide variety of other 'quadrilaterals' given as an answer.

Question 6

(a) Candidates did very well on this part and recognised that the first step was to divide 120 by 5. Some arithmetic slips were seen and could have been corrected if candidates had carried out a quick check to ensure that their answers added up to 120.

(b) This algebraic test of ratios was well attempted and many correct answers were seen.

Question 7

(a) Nearly all candidates answered this part correctly.

(b) The majority of candidates gave the correct relative frequency as a fraction, decimal or percentage. The most common error was to simply write the frequency as 7.

Question 8

(a) Candidates were able to multiply out brackets correctly and collect terms. Some candidates factorised their final answer which was not necessary.

(b) (i) Nearly all candidates scored this mark.

(ii) This part was correctly answered by nearly all candidates.

(iii) Again, this part was well answered, with candidates demonstrating good skills in factorising quadratics.

Question 9

(a) Almost all candidates identified the mode as 1.

(b) This part was not as well answered and many candidates struggled to find the upper and lower quartiles from the data in the frequency table.

Question 10

Candidates used set notation correctly and came up with a variety of unusual, but correct, responses.

Question 11

This was a tricky question but it was very well attempted.

Nearly all candidates scored at least one mark by finding either the numerical or algebraic part correctly.

Question 12

It was impressive to see many detailed attempts in this 'show that 'question.

Candidates seemed to understand that each step needed to be clearly communicated and set out their working mostly line by line.

The most common error was to square root instead of cube root.

A small number of candidates tried to use the given value of $x = 20$ and substitute it into their volume expressions to show that the total was 32 000. Candidates need to remember that they should not use the information they are meant to be showing.

Question 13

(a) Most candidates used sin30 correctly and clearly showed sin30 = 0.5 as part of their explanation.

(b) Nearly all candidates realised the need to use Pythagoras' theorem to find y.

There were occasional slips with calculating 13^2 and a small number of candidates started incorrectly with $5^2 + 13^2$.

Question 14

Most candidates scored one mark in this question, being able to find the value of 12 and one of the algebraic parts correctly.

Question 15

This question proved to be challenging. Most candidates were able to identify one of the correct products but many did not consider the different possible arrangements for the three rolls of the die.

Some candidates included a product of 2 fractions, misinterpreting two or more times

Question 16

(a) Nearly all candidates were able to find both the next term and *n*th term of this simple arithmetic sequence.

(b) This part proved to be a good discriminator. Many candidates were able to find the correct next term, but the *n*th term proved to be demanding.

Question 17

Angle theorems appeared to be well understood, with many candidates scoring full marks.

Question 18

Candidates who were able to set up the correct initial equation usually were successful in rearranging it to gain full marks.

However, many candidates simply stated $2.5x + y = 10$ and did not score any marks.

Question 19

(a) Nearly all candidates scored this mark.

(b) Excellent again, although there were occasional slips in subtracting 4 when solving the equation $5x - 4 = 11$.

(c) Most candidates were able to start the correct process to find the inverse function and scored at least one mark.

Candidates need to realise that a fraction within a fraction is not a suitable form for a final answer.

Question 20

(a) The manipulation of surds was used correctly in most cases.

Candidates started to multiply by the correct conjugate. Errors occurred, usually in the numerator, either with sign errors or sometimes rewriting $-\sqrt{6}-\sqrt{6}$ as $-\sqrt{12}$.

(b) Nearly all candidates found the correct answer of 1.

Question 21

(a) This part was really well answered, with candidates finding the negative reciprocal and using the point (3, 12) to find the *y*-intercept and hence the equation of the line.

(b) Candidates needed to find the point of intersection of the line *L* and their answer for the perpendicular line found in **part (a)**.

Most candidates realised that they needed to use $\sqrt{(x-3)^2+(y-12)^2}$, but did not always have a correct point when solving $2x + 1 = -0.5x + 13.5$.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/23
Non-calculator (Extended)

Key messages

This examination was the first summer series of the new specification and this paper now 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 of their working to score full marks.

General comments

Candidates were generally 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.

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

The majority of candidates scored this mark.

Question 2

Candidates clearly recognised both square numbers and prime numbers but very few candidates were able to recognise that 21 was the triangle number.

Question 3

This question was correctly answered by nearly all of the candidates.

Question 4

This question proved to be more challenging.

Candidates who attempted the question by considering the exterior angles of the polygon were, in general, successful.

Candidates who attempted the question by considering the interior angles of the polygon, were prone to making numerical errors when calculating $\frac{180\,(20-2)}{20}$.

Question 5

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

(b) This part was found to be more challenging. Candidates needed to set up the equation $140 - x = 2(100 - x)$, which then could be solved.

Question 6

Candidates did very well on the first steps of the question and were able to correctly form two simultaneous equations. There were, however, a number of careless arithmetic mistakes when equating coefficients.

Question 7

Nearly all candidates scored some marks in this question.

Some candidates who set up the correct expression $\frac{16}{3} \times \frac{5}{8}$ made careless mistakes on the simplification, or in the conversion of their answer to a mixed number.

Question 8

(a) Candidates were able to correctly draw the image after the given translation.

(b) This part proved to be very demanding. Nearly all candidates realised that the transformation was an enlargement but very few candidates could identify the centre as (1, 1) or that the scale factor was –2.

Question 9

The majority of candidates were able to score at least one mark, for a correct first step.

Question 10

Candidates clearly have a good understanding of all circle theorems as this question was well answered with most candidates scoring full marks.

Question 11

(a) Nearly all candidates scored at least one mark by correctly writing one of the expressions in terms of $\sqrt{3}$.

(b) This was a tricky question but it was well attempted. Candidates realised that they had to multiply by $\frac{\sqrt{5}+\sqrt{2}}{\sqrt{5}+\sqrt{2}}$. There were slips when simplifying $\left(\sqrt{5}\right)^2 - \left(\sqrt{2}\right)^2$ in the denominator. Some candidates lost the final mark by not cancelling their fraction.

Question 12

Candidates were able to realise that the value of *a* was 16 and scored one mark.

Some candidates then realised that they needed to find the sector angle and then use this sector angle to find the arc length.

Question 13

Candidates needed to write both numbers to the same power and then ensure that their final answer was in standard form.

Question 14

(a) (i) There were many correct answers to this part.

(ii) This part was also well answered. It was pleasing to see that candidates knew the exact values of trig ratios.

(b) There were many correct sketches. However, a number of candidates drew the graph of sin *x*.

(c) This part was correctly answered by the majority of candidates.

Question 15

This question proved to be challenging. Most candidates were unable to set up an equation in terms of *k*.

Candidates who started the question correctly, normally went on to score full marks.

Question 16

This question proved to be a good discriminator. Many candidates realised that initially they had to collect like terms, but they then struggled to isolate *y* correctly.

Question 17

This question proved to be challenging.

Many candidates scored one mark by substituting (1, –2) into the given equation, but then were not able to make any further progress.

Question 18

This question was well attempted with candidates able to score at least two marks by correctly expanding the brackets and isolating the term in *x*.

Question 19

This question was found very challenging, and more work on logs would be beneficial.

(a) There were very few correct answers to this part.

(b) Again, there were very few correct answers to this part.

Question 20

(a) Nearly all candidates correctly gave the next term as 96.

(b) Many candidates were able to score at least one mark by realising that the *n*th term must include a power of 2.

Question 21

(a) Candidates were expected to use Pythagoras' theorem twice to find the length *BF*.

Many candidates were able to score at least one mark for one correct expression.

(b) Candidates needed to use their value of *BF* to answer this part.

A number of candidates who were unsuccessful in **part (a)** were able to score this mark as they used a trigonometric equation correctly.

Question 22

Candidates were able to score one mark for $2(x - 2) - 3$. Only the better candidates scored both marks.

Question 23

(a) Some candidates found one of the correct combined probabilities $\frac{3}{7} \times \frac{4}{9}$ or $\frac{4}{7} \times \frac{5}{9}$, to score at least one mark.

Candidates who considered both balls being black and both balls being white normally went on to score full marks.

(b) Candidates needed to consider the first ball being chosen as black and then the first ball chosen was white. Correct answers were seen from a few candidates.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/31
Calculator (Core)

Key messages

Candidates need more practice in answering questions that need an explanation.

Candidates should have a graphic display calculator and ensure that they know how to carry out all the functions that are listed in the syllabus.

Candidates should be encouraged to show all their working out. Many marks were lost because working out was not written down and the answer given to only one or two significant figures.

If the question states 'you must show your working' then no marks will be awarded if no working is shown, even if the answer is correct.

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

Candidates should bring the correct mathematical instruments to the exam.

General comments

In general, candidates attempted all the questions, so it appeared that they had sufficient time to complete the paper.

Some candidates appeared to have difficulty with giving a clear explanation for an answer.

Not all candidates appeared to have a graphic display calculator. The graph of $y = \frac{7}{x+2}$ was often left blank or incorrectly drawn. Not all candidates had mathematical instruments with them. A ruler should always be used to draw straight lines. Candidates should practice transferring what is on their calculator 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. Many marks were lost because working out was not written down and the answer given to only one or two significant figures. Giving answers to fewer significant figures will result in a loss of marks and, if no working out is seen, then no marks will be awarded. When working out is shown and is correct then partial marks can be awarded. Candidates should know the difference between significant figures and decimal places.

Candidates should be aware that if the question states 'Write down' then they do not have to work anything out. Candidates should be familiar with correct mathematical terminology.

Comments on specific questions

Question 1

Many candidates found it difficult to explain why 4 was the minimum number of coaches required. There were 2 marks available with one mark being for the method. This was either a calculation to show that 3 coaches was not enough, but 4 coaches was plenty, or dividing 105 by 32 to show that not all students would fit into 3 coaches. The second mark was for a concluding statement.

Question 2

(a) The majority of candidates gave the correct answer. Some candidates did not appear to know how to use their calculator to find the cube root.

(b) Some candidates lost a mark because they did not give their answer to 2 decimal places as requested. Others did not round their answer correctly and wrote 4.02 as their answer. Candidates who showed some clear working and gave a more accurate answer were awarded 1 mark. If no working out was seen, they were awarded 0 marks. A few candidates used their calculator incorrectly and worked out $\frac{7.45}{11.23} - 9.38$ and arrived at a negative answer.

Question 3

(a) When writing a time as a 12-hour clock time, candidates need to write a.m. or p.m. as part of their answer. Many candidates did not write p.m. after their time and were awarded 0 marks for their answer of 6 42. Perhaps more practice is needed to write time as a 12-hour clock time.

(b) The majority of candidates were able to find the correct time for when the film ended.

Question 4

(a) There were many correct stem-and-leaf diagrams seen. Some candidates did not order their rows, and some missed out a number. A few candidates incorrectly wrote the full number in the rows. Not all candidates knew how to complete the key.

(b) Most candidates were able to give the correct answer for the range.

(c) A small majority of candidates gave the correct answer for the median. A common incorrect answer was 73.5.

Question 5

Only a minority of candidates knew the word reciprocal. Common incorrect answers were $\frac{4}{10}$, 0.4 and $\frac{3}{5}$.

Question 6

A good number of candidates were familiar with types of correlation. Others perhaps did not understand the question and tried to describe what was happening between the height and temperature. Candidates need to be able to describe correlation in examples such as this where they have not been given a scatter diagram.

Question 7

(a) Nearly all candidates were able to find the correct distance.

(b) About half of the candidates were able to gain full marks in this question. A variety of errors were made by the other candidates. Some added an extra distance to each route. A few subtracted their distances instead of adding them. A few showed no working out and gave an incorrect answer and, as a result, were awarded no marks.

Question 8

(a) Many candidates knew that this shape was a trapezium – although not all could spell it correctly. Incorrect spelling was accepted as long as the candidate was clearly attempting to write trapezium. Other common answers were parallelogram, rectangle and rhombus.

(b) This was very well answered with most candidates finding the correct value for x.

(c) This too had a large majority of correct answers for angle y. The most common incorrect answer was 107.

Question 9

(a) This was very well answered. Some candidates gave the nth term which was accepted, but others wrote $n + 6$, which was not accepted as a correct answer.

(b) This proved more difficult. Some candidates wrote $54n – 3$ instead of $54 – 3n$ and others just wrote $n – 3$ for their answer.

(c) This also proved challenging for some candidates with many wrong answers given. The most common being 29 and 104.

Question 10

This question was very well answered with most candidates showing clearly how they arrived at their answer.

Question 11

(a) A good number of candidates managed to write the ratio in its simplest form. A few left their answer as 10 : 8 and some other candidates cancelled incorrectly.

(b) There were fewer correct answers to this part. The most common wrong method was dividing 90 by 5. Some candidates were awarded method marks for dividing 72 by 3 to get 24 and then doubling their answer to get 48. But they then forgot to take this answer from 90 to find the number of bowls sold.

Question 12

In this question candidates were equally likely to correctly divide by 1.297 or to multiply by 1.297 to get an incorrect answer.

Question 13

(a) Not all candidates knew how to use trigonometry to find the angle. Some appeared to have measured the angle with a protractor. Candidates should be reminded that angles will not be drawn accurately in this type of question. A few used the wrong trigonometric ratio.

(b) Candidates were better able to use Pythagoras' theorem and there were a good number of correct answers. Some candidates, however, worked out the length incorrectly by adding the squares of the two sides given rather than subtracting them.

Question 14

This was a challenging question. Many candidates were awarded one method mark for their attempt at dividing distance by speed. However, there were not very many correct answers given for the time.

Question 15

(a) Many candidates gained at least 2 marks for this part question. Most lost the final mark because they did not write their answer to more than three significant figures first.

(b) This part was more challenging and there were not many correct answers seen. Few candidates realised that all they had to do was multiply the answer given in part **(a)** by 12.

Question 16

(a) There were many correct answers to this question. The most common error was first to divide through by 3 but most candidates forgot to divide the x as well as the numbers. Those who rearranged the equation by moving the x first usually managed to reach the correct answer.

(b) This part was found very challenging and there were not many correct answers for the equation of the parallel line. A lot of the candidates did not appear to know how to tackle this question.

Question 17

There were many correct answers for the increased price of the game. Some candidates found the 1.80 but then subtracted it from, rather than adding it to 15.

Question 18

(a) Those candidates who had a calculator and knew how to use it managed to sketch the graph correctly. Sometimes they were rather messy and too inaccurate. More practice is needed in transferring what is on their calculator to paper. Their answer should be a sketch not an accurate graph, but it should bear a good resemblance to the correct shape. A few candidates entered the equation incorrectly into their calculator as $y = \frac{7}{x} + 2$ and, as a result, their graph was not correct.

(b) Most of the candidates who had drawn the graph could find the point correctly.

(c) Not all candidates used a ruler to draw their line, and not all lines passed through the origin. Even though this was a sketch, a linear graph should always be drawn with a ruler.

(d) Candidates who drew a correct graph and line usually also managed to find the correct intersection values.

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 graphic display 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, although some candidates are still reluctant to show their working and just write down answers. An incorrect answer with no working scores zero, whereas an incorrect answer with working shown may score some of the method marks available. Calculators were used with confidence, although it does appear that some candidates did not have a graphics display calculator, as the syllabus requires. Candidates had sufficient time to complete the paper. Most candidates attempted all of the questions.

Comments on specific questions

Question 1

Nearly all candidates were able to gain full marks with this question. All knew to subtract 2.75 from 10 and then divide by 5 for the answer.

Question 2

Although there were many correct answers to this question, a significant number of candidates either truncated their answer to four decimal places or gave an answer correct to four significant figures.

Question 3

(a) Nearly all candidates gained full marks in this question. It was common to see candidates using 24 and 60 either with 402 or 578 880 to establish the connection.

(b) Most correctly divided 402 by 6, although some mistakenly divided 578 880 by 6.

Question 4

There were many correct answers. Most of these were given with no working shown, a risky strategy. Others correctly showed substitution and evaluation for the first answer and set up and solved an equation for the second answer.

Question 5

The success rate was variable in this question. It was common to see correct answers with no working to check the equivalence of the fractions. A few used a card more than once and some appeared to have just guessed.

Question 6

There were many correct answers with the correct algebra steps shown clearly. Very few forgot to change signs when moving a term from one side of the equals sign to the other. Algebra continues to show improvement.

Question 7

(a) A number of candidates did not see that the two triangular ends of the shape could be combined to give two squares. It was common to see the area of a triangle formula or the area of a trapezium formula being used here, where counting squares was all that was needed.

(b) In general, candidates were not quite so confident about using trigonometry. Most could identify the triangle needed and, of these, many reasoned that tangent was the trigonometric ratio required to find the angle. Some did not then give their answer to an acceptable degree of accuracy. A few went on to find the length of the hypotenuse and use the sine or cosine formulae. A number just guessed the answer or measured the angle in the diagram.

Question 8

(a) Most candidates substituted the values into the formula and evaluated the expression correctly.

(b) Again, many substituted the values correctly into the formula but some then had trouble solving the equation that this gave.

Question 9

(a) Most knew to multiply or divide by 60 to establish the equivalence.

(b) It was common to see distance divided by time being used to find the speed. However, some divided by 2.25 instead of 135. A few did not give their answer to an appropriate degree of accuracy. At least 3 significant figures are required.

Question 10

Many candidates started their answer correctly by finding the reduction in the cost. Most correctly went on to divide by the original cost and from there to the answer. Some, however, incorrectly divided the reduction by the sale price or even 100. Others found what the sale price was as a percentage of the original cost (88%), but did not go on to find the percentage reduction.

Question 11

(a) Most candidates knew that the shape was a pentagon, although a number thought it was a hexagon.

(b) Many employed the formula $\frac{(n-2)\times 180}{n}$ to find the answer. Most of these substituted $n = 5$ and evaluated the expression correctly. Others found the external angle of the polygon; some then omitted to go on to find the internal angle. A few found the total sum of the internal angles to be 540° but then did not know how to proceed to find the size of one of the internal angles.

Question 12

(a) Although the midpoint could be found directly from the diagram, many used the formula involving the end points of the line.

(b) Again, candidates preferred to use the formula involving the end points to find the gradient of the line, rather than working with the diagram.

(c) It appears that some candidates did not know that the equation of a straight line is of the form $y = mx + c$. Of those who did, many were successful in obtaining the correct equation. However, for the value of *c*, a number did not read the intercept from the graph but employed an algebraic technique.

Question 13

(a) and (b) Many candidates did not see the significance of the triangles being equilateral. Consequently, 8 and 60 were seen less often than expected.

(c) Although it was common to see candidates using Pythagoras' theorem here, a significant number did not show their answer to more than 3 significant figures so that the rounding to 3 significant figures could be demonstrated.

(d) This part was more successful for many candidates. Most found the area of the square correctly but many did not use the value given in **part (c)** to find the area of each triangle.

Question 14

(a) Although many candidates gained both marks, a number of candidates could not cope with the vertical scale and points were plotted incorrectly.

(b) Most knew that the diagram displayed positive correlation.

(c) (i) and (ii) Candidates could find the mean of the two sets of data with few errors seen.

(d) Candidates, in general, drew a ruled straight line for the line of best fit. However, a significant number of these did not pass through the mean point, values for which had been calculated in the previous part.

Question 15

Many candidates incorrectly used a simple interest formula to answer this question. However, only a minority of candidates gained many marks. Of those that did use the correct formula, some then forgot to subtract the original amount invested to find the interest. Some could not cope with the 1.3% becoming 0.013 in the formula and others quoted the formula incorrectly.

Question 16

(a) Nearly all candidates correctly multiplied 2000 and 0.9759 to find the answer.

(b) Nearly half of the candidates gave fully correct answers to this part. After a correct calculation, some did not round their answer appropriately and gave, for example, 462.9. One incorrect start seen was to subtract 1500 from 2000 instead of subtracting it from 1951.80.

Question 17

It appeared that some candidates did not have access to a graphics display calculator, necessary for this question. It is a requirement of the syllabus that candidates should have such a calculator.

(a) Those with a graphics display calculator managed to sketch the graph of the hyperbola well. Some only drew the left-hand branch.

(b) Many correctly found the coordinate of the point where the graph crosses the *x*-axis.

(c) The graph of the straight line was sketched accurately in many cases. Most used a ruler, as required.

(d) Many correctly found at least one of the points of intersection of the line and the curve.

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 graphic display calculator that are listed in the syllabus.

General comments

Candidates performed quite well on this paper. Many were well prepared and, in general, showed a sound understanding of the syllabus content. Presentation of work continues to improve although some candidates are still reluctant to show their working and just write down answers. Calculators were used with confidence, although it does appear that some do not have a graphics display calculator, as the syllabus requires. Candidates had sufficient time to complete the paper.

Work on algebra questions continues to show improvement. Most candidates have a firm grasp of the conventions and procedures required. Drawing work was generally good. Venn diagrams and trigonometry were topics less well understood. Some continue to use ‘pencil and paper’ methods to solve arithmetic problems, even when they have a calculator available.

Comments on specific questions

Question 1

(a) Most candidates could write the number in words and there were few errors.

(b) The majority of candidates gave a correct factor of 36. A small number gave a multiple of 36, confusing factor with multiple.

Question 2

(a) Although converting the fraction to a percentage was often done correctly, few went on to give their answer to the required accuracy. Answers of 46 (2 significant figures rather than 2 decimal places) and 46.66 (truncating to 2 decimal places) were common.

(b) Very few candidates used their calculator to answer this question, preferring pencil and paper methods. Many made errors in their working, leading to incorrect answers.

Question 3

(a) Most knew that *OX* was a radius of the circle. Fewer identified *XY* as a chord.

(b) Only a small number of candidates were able to draw a tangent at *Y* on the circle. Most of these correctly used a ruler for their line. A significant number of candidates did not attempt this part of the question.

Question 4

There were many correct answers to all parts of this question, often with little or no working shown.

(a) The vast majority managed to add all the masses correctly.

(b) Again, there were many correct answers here. Some found that there was twice the amount of butter used but then omitted to multiply by 8 to find the number of biscuits.

(c) Candidates used different methods here, many arriving at a correct answer. Some found how much chocolate was needed for 1 biscuit and multiplied by 10, while others added the mass of chocolate needed for 8 biscuits and that needed for 2 biscuits.

Question 5

(a) Most candidates substituted the given values into the formula and evaluated their expression correctly.

(b) In general, candidates substituted the values into the formula and solved the resulting equation to find the answer. A few used trial and improvement correctly to solve the equation.

Question 6

(a) A number of candidates could not find 7% of 45. A few worked out 0.7×45 instead of 0.07×45.

(b) Invariably, candidates correctly found the total of 45 plus their answer to **part (a)**.

Question 7

(a) Most knew that angles on a straight line add up to 180° and correctly found x,

(b) Candidates recognised the alternate angles within the parallel lines and a correct answer of 70 was seen often.

(c) There were many well-reasoned answers here. Candidates correctly found the size of the angle at A and concluded that a triangle with two equal angles was isosceles. Some found the angle but then did not come to an appropriate conclusion. A few focused incorrectly on the lengths of the sides, remembering that an isosceles triangle has two equal length sides.

Question 8

(a), (b) and (c) Many candidates used their calculator to good effect in the first three parts of this question giving correct answers to each. Some used pencil and paper methods, often with incorrect answers. In the calculator paper, it is expected that calculators would be used at least in the first two parts.

(d) Calculators were again usually used successfully in this part. However, many did not convert their calculator answer into standard form, as requested in the question.

Question 9

There were many fully correct answers to both parts of this question, showing an improvement in this aspect of algebra.

(a) A small number of candidates still perform the algebraic steps incorrectly. For example, giving as a first step $x - 1 = 10$.

(b) Most realised that a good start was to remove the brackets. However, this was not always done correctly. For example, 3×7 was given sometimes as 18 or 42. This highlights how candidates need to check their work.

Question 10

There were many fully correct answers to this question. By far the most common error made by candidates was to assume that there were 100 grams in 1 kilogram. Another error seen was to round the area of the rectangle to 129 and hence end up with an incorrect answer of 6.45. This premature rounding of an intermediate value should be discouraged.

Question 11

(a) Most candidates realised that the die was biased because of the wide variation in the frequencies. However, few mentioned that this is only significant because this is in a large number of trials.

(b) Many gave a correct answer for the probability. Some went back to assuming it was an unbiased die and gave an incorrect answer of $\frac{1}{6}$.

Question 12

Although many candidates found the formula needed from the formula list on page 2 of the question paper, a number did not. Most identified the radius and height and substituted correctly into the formula. It was clear, however, that some were using an inappropriate value for pi, usually 3.14. This led to inaccurate answers. Candidates are expected to use the pi button on their calculator. Many candidates did not know the units of their answer with cm^2 being a common wrong answer. Others left the units section on the answer line blank or filled it with spurious numbers.

Question 13

(a) Most candidates did not interpret the diagram correctly. A common answer was 11, 3 where candidates did not add the two values. Another common wrong answer was 15 where candidates had not correctly identified the region representing the complement of set *A*.

(b) As in **part (a)**, there were few correct answers. $\frac{1}{4}$ was a common wrong answer.

Question 14

Even with the prompt to use trigonometry, many candidates just guessed the answer. Some knew the trigonometrical ratios but not how to use them. Others used the correct tangent ratio but often this was evaluated incorrectly. A few first used Pythagoras' theorem to find the hypotenuse and then used trigonometry. These usually lost accuracy in their answers due to premature rounding.

Question 15

Most could complete the table successfully but very few knew how to combine the values in the table to work out an estimate of the mean.

Question 16

This question proved quite challenging for a number of candidates. Some did find the interest gained although many of these struggled to know how to proceed. A small number incorrectly used the compound interest formula and soon found the algebra needed was too hard.

Question 17

A number of candidates did not attempt any part of this question, probably due to not having a graphic display calculator. It is expected that candidates will have access to, and be practised in using, such a calculator, as laid out in the syllabus.

(a) (i) Those with a graphic display calculator drew an appropriate cubic curve.

(ii) There were a number of good attempts to find the x-coordinate of the local maximum. However, these were spoilt by a loss of accuracy in the answers. Common inaccurate answers were –3.8, –4 and –3. Some gave both coordinates of the maximum rather than just the x-coordinate.

(b) Again, those with a graphic display calculator had little problem drawing a sketch of the straight line. Most, sensibly, used a ruler to draw the line as they are expected to do.

(c) Many of those who attempted this question found at least some, if not all, of the points of intersection. Once again, some had problems with the accuracy of their answers.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/41
Calculator (Extended)

Key messages

Candidates need to show sufficient working so that method marks are obtainable even if the answer is wrong. When questions ask for a result to be shown, it is essential to put every step of the working in. Candidates should try to set working out in a logical order preferably starting on the lefthand side of the answer space. Some of the steps can be difficult to find when the work is not shown in a logical order.

Working should be to sufficient degree of accuracy to give a final answer to at least 3 significant figures. Usually that means working to 4 significant figure accuracy. When asked to show a numerical result is accurate to e.g. 3 significant figures, it is necessary to initially show that result to a greater degree of accuracy.

General comments

The paper proved accessible to most candidates with omission rates fairly low. Scores were seen across the whole range, but very low scores were fairly rare. There was some impressive work from the better candidates with a pleasing number of very high scores.

Comments on specific questions

Question 1

(a) (i) This was generally well answered although a small number of candidates wrote the frequency (45) rather than the mode.

(ii) This too was well answered, although a few candidates worked out the mean. Candidates were expected to put the data into their graphic display calculator to obtain the median and the upper quartile in **part (iv)**

(iii) Most candidates did this well. Here too, some used the frequencies rather than the values.

(iv) This proved a little more difficult but, nevertheless, most candidates gave the correct answer.

(b) Almost all candidates gave the correct probability.

Question 2

(a) This was done well by a large majority of the candidates. The only fairly common error was to produce an answer of 25.2 from 60% of 42 or 42% of 60.

(b) This was almost always correct.

Question 3

(a) This was almost always correct.

(b) A high proportion of candidates reached the correct answer. Where a mistake was made it was usually in the expansion of the second bracket as $-5 - 20x$, with a final answer of $-14x - 9$. A few candidates expanded the two brackets and then multiplied them together.

Question 4

This question proved very demanding. The first part was well done by the better candidates, but most found the second part very difficult. Many confused union and intersection and many omitted the brackets from the second part even if they had some appreciation of what was required.

Question 5

Almost all candidates gave the correct answer.

Question 6

(a) The great majority of candidates set up the Pythagoras equation correctly, but there are still too many candidates who do not write down a value with at least one more decimal than the given answer.

A few candidates used the given answer in their Pythagoras equation in order to show the two sides of the equation were equal. This is not acceptable

(b) The main issue here was one of accuracy, with many candidates losing the final accuracy mark with an answer outside the acceptable range. This was caused by premature rounding of intermediate values.

Many candidates set their work out clearly so that it could be easily followed; this facilitates the awarding of method marks if the final answer is inaccurate. This is particularly important in a question such as this, where a number of different methods are equally valid. However, a small number of candidates' work was very difficult to follow, as it was set down in a disorganised manner around the working space.

A few candidates worked with the right-hand side of the prism only.

Question 7

Almost all candidates gave at least one part of the answer correctly, although finding all three sometimes proved difficult. The number part of the answer proved to be the most difficult to achieve with a number of candidates not evaluating 2^7.

Question 8

This was proved a straightforward vector question which produced a very high number of correct answers. Some candidates gave the reverse vector. A very small number of candidates reversed the components.

Question 9

(a) (i) Many candidates did not appreciate that this was a 'reverse percentage' question. The response 20 400 × 1.15 was seen at least as often as the correct answer.

(ii) This part was done much better but, here too, the use of 1.15 was fairly common.

(c) This part was well done with a variety of approaches. Many used logarithms where much of the work was very impressive. Those using trial and improvement sometimes showed insufficient trials. For a fully correct response for this method, it is necessary to show sufficient trials up to the first one below 5000. A few candidates carried out correct calculator work but attributed the results to the incorrect years. Very few candidates used the method of sketching curves of appropriate functions on their graphic display calculator.

Question 10

(a) The overwhelming majority of candidates showed a correct substitution in the formula for the volume of a cylinder.

(b) Most candidates successfully found the radius of the cone. Some omitted π from 300π when equating the two volumes or thought that $300 \div \frac{1}{3}$ was equal to 100. For the continuation, the usual error was to take the value of the sloping side in the surface area formula to be 15. Premature rounding or forgetting to add the area of the base often resulted in the final answer being inaccurate or incorrect.

Question 11

(a) There were many good sketches. As usual, the best ones often had the asymptotes drawn in first, in order to ensure that the branches of the graph did not overlap. Most candidates realised that it was important to show on the sketch that the central branch passed through the origin. Where marks were lost, it was usually due to excessive overlap or wide gaps at the asymptotes.

(b) Most candidates understood the concept of a local minimum and were able to read off correctly from their graphic display calculator. However, a significant number did not give one or both answers to the required accuracy of at least three significant figures.

(c) The equations of the asymptotes were usually correct. Where errors occurred, they were usually giving the answers as $y = -2$ and $y = 3$ or simply giving the answers –2 and 3.

(d) A good deal of work was required to gain all 4 marks. To their credit, a good number of candidates were successful in providing all correct solutions. Many candidates were able to read off the x-coordinates of the points of intersection of their curve and the line $y = x + 7$ but could not see the relevance of the asymptotes. Those candidates who had drawn the asymptotes on their sketch were at an advantage here. Very few candidates drew the sketch of $y = x + 7$ on their diagram.

Question 12

(a) Nearly all candidates used the cosine rule correctly. A small proportion of candidates omitted to indicate square root. The majority of candidates did not show the answer correct to two decimal places which was necessary to show that the answer was 224.8 correct to one decimal place.

(b) There was a mixed response to this part, with some candidates setting out detailed and well organised work, making full use of the diagram to show lengths and angles. At the other extreme there were many candidates who made no real progress, and who, all too often, tried to work out the incorrect length. Most candidates successfully worked out an appropriate angle or length. Far fewer then went on to complete to the required length. Many found the length of the perpendicular from *B* to *AC* instead of the required length from *A* to the point of intersection of the perpendicular with *AC*. A number of candidates showed poor organisation of their work with isolated remnants of correct working scattered across the working space.

Question 13

(a) Relatively few candidates were able to form the initial algebraic fraction equation for time and hence many made no progress. Those who did form the equation correctly usually possessed the algebraic skills to go on and complete the simplification to the given quadratic equation. A substantial number solved the equation here rather than showing the derivation of the equation.

(b) (i) Almost all candidates used the formula here and scored well. Some errors did occur with the use of the negative numbers in the formula but in most cases, they recovered to the correct answers. There was some inaccuracy seen in giving the final answer of the negative solution, –5.99. Just a few candidates showed a sketch from their graphic display calculator to reach the correct answers.

(ii) Many candidates overcomplicated this question, not appreciating that the addition of 10 to their previous positive answer was all that was required.

Question 14

(a) A large number of candidates successfully reached the correct answer, usually showing all the necessary working. There was little evidence of the use of the statistical functions on their graphic display calculator. A number made an error in one or more of the mid-interval values including using 2.5 for the interval $2 < m \leqslant 5$. A few used either end of the intervals and others divided by 5 instead of 50 or added the mid-interval values taking no account of the frequencies.

(b) This question discriminated well. A relatively small number reached the right answer. Better candidates often did the correct multiplication of $\frac{10}{50} \times \frac{13}{49}$ but omitted to multiply this by 2.

Many candidates, however, used both denominators as 50, not appreciating that the question involved probabilities without replacement.

Question 15

Almost all the candidates fell into one of two groups: those who used the volume scale factor as the linear scale factor producing the incorrect answer 12.5, and those using the correct cube root of the volume scale factor and reaching the correct answer. Unfortunately, the former were in the majority.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/42
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 but 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 graphic display calculator is an important aid and candidates are expected to be fully experienced in the appropriate use of such a useful device. It is anticipated that the calculator has been used as a teaching and learning aid throughout the course. In the syllabus 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 some complicated algebra and candidates need to be aware of such opportunities.

General comments

The candidates were very well prepared for this paper and there were many excellent scripts, showing all necessary working and a suitable level of accuracy. Candidates were able to attempt all the questions and to complete the paper in the allotted time. The different style of the paper with the new syllabus had many shorter questions at the beginning enabling candidates to make a positive, confident start to the examination. The overall standard of work was very 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 a number of 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:

- handwriting, particularly with numbers
- candidates should not overwrite answers
- care in copying values from one line to the next
- care in reading the question, for example, transformation questions which ask for a single transformation, extras automatically score zero marks.

The sketching of graphs does continue to improve and there was more evidence of the use of a graphic display calculator supported by working, which is in the spirit of the syllabus.

Topics on which questions were well answered include solving linear equations, currency exchange, transformations, compound interest, functions, trigonometry and curve sketching.

Difficult topics were; understanding of mathematical language, direct and inverse proportionality, solving inequalities, similar shapes/scale factors and mensuration, 'show that' questions.

There were mixed responses in other questions as will be explained in the following comments.

Comments on specific questions

Question 1

(a) This part was very well answered with most candidates obtaining the correct answer of 13 200. However, some misread the question and gave the answer to 3 decimal places instead of 3 significant figures. It was less common for candidates to give their answer in standard form, but this was seen and was usually correct. Some candidates included superfluous extra zeros, but these zeros were not significant and so were not penalised.

(b) There were more errors in this part, possibly because some candidates misread the question as 'nearest tenth' given the decimal form of the number given. Common incorrect answers seen were 13 205.2 or 13 200. Standard form answers tended to be less successful here than the previous part. Some did not have the correct standard form equivalent, due to their leading number being greater than 10. Standard form answers with superfluous extra zeros were rarely seen. There were relatively few miscopies evident, but some candidates did miscopy their own writing onto the answer line.

Question 2

(a) The majority of candidates scored full marks on this part. However, some only gained the method mark for not fully simplifying their answer, for example, leaving it as $\frac{18}{4}$. Very few candidates were unable to make a correct first method step.

(b) Most candidates also scored full marks on this part with a few gaining just the method mark for showing the steps of their working clearly, but then making an error in the final processing stage.

Question 3

The majority of candidates demonstrated a good understanding of how to use a calculator and arrived at the correct answer to a suitable degree of accuracy. However, the most common error seen was giving the answer to 1 or 2 significant figures without first showing the full calculator display value. A few candidates made other mistakes, such as omitting a zero or the negative sign, for example, writing 0.0255 or – 0.255 instead of – 0.0255.

Question 4

Almost all candidates answered this question correctly with few real difficulties seen. A variety of methods and approaches were used with many clearly just using their calculator and reaching 0.25. However, despite having access to a calculator, there were still a significant number of candidates that used common denominators (usually 12) leading to $\frac{3}{12}$ or $\frac{1}{4}$.

Question 5

Another well-answered straightforward question with most responses gaining the mark. Some incorrect answers of 66.14 were seen where the quantities had been divided instead of being multiplied. A few candidates rounded their answer prematurely without showing a more accurate value first, which cost them the mark.

Question 6

(a) This was another straightforward part with most finding the correct value. The decimal answer of 58.5 was the most common seen with $\frac{117}{2}$ occasionally appearing as a final answer.

(b) Many candidates were able to do this rearrangement successfully, giving their answer in one of the acceptable simplified forms. Those who did not score full marks often gained the method mark for a correct first step. Some divided by $\frac{1}{2}h$ as their correct first step but then were unable to simplify an expression such as $\frac{A}{\frac{1}{2}h}$. Those who expanded the brackets first seemed more likely to give a final answer in an unsimplified form. The most elegant approach usually saw both sides initially multiplied by 2 to clear the denominator.

Question 7

The majority of candidates calculated the required dimension correctly. Most identified that the volume of the cuboid subtracting the volume of the cylinder was equal to 976 and set up the correct equation. Those that did not, tended to either use the radius of the cylinder as 5 cm leading to the special case answer of 11.1 cm or the volume of the cuboid as $22 \times 2x$ instead of $22 \times x^2$.

However, despite stating the correct equation, a common error was to find the volume of the cylinder correctly but then subtract it from 976 in the next step. In many cases, candidates went on to divide their answer by 22 and found the square root correctly. Answers were nearly always rounded to 8 cm.

Question 8

(a) The vast majority gave the correct answer of 720 for this part. Occasionally a candidate multiplied the numbers together rather than dividing them.

(b) Many candidates found one of the acceptable forms of the required answer here. A few misinterpreted 'ahead of the local time' and subtracted 8 hours rather than adding. Most did the question in two stages and showed the stages fairly clearly; some used the 12-hour format for the answer but then omitted the pm. Despite a risky strategy, some successfully changed the times to hours in decimals to arrive at the correct answer. A mark was given on many scripts for showing 41 15, 09 15 or 04 45 in their working.

Question 9

(a) The majority of candidates drew the image in the correct position on the grid. In some cases, candidates translated triangle *A* using an incorrect vector that had one correct component and scored a method mark. Almost all candidates produced a triangle that was congruent to triangle *A*.

(b) This question was well answered by the majority of candidates. Nearly all correctly identified the transformation as a reflection, and most were able to state the correct equation of the line of reflection. A few made errors in writing the equation of the line, with the most common incorrect response of $y = -2$ seen. A small number of candidates incorrectly described the transformation using more than a single step or giving more than one transformation.

(c) The majority of candidates found the required image, although a few used the correct angle and direction but rotated about an incorrect centre earning a method mark. Despite this, almost all candidates drew a triangle that was congruent to triangle *A*.

Question 10

(a) This part was answered very well with the vast majority of candidates finding the correct answer of 57. Those candidates that were not successful tended to attempt to find the mean by adding the values and dividing by 10 with input errors leading to incorrect answers.

(b)(i) This was generally well answered with most candidates demonstrating proficient use of the graphic display calculator to find the line of regression. A number of candidates tried to find an equation for the line of best fit. A mark was often awarded for candidates that did not give their answer to 3 significant figures; this was predominantly the 0.548 rounded to 0.55, it was rare to see 26.6 rounded to 27. There were a few candidates that attempted to calculate the regression line by hand by choosing 2 pairs of values to find the gradient and then substitute in to find *c*.

(ii) Candidates answered this very well; correctly substituting into their equation from the previous part. Occasionally some candidates substituted the 46 for *y* instead and solved to find *x* but this was not common.

(c) Candidates found this part much more difficult and many were unsuccessful. It was very common for candidates to work with all 10 students rather than just with those who scored more than 35 (7 students); this led to candidates calculating $\frac{4}{10}\times\frac{3}{9}$ instead of $\frac{4}{7}\times\frac{3}{6}$. Occasionally, candidates spoiled their method by multiplying $\frac{2}{7}$ by 2 and only scored a method mark as a result.

Question 11

(a) (i) Most candidates gave a good sketch of the curve worthy of full marks. Out of those that did not, almost all candidates earned a mark for each branch correctly shaped, with the most common error being excessive gaps or overlapping between the branches and the asymptotes. Those that drew in the asymptotes generally avoided that mistake; only a few showed excessive feathering.

(ii) Most candidates gave the correct equations as $x = -0.5$ and $y = 2$ but a minority lost the marks for not forming equations and giving –0.5 and 2 as their final answers. Candidates were more successful in identifying the vertical asymptote but then made the mistake of putting $4x - 3 = 0$ to try to find the other, often giving $x = \frac{3}{4}$ as their answer.

(iii) Many candidates gave the correct coordinates as (0, – 3) and (0.75, 0). The most common mistake seen was incorrect signs.

(b) This part was the most discriminating question on the paper. Of the large majority that found the correct values of –1.85 and 1.35 very few candidates were able to complete the inequalities entirely successfully. Several gave $x > 1.35$ but far fewer were able to give the complete solution $-1.85 < x < -0.5$ giving only $-1.85 < x$. A less common error seen was to use the values as $-1.85 < x < 1.35$ or $-1.85 < x > 1.35$.

It was extremely rare to see the line $y = 2 - x$ on the sketch, though this would have been beneficial in selecting the correct inequalities. Those that did not find the correct values of –1.85 and 1.35, were occasionally able to rearrange the inequality into the correct $2x^2 + x - 5$ form to gain the special case mark.

Question 12

(a) This was a discriminating question involving two reverse percentage steps. Many candidates reduced the given value by 10% and then by 6%, multiplying by 0.9 and then 0.94 instead of dividing by 1.10 and then by 1.06. Some of the weaker candidates added the two percentages and treated the question as an increase of 16%.

(b) This part was answered more successfully than the previous one. Candidates appear to be well prepared for this type of problem and the most common and effective method seen was the use of logarithms. A few graphical methods were seen as well as using trials; time-consuming working using an increase of 6% each time until $400 000 was reached. Quite a few candidates lost a mark by giving the number of years instead of reaching the actual year of 2036. A small number of candidates overlooked the exponential aspect of this question.

Question 13

Many candidates demonstrated good use of their graphic display calculators and showed a sketch of a straight line and an exponential curve intersecting in the second quadrant. However, many others missed the instruction ‘graphical method’ and only scored the independent mark for the correct value, although often the negative sign was omitted. Some sketches did not clearly show an exponential curve so only gained B1, more accurate answers than the required 2 decimal place accuracy was allowed here.

Question 14

(a) This was a discriminating part with many candidates getting confused between direct and inverse relationships; several others squared instead of square rooting (x – 1) resulting in incorrect equations being formed. Those that did set up a correct equation usually managed to solve for 'k' correctly as 2 and give the correct final expression.

(b) Very few candidates managed to achieve full marks here as they often did not give their final answer in the required form, gaining 3 marks for $\frac{20}{(x-1)}$ or $5\left(\frac{2}{\sqrt{(x-1)}}\right)^2$. Many set up the initial equation and substituted correctly, finding 'k' as 5 but then did not use their answer from the previous part to find the new relationship, so often did not score here.

Question 15

(a) In this part, most candidates set up a correct expression for the given area of triangle *ABC*. However, many only scored the method mark as they did not sufficiently show how the given result was obtained using complete division at all stages. Candidates are reminded that in a 'show that' type question, all stages of working are required to be shown, and any gaps in working or missing steps, even if they are deemed trivial, may result in marks being withheld.

(b) The cosine rule was routinely applied correctly with minimal errors. Some candidates included 'sin 30' in their solution, even after the correct formula had been quoted. Other errors included evaluating the correct expression incorrectly and/or rounding prematurely. Some candidates seem uncomfortable with typing in the correct expression into their calculators in one go, instead preferring to approximate and evaluate in stages. This inevitably led to more errors than if the candidate had made use of the previous answer function (Ans) on their calculator.

(c) This part was less successfully answered than the previous parts. There were several different approaches seen, each with potential for errors. The most common approach was to apply the sine rule, but weaker candidates had the pairings of sides and angles mixed up. It was rare to see methods involving expressions for the area used.

Using rounded values and performing the calculation in stages, for example approximating their expression for sin*A* as 0.8 or 0.82 instead of using the exact value 0.821917… or using an incorrect value for *AC* inevitably led to rounding errors. Some candidates appeared to misunderstand the term 'obtuse angle' and attempted to find a reflex angle instead, by subtracting a correctly obtained acute angle from 360 degrees. Attempts at using the cosine rule yielded more errors, with inconsistencies between sides and angles and/or an incomplete method shown. Some did resort to finding angle *ACB* first and then subtracting this and 30 degrees from 180 degrees to find the required angle. Two method marks were awarded on many responses here.

The advantage of using the cosine rule here was that the calculated quotient was negative, leading to the correct obtuse angle immediately, without having to subtract from 180 degrees.

(d) This question proved to be very challenging for most, with many incorrect attempts seen. The most common incorrect approach was to square the ratio of the areas to obtain the length scale factor instead of square rooting, or to multiply 24 by the reciprocal of the correct ratio. Given that *XYZ* was a smaller triangle, candidates are reminded to check their answer against what they are expecting to find, so the length of *YZ* should be less than the equivalent length (24 cm) in triangle *ABC*. This should provide a guide as to whether division or multiplication is required to find the correct length of *YZ*.

Question 16

(a) The more able candidates produced solutions initially using Pythagoras' theorem, placing brackets round the $x\sqrt{3}$ in showing $\left(AE^2 =\right)\left(x\sqrt{3}\right)^2 + x^2$ and then proceeding to $3x^2 + x^2$ before gaining the accuracy mark for 'showing' the square root of $4x^2$. It was key to label the diagram and draw the diagonals as a guide to getting started. Very few started their solution using trigonometry as a valid first step.

Candidates who struggled with this part often made assumptions about the size of the angles and the symmetry of the diagram; a common example was that triangle *ABE* was equilateral without evidence, so *AE* = *BE* = 2*x*. It was essential to recognise that a 'show that' question, needs all the stages of working to be evident.

(b) Candidates were more successful in this part with many getting to the correct final answer; several gave an allowed decimal answer for full marks. Most candidates who gained independent marks did so by stating which lengths they were calculating; others wrote the lengths of *CD* and *DE* on the diagram, vital when awarding B marks. Many struggled to apply correct trigonometry to triangle *CDE* to calculate the missing lengths.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/43
Calculator (Extended)

Key messages

Full syllabus coverage is necessary as candidates must answer all questions. This includes all core topics as well as the extended topics. 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.

General comments

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. Candidates are strongly advised not to round off during their working but to work at a minimum of 4 significant figures. Most candidates followed the rubric instructions carefully but there continues to be a number of candidates, of all abilities, losing unnecessary 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.

The graphic display calculator is an important aid and candidates are expected to be fully experienced in the appropriate use of such a useful device. It is anticipated that the calculator has been used as a teaching and learning aid throughout the course. In the syllabus, 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 some complicated algebra and candidates need to be aware of such opportunities.

Comments on specific questions

Question 1

Only a minority of candidates were able to gain both marks in this question. Nearly half of the candidates were awarded one mark, usually for knowing the rotational order of symmetry of a rhombus. A common error was to state that a parallelogram has 2 lines of symmetry.

Question 2

This question was better answered with a majority converting the distance correctly. Common errors were to multiply by 100 or 1000.

Question 3

This question was answered well by the majority of candidates. Those who did not earn full marks had often not given their answer to 4 significant figures as required by the question. Candidates should ensure that, when requested to give their answer to a specific degree of accuracy, they comply with the instruction as it will always be awarded a mark.

Question 4

This question was very well answered with the majority of candidates gaining both marks.

Question 5

Again, this question was answered very well with the vast majority of candidates gaining the mark.

Question 6

This question was found more challenging by some candidates. Often, those candidates who did not gain full marks were awarded a mark for knowing which trigonometrical ratio to use. Other candidates used Pythagoras' theorem to find the hypotenuse but were still unable to make any progress. A number of candidates did not realise that trigonometry was needed in this question.

Question 7

(a) The majority of candidates were able to identify the correlation as positive. Some candidates used words such as direct.

(b) (i) This question was poorly answered. Only a minority of candidates were awarded both marks. Many candidates lost marks because they did not give the values in their equation to 3 significant figures.

(ii) Candidates who had given a line of regression to an incorrect degree of accuracy were still able to gain the mark for this question if they substituted correctly.

Question 8

(a) There were good sketches from many candidates.

However it would appear to be the case still, that some candidates do not have access to a graphic display calculator. There were many cases seen where candidates had calculated and plotted points. Although these were often sufficiently accurate to be awarded the marks for a sketch, they were not able to be used to answer **parts (b)**, **(d)** and **(e)**.

(b) Those candidates who had not used a graphic display calculator were unable to answer this part accurately enough to earn the mark.

(c) The common error in this part was to give the equation $y = 0$.

(d) Candidates who had access to a graphic display calculator were usually able to find the coordinates of the local maximum point. Again, those without such a calculator could not access this question.

(e) Many candidates did not attempt this part. Of those who did, only a minority were able to give the correct range. A common error was to give the incorrect inequality sign. This proved to be a very challenging and discriminating question.

Question 9

The majority of candidates earned both marks. Of those who did not, there were many examples of an incorrect formula used. The volume of a sphere is given in the formulas page of the question paper and candidates should be reminded to use these formula.

Question 10

This question was answer quite well with many candidates gaining full marks. Many candidates were able to gain a mark for identifying some correct midpoints, but were then unable to get the correct mean speed. Only a small number of candidates appeared to use the graphic display calculator even though there were only 2 marks for this question.

Question 11

This question was found challenging by many candidates. Only a minority of candidates were able to successfully arrive at the correct answer. A common error was to rewrite the vector as $\begin{pmatrix} -5 \\ 4 \end{pmatrix}$. A number of candidates omitted the question. Many candidates did not recognise the modulus notation.

Question 12

In this question also, only a minority of candidates gained full marks. The most common error made by candidates was to assume that the proportion symbol could be replaced by an equals sign. A few candidates treated it as an inverse proportion question.

Question 13

This question was very well answered with the majority of candidates gaining all three marks. Many other candidates were awarded a mark for finding one of the volumes. A common error was to find the volume of the sphere but forget to halve this value.

Question 14

(a) It had been expected that candidates would find this part easy, but this did not prove to be the case. The common error, made by a large number of candidates, was to write an equation such as $420 = x \times a$ or $x = \dfrac{420}{a}$.

(b) **(i)** Candidates also found this part difficult. Some misread the question and assumed that the 13 pieces of fruit were all oranges. Others started to solve the equation using the quadratic formula. Very few candidates were able to make much progress with the question.

(ii) Few candidates were able to factorise the quadratic expression. Some made an attempt at factorisation and some attempted to use the quadratic formula.

(iii) There were very few correct answers to this part. Having been unable to factorise the quadratic expression, candidates were unable to get a solution. A large number of candidates omitted this part.

Question 15

This question was answered well by many candidates. Many candidates who were not awarded full marks gained a mark for finding the third angle in the triangle. Many candidates realised that they needed to use the sine rule but did not find the third angle and so could make no progress.

Question 16

(a) Only a minority of candidates could successfully describe the shaded region.

(b) This part was much better answered with the majority of candidates shading the correct region.

Question 17

(a) This was answered correctly by a large majority of candidates. Some candidates were unable to correctly calculate $-(2 \times -2)$.

(b) Again, the majority of candidates were awarded both marks. Of those who did not get the correct answer, a common error was to assume that they were being asked to find f(6).

(c) This part was more challenging but a sizeable minority still gained full marks. Some candidates set up an initial expression but were then unable to simplify it. Others thought that $\mathrm{fg}(x)$ meant $\mathrm{f}(x) \times \mathrm{g}(x)$.

(d) Candidates found this part a challenge, but a sizeable minority were able to gain full marks. Some candidates thought that all they had to do was change the signs in the original function and a few thought that $g^{-1}(x)$ was the reciprocal of $g(x)$. Others started out correctly but made sign errors in their rearrangement.

Question 18

(a) Only a minority of candidates were able to gain marks on this question. The most common answer was 35%, from adding 20% and 15%.

(b) This part was better answered with about a third of the candidates gaining full marks. There were many candidates demonstrating a good knowledge of the use of logarithms to arrive at the correct value. A common error was to state that 5% of 20 000 was 1000 and the answer was 12 years since 20 000 – 8000 = 12 000. A small number of candidates used increasing exponentially instead of decreasing exponentially.

(c) This part was again more challenging for candidates and only a minority were able to make significant progress with this reverse percentage question. Some candidates were able to gain one mark for setting up an initial statement but were then unable to solve it correctly. Other candidates attempted to work out the value for each year, but inevitably made a mistake at some point.

Question 19

There were good answers seen from some candidates. The most common error was to find that the volume scale factor was 8 and just multiply the total surface area of the small solid by 8. Some candidates gained a mark for getting as far as $\sqrt[3]{\frac{416}{52}}$.

Question 20

There were many candidates who omitted this question completely. Only a few candidates were awarded full marks, although a number were able to gain two marks for the correct factorisation of the denominator or one mark for its partial factorisation. Some candidates attempted to simplify by canceling the *x*s in the numerator and denominator.

Question 21

This was a challenging and discriminating final question and only the best were able to gain full marks. A number of candidates gained marks for finding the gradient of *AB*, the gradient of the perpendicular line or the coordinates of the midpoint. A number of candidates did not attempt this question.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/51
Investigation (Core)

Key messages

To do well on this paper, candidates needed to be able to use algebra to write expressions, to multiply terms including 2-term factor brackets and to solve equations of the form $an^2 = k$, preferably by drawing the graph on their calculator. It was also helpful if candidates understood and could work with squares and square roots. Candidates need to understand that every step of working must be shown to gain communication marks.

General comments

Candidates were successful with the mechanics of this task and completed the numeracy aspects well, understanding the processes involved. The algebraic parts they found more difficult, and they were often not very thorough in their communication. When writing algebraic expressions candidates should know the difference between, for example, $a + 11$ and $11a$. They should also be able to find the nth term using common differences or known sequences like square numbers. They should be able to multiply out factor brackets correctly such as $a(a + 33)$ and $(a + 11)(a + 22)$, and to collect like terms in this and other situations. They also need to be able to use their graphic display calculator to solve equations, not by using 'equation solver' but by constructing a table of values or drawing a graph.

Comments on specific questions

Question 1

(a) (i) Candidates showed that they had read and understood the explanation of this investigation by correctly completing the inside and outside pair numbers.

(ii) There was a total of 25 values to be completed correctly in this table. Any errors made were usually due to mistakes in calculations or slips in working, which sometimes were seen to be corrected. Candidates should be encouraged to check their arithmetic, even when using a calculator, by using a different method if possible, such as working backwards.

(b) (i) Candidates answered this well, showing both the calculations and the answers. Very few wrote the subtraction the wrong way round.

(ii) Most candidates were awarded the first of the communication marks for this question for showing their multiplication sums, and their answers were usually correct.

(c) (i) It would be useful if candidates were aware that the numbering of the questions relates topics and sequences of events together or separates them completely. This part, by labelling it **(c)**, linked it to the previous parts of **Question 1** which meant the gaps in the statement should be completed by words/numbers that were used in the earlier parts of the question. The first space could not, therefore, be completed by even, odd, prime or integer and the product difference was 2. In this instance although 2 is an even integer, the words even or integer were not precise enough.

(ii) Candidates found this question much more challenging, with very few using the requested algebraic route – 'Show algebraically'. Usually candidates made up a sequence by choosing a value for a and substituting it into the four algebraic terms. They then showed numerically that the product difference was 2. To 'show algebraically', candidates needed to find the products of the inside and outside pairs using the algebraic expressions and then subtract the products, the correct way round, to give an answer of 2. Of those candidates who tried this route, many were unable to multiply the two inside terms correctly, with some also forgetting that $-a(a + 3)$ equals $-a^2 - 3a$ not $-a^2 + 3a$.

Question 2

(a) (i) Although there were fewer cells to complete than the table in **Question 1(a)**, this table required more thought, and different calculations were required to complete the missing values. Candidates found the last sequence the most difficult. Some managed to find a way to find the inside pair – this was often done by counting a list from 88 to 100. To gain the communication mark it was only necessary to show one calculation, which could have been as simple as 8 + 2 = 10 for the second row.

(ii) Many candidates found the correct four terms for the sequence and one communication mark was also awarded quite often for writing down 75 × 80 = 6000. Sketches and $\sqrt{6000}$ were hardly ever seen. Candidates who were using trials to find the inside pair, usually wrote down the correct answer of 75 × 80 and did not think to write down other trials that they did on their calculator. They should be encouraged to show all working/trials as this is part of communicating.

(b) (i) This was quite well answered with many candidates working out a pattern either in the sequence of the product differences or between the increase, n, and the product difference. This time the communication mark was awarded quite often, usually for differences of 6, 10, 14 etc. seen in the table.

(ii) What should have been a standard question on finding the nth term caused quite a challenge for many candidates who rarely saw the link to square numbers. Common differences of 4 were more often noticed and gained a communication mark. It would be useful to look at both these methods that can be used to find the nth term of quadratic sequences.

(c) (i) There was follow through from **part (b)(ii)** for those candidates who had not managed to find the correct expression. The key was to substitute the value of 11 for n and the majority who did have the correct expression were successful and scored the communication mark. Some candidates went back to first principles and although they did not get the communication mark for doing this, some of them did find the correct answer.

(ii) This was a straightforward question that was well answered by most candidates.

(iii) Moving into algebra again caused problems for some candidates. A substantial number wrote the terms as $11a$, $22a$ and $33a$, confusing adding 11 to multiplying by 11. This is another case when more work on writing expressions would have been valuable.

(iv) Much work is needed on multiplying algebraic terms. Some of those who had the incorrect terms as mentioned in **part (iii)** multiplied, for example, a by $33a$ to get $34a$. Others, with the correct terms, were unable to correctly multiply $a(a + 33)$ getting an answer of $a + 33a$. Multiplying out the two brackets for the inside pair caused problems for many candidates. A wide variety of answers were seen.

This question asked the candidates to ‘show algebraically’, like **Question 1(c)(ii)**. Very many candidates decided to show this numerically instead. Candidates should know what the terminology of a question tells them to do and, very importantly, that one numerical case that works is not proof that the result works for all cases.

Question 3

This question again caused quite a challenge. Some candidates used their calculators to do trial and improvement, rarely writing down their trials. Sketches were not seen but trials often found the solution of 17 for n. Others were able to solve the equation $2n^2 = 578$, although many of these used trials rather than the square root to get the answer. Again, it would be very useful for candidates to understand and be able to use the square root, as well as not only how to draw graphs on their calculator but that this will give them solutions very quickly and a labelled sketch is all that is necessary for communication. The communication mark was not often awarded.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/52
Investigation (Core)

Key messages

To do well on this paper, candidates needed to communicate by showing working for all questions. They also needed to understand squares and square roots and how to find them. Up to 3 marks were lost on the last question because candidates did not use their calculator to draw a graph to solve an equation.

General comments

The main element that should be focused on from the key messages is that of using the graphing mode on the calculator to solve equations and not 'Equation Solver'. Although the algebra to solve the equation on this paper was within the scope of Core candidates, the work would have been much easier and the result would have been reached much more quickly if the equation had been drawn on the calculator.

Comments on specific questions

Question 1

(a) Most candidates understood the explanation about the Core and Shell of sequences and were able to complete these answers correctly.

(b) Similarly, candidates found that calculating the value of the Core was straightforward.

(c) The correct value of the Shell for this part was also found by most candidates. There were marks for correctly calculating the answers to **1(b)** and **1(c)** based on incorrect answers to **part (a)**, but it was rarely necessary to award these.

Question 2

(a) Candidates were able to apply the same rules to find *C* and *S* for this exponential sequence. Quite a few candidates lost the communication mark by only giving answers and not showing working.

(b) (i) A large majority of candidates were able to work out the next two terms in the next exponential sequence.

(ii) The calculation of this *C* and this *S* followed successfully. As in **Question 1** these answers could have been awarded follow through marks if a candidate had calculated the 4th and 5th terms of the sequence incorrectly. This very rarely happened. The communication mark was not always earned.

(c) Most candidates had the same answers in **part (a)** and **part (b)(ii)** and were able to explain this in words.

(d) (i) Candidates who had the knowledge that am can be written as am^1 had no difficulty in correctly completing the two missing answers. Others found the correct terms by using the pattern and the given 4th term.

(ii) Candidates found using algebra more demanding than the numerical questions and did not always use the powers correctly. It would be useful to work on using brackets to square terms, such as

$\left(am^2\right)^2$, and how to multiply terms together correctly, e.g. $a \times am^4$. Many candidates said $\left(am^2\right)^2 = am^4$ or $a \times a \times m = am$.

(e) Many candidates found this quite difficult, especially those who had not managed to complete **part (d)(ii)** successfully. Some of those who had correctly found the middle term to be am^2 still found it difficult to use this to calculate the value of *m*. Others needed to know that having reached $m^2 = 361$ they then had to take the square root to find *m*. There was often only one or zero marks awarded for communication.

Question 3

(a) (i) The values of *C* and *S* for terms 2, 3 and 4 were calculated successfully.

(ii) The values of *C* and *S* for terms 4, 5 and 6 were also found correctly by many candidates.

(iii) There appeared to be some confusion for some candidates as to which terms were the 6th, 7th and 8th. Some counted the 6th term in this question as 13, despite having been told in **part (a)(ii)** that the 6th term was 8. They were awarded a mark for 21 if seen but their answers for *C* and *S* were based on 13, 21 and 34 instead of 8, 13 and 21.

(b) This connection was not seen by many candidates. Some, as in **Question 2(e)**, used trials to try to find the answer rather than taking the square root. The communication mark was not awarded very often, indicating that many candidates did not realise they needed to find the square root.

Question 4

(a) The missing sequence numbers were straightforward to find. This meant very few errors were made in completing the Common Difference column. Candidates were told that $F = C - S$ to enable them to complete the *F* column. This column had the most errors. The communication mark was rarely awarded in this question. Candidates should think about the amount of space provided, usually below a table or at the side, as well as the number of marks allocated to the question. Only 3 rows or 7 cells needed to be completed here which should suggest to candidates that out of the 5 marks there was probably at least 1 communication mark.

(b) The question asked for a formula for *F* so the answer needed to start with *F* =. Candidates should know the difference between a formula and an expression to achieve full marks for questions like these.

(c) This was a straightforward substitution, but some candidates had difficulty with this question. Some had not realised the connection between *F* and *d* and others, who knew about squares, did not know how to reverse the situation and find the square root. A common difference of 7 was seen although sometimes not used correctly.

Question 5

(a) Communication is more than jotting some numbers down. The communication mark was frequently not awarded because the working showed numbers, often relevant, but not the process. For example, 22^2 and 20×24 might have been seen but without the minus sign between them.

(b) Any substitution of *F* with *n* from the table was sufficient to find the value for *k*. Some candidates did not see the connection as given in the headings of the table. Those who did were able to find the answer very quickly. It should be noted that more than a few went from $1 = 4k$ to $k = 4$. Again, a lack of working shown meant the communication mark was not awarded.

(c) When this question was well answered the candidates used the formula for *F* given in **part (b)** and the value for *k* found in **part (c)** correctly.

(d) This final question could have been quickly answered by sketching on the calculator and transferring these sketches to the page for communication. Those candidates who attempted this question tried various routes to obtain a solution but not by sketching. Too often their algebraic skills let them down. Candidates are expected to be able to solve equations like these with or without a sketch. Again, it would be good to have practice on using the calculator to draw graphs and on finding square roots, especially for solving these quadratics.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/53
Investigation (Core)

Key messages

This paper awards marks specifically for clear and precise communication of mathematics. Therefore, it is essential to provide full reasons and steps in working to achieve full marks.

General comments

Candidates need to be made aware that the investigation builds and therefore they need to remember and often use what they have discovered earlier on in the investigation in latter parts. Candidates need to be prepared for any topic from the syllabus to come up and draw on their knowledge.

Comments on specific questions

Question 1

This question was completed very well by almost all candidates showing an understanding of the basics of the investigation ahead.

(a) The question required candidates to fill in the bottom row of the pyramid. Nearly all candidates could do this correctly.

(b) (i) Almost all candidates could complete the statement by following the given examples.

(ii) Almost all candidates could fill in the missing values by following the examples above.

(c) This question required candidates to realise that there were the same number of numbers in a row as the number of the row itself. Nearly all candidates could realise this.

Question 2

This question required candidates to link numerical responses with algebraic methods which many found difficult.

(a) Only a few candidates recognised that this was the sequence of triangle numbers. Candidates need to be able to recognise sequences such as squares, cubes and triangle numbers as these are often found in investigations.

(b) (i) Most candidates were able to follow the patterns and complete the table correctly.

(ii) This question required the candidates to recognise how the last column of the table had been calculated and repeat the stages of the calculation using the number 50. Some could do this correctly. No credit was given to those candidates who had looked ahead and used the formula given in **Question 3(b)**.

(iii) This question required the candidates to generalise the pattern they had noticed in the table and combine the stages into one expression using *R*. The best answers used algebraic notation for the numerator with brackets only i.e., $R\,(R + 1)$ not $R \times (R + 1)$ and it should be noted that $R \times R + 1$ does not give the same value and is therefore incorrect.

Question 3

This question was about finding a number in the pyramid using its position in the row and the last number of the row before.

(a) (i) Almost all candidates could complete this statement.

(ii) Many candidates put N (9, 9) = 45 + 5 = 50 but N (9, 9) only finds the 45 which is the end of the 9th row. N (10, 5) is five positions along the row below which is the 10th row.

(b) (i) To obtain the mark, candidates had to replace 6 and 4 in the given formula and evaluate it to 19 which was the given value at the top of the page. Most could do this correctly.

(ii) Most candidates showed they could use the formula correctly to obtain 1495. Just giving the answer meant only 1 mark. Candidates needed to show their substitution into the formula in order to gain the communication mark.

(c) (i) Most candidates showed they could use the formula correctly to obtain 351. Just providing the answer meant only 1 mark. Again, substitution into the formula was required for the communication mark.

(ii) Successful candidates used their answer of 351 for the last number in row 26 to realise that 362 must be on row 27. A simple subtraction then told them that it would be in position 11. Some were able to do this.

Question 4

This question was about making diamonds from the numbers in the pyramid and recording the vertices and the width of the diamond.

(a) (i) Most candidates could recognise where the righthand vertex should go on the smallest diamond. Many could work out the top and bottom vertices of the middle-sized diamond. Some could work out the left and righthand vertices of the large diamond, but not the bottom vertex, which required working out what the number on the row below would be to make a similar diamond. For the full 6 marks, candidates were required to draw clearly one of the diamonds on the pyramid.

(ii) Most candidates were able to identify Violetta's diamond. For full marks, it had to be drawn clearly on the pyramid.

(iii) The majority of candidates could write an expression showing that the width of the pyramid is $c - b$

(b) (i) Nearly all candidates could fill in the table correctly following the patterns.

(ii) Some candidates were able to realise that the middle column in the table was the square of the final column, hence w^2.

(c) Most candidates were able to use the fact that $w = c - b$ to find that $b = 145$, or to substitute the values given into the equation $(a + d) - (b + c) = w^2$. If they could do both and solve their equations then they could earn full marks, which some candidates did.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/61
Investigation & Modelling (Extended)

Key messages

In order to succeed in this examination, candidates need to give clear and logical answers to questions. Candidates must show all necessary working clearly, including sketches, to gain full marks for correct methods and communication. They are expected to use a graphic display calculator to help them draw and interpret graphs. They should know how to choose the correct scale on each axis so that the overall shape of a graph over the given domain is clear and their calculator shows the most important features, e.g. x-intercepts and y-intercepts with coordinates or values marked on the axes, where appropriate. Graphs should be drawn with a pencil to allow corrections to the shape to be made if needed. Candidates should be aware of the functions that they are permitted to use on their calculator, and they should know that use of other in-built applications will not be credited. Statements such as ‘Solved using GDC’ are not acceptable for communication marks. Explanations need to be clear, contain no contradiction and interpret the mathematics under consideration. Candidates should know that, in the modelling task, overly accurate values can result in an incorrect impression of precision. In the modelling task, therefore, answers should be given to an appropriate degree of accuracy and units, where appropriate, should be stated.

General comments

Candidates generally found the initial stages of both the investigation and the modelling task to be reasonably accessible. **Question 2(b)** in the investigation and **Question 5** in the modelling task were more challenging for many candidates.

The methods candidates used to solve each problem needed to be sufficiently detailed to communicate understanding to earn full credit. Candidates should be aware that any work they delete cannot be credited for communication. Communication could be achieved in a variety of ways. In the investigation: stating calculations, first and second differences in sequences, showing substitution of values into formulae and expressions, showing use of all the steps in a process and drawing sketch-graphs, for example. In the modelling task: stating calculations, such as Pythagoras’ theorem, labelling intercepts or indicating a scale for a sketch-graph, justifying values used in calculations, stating expressions and calculations, for example. Candidates needed to write down any simple process that formed part of their solution. The level of communication was fairly good in the investigation task. Communication in the modelling task was not as good, particularly in **Question 4(b)** where many did not fully communicate their method.

When candidates are asked to ‘show that’ a result is valid, they should produce a clear, accurate and complete mathematical justification leading to the given answer. All method steps should be shown. Candidates should know that selecting parts of the given expression, or formula, and trying to describe their origin is not a valid method. This was required in **Question 3(c)(i)** and **Question 5** in this examination.

Many candidates presented their work in a neat, logical and orderly way, with correct mathematical form. These candidates used brackets and square roots correctly to indicate a correct order of operations. Other candidates may have improved if they had taken a little more care with these. Sometimes brackets were omitted. A square root was only acceptable if it covered enough of an expression to suggest that the intention was to group the whole expression. Sometimes these were far too short.

Comments on specific questions

Investigation: Regular polygons

Question 1

This question involved the calculation of product differences for sequences of 4 terms.

(a) In this part, candidates applied the method they were given, with structure to support their solutions. Most candidates found it to be an accessible start to the paper. Some candidates earned full credit. Other candidates offered four correct rows but omitted to communicate any method which generated a value they had stated. Stating a calculation which generated a value for the second, third or fourth rows was simpler, as the work was numerical. Many candidates only attempted to communicate method for the final row and generally attempted to offer something algebraic. In weaker responses, a common error was to write the product of the inside pair as 98.64 instead of 134.64.

(b) This part of the question involved finding and checking an expression for the product difference in terms of the increase.

(i) Candidates needed to complete the table of product differences by extending the sequence. This was usually correctly done. A communication mark was available for indicating at least three common first differences or writing down a 4-term sequence with increase 6 and applying the method to it. A good number of candidates earned this mark, usually for the differences. Some candidates made no attempt to communicate their method.

(ii) Candidates now needed to generalise the pattern and write it algebraically. A good number of candidates were able to do this successfully. In weaker responses, candidates sometimes offered quadratic algebraic expressions with more than one term or an incorrect multiple of n^2, or offered a linear expression in *n*. Others made no attempt to answer. Again, a communication mark was available. In this part it was for indicating at least three common second differences or writing down a list of square numbers. Not as many candidates earned this mark. Those that did, usually stated the second differences. Candidates who chose to form and solve equations such as $an^2 + bn + c = 0$ and $2a = 4$, $3a + b = 6$, $a + b + c = 2$ often made the assumption that the expression was quadratic without any justification. These equations alone were not accepted for communication. Some candidates made no attempt to communicate their method.

(iii) In this part, candidates needed to use the expression they had generated in the previous parts of the question to find a particular product difference. Many candidates did this successfully. A communication mark was available for showing the substitution of 11 into their expression in *n* from the previous part of the question. Many candidates also earned this mark.

(iv) Finally, candidates were expected to generate a 4-term sequence with increase 11 and apply the given method as a check that their expression returned the same result. Many candidates did this successfully. Some candidates did not use an increase of 11 but, instead, chose a different increase and tested their expression and used the given method for their stated increase. This was not accepted as it did not answer the question. A few candidates chose a first term of 0. This was not accepted as this task related to an increasing linear sequence of positive numbers. The use of 0 eased the solution.

Question 2

(a) This part of the question involved the calculation of product differences for sequences of 3 terms.

(i) In this part, candidates applied the method they were given, without structure to support their solutions. Many candidates earned all the marks available. A communication mark was available for clear evidence of how at least one of the product differences in the table had been generated using the method given in the example with a suitable, stated sequence. It was important that candidates indicated to which product difference in the table their method related. The simplest way to do this was to state it with the calculation or values. Some candidates omitted to make this link. As previously, a few candidates chose a first term of 0 when a sequence of positive numbers was expected. In weaker responses, candidates sometimes assumed common first differences and offered a linear sequence of values in the table.

(ii) Candidates now needed to generalise the pattern and write it algebraically. Candidates with the correct values in the table in the previous part of the question usually found this to be straightforward as the values were the list of square numbers.

(b) This part of the question involved the calculation of product differences for sequences of 5 terms.

(i) In this part, candidates again applied the method they were given, without structure to support their solutions. Many candidates earned full credit. Two communication marks were available. One communication mark was awarded for clear evidence of how at least one of the product differences in the table had been generated using the method given in the example with a suitable, stated sequence. Again, it was important that candidates indicated to which product difference in the table their method related. A second mark was available for the clear statement of at least one further sequence that could be used to generate one of the other product differences required. A few candidates stated and applied the method to one sequence only. A few other candidates made arithmetic slips in either the statement of their sequences or the evaluation of the products needed. Some candidates stated sequences but showed no use of the method. As previously, a few candidates chose a first term of 0 when a sequence of positive numbers was expected.

(ii) Given both the value of a product difference and the algebraic expression for this product difference, candidates needed to find the increase. This part was very well answered. Almost all candidates stated the correct answer, 12. In weaker responses, candidates used 432 as the value of n and offered an answer of 559 872. These candidates may have misinterpreted or misread the question. A few candidates applied an incorrect order of operations and square rooted before dividing by 3. Some candidates made no attempt to answer.

(c) In this part, candidates developed the relationship between the number of terms in the sequence and the product difference in terms of the increase, n.

(i) Most of the candidates who had correct expressions in the appropriate previous questions were able to continue the pattern and complete the table.

(ii) In this part, candidates needed to write the correct expression for the product difference using the number of terms and the increase. While candidates found this to be more challenging, a reasonable number of candidates offered the correct expression in a correct form. Some candidates omitted brackets that were necessary for a correct order of operations. Others used brackets inappropriately and stated, for example $x-2\left(n^2\right)$. This was not condoned. A few candidates struggled to write the pattern as an expression in more than one variable. Sometimes these candidates offered answers such as $x-2=n^2$, for example. Some candidates made no attempt to answer.

(d) Two communication marks were available in this part, but few candidates earned both of these marks. Many candidates found this part of the task to be somewhat challenging. A reasonable number of candidates earned the mark available for finding the number of terms and the increase to be 13. The first communication mark was given for showing how this value had been found. A few candidates earned the mark for drawing appropriate sketch-graphs. A few more candidates gained this communication mark for a table or list of at least 3 trials, including the trial for x or n = 13. While it was acceptable for this communication mark, very few candidates stated $\sqrt[3]{1859}$. Many candidates divided 1859 by 11 and then took the square root of 169, without justification of the use of these values. A few of these candidates confused themselves and used 11 as the number of terms and increase, rather than 13. The second communication mark was available for showing how the last term had been found, using their first term. This mark was available for use of a reasonable value of x or n. Many of the candidates who earned this mark did so by generating an appropriate sequence, as they had been encouraged to do previously. This was a good, simple strategy. In other successfully communicated methods, candidates offered a calculation for their last term using their value of x or n or, less commonly, found the expression for the nth term of their sequence. In order to earn the final mark, candidates needed to state an appropriate pair of values consistent with their number of terms and product difference. A good number were able to do this.

In weaker responses, the number of terms and/or first and last terms were not positive integers. Some candidates made no attempt to answer or made no real progress.

Modelling: Crossed poles

Question 3

(a) (i) This was almost universally correctly answered.

(ii) Candidates needed to demonstrate understanding of similar triangles by completing a statement. A good number of correct responses were seen. Some candidates did not use *a* and *h* which was not accepted. For example, some offered *ZY* and *ZQ* or $\frac{1}{2}a$ and *a*, while others offered numerical fractions such as $\frac{1}{2}$.

(b) (i) This part of the question was well-answered, with almost all candidates offering the correct value. A few candidates offered 2, misinterpreting the relationship. These candidates may have improved if they had written the value of *h* on the diagram, for example.

(ii) Many candidates gave the correct answer, 6. A communication mark was available in this part of the question and a good number of candidates also earned this mark. The communication mark was awarded to candidates who stated a correct calculation which could be used to find the value of *d*, using Pythagoras' theorem as required in the question. Candidates who used mismatched values from different triangles in a single calculation, or used 10 as a short side instead of the hypotenuse, in their use of Pythagoras' theorem may have improved if they had made a simple sketch. A few candidates communicated no method at all. Most candidates attempted to answer.

(c) (i) Candidates found this part of the question to be challenging and fewer correct responses were seen. As the model had been given in the question, it was essential for candidates to show enough detailed and correct method to demonstrate that they understood how to derive the relationship. A reasonable number of candidates were successful. These candidates started with a correct statement of Pythagoras' theorem in an unsimplified form, such as $(2h)^2 + d^2 = 10^2$ and then rearranged for *h* or solved a pair of correct simultaneous equations such as $a^2 + d^2 = 10^2$ and $h = \frac{1}{2}a$. All methods involved taking a square root at some point. All methods required correctly expressed statements with appropriate bracketing, if needed, and a square root of appropriate length to convincingly include the whole expression underneath it. Some candidates stated $2h^2 + d^2 = 10^2$, which was not accepted. These candidates often rearranged to $2h^2 = 100 - d^2$ and then took the square root before dividing by 2. Other candidates started by writing an expression such as $a = \sqrt{100 - d^2}$. This was not accepted without justification. In the weakest responses, candidates drew arrows to different parts of the model in the question and attempted to describe their origin.

(ii) Some excellent graphs were drawn. Some candidates drew very neat, smooth curves. Good use of the graphic display calculator was evident in these cases. A few candidates drew graphs of the correct shape but which were not sufficiently close to the *h*-axis or *d*-axis. Communication was awarded for having an *h*-intercept of 5 and a *d*-intercept of 10 or some other clear indication of scale for both axes. Some candidates stated one correct intercept and often omitted the other. Some candidates were clearly still working with *h* = 4 in this part. In weaker responses, candidates drew graphs that had a clear maximum point, or started from the origin, or had completely incorrect curvature, or were linear, or had ruled sections, for example. It may be the case that some of these candidates needed to adjust the view window on the calculator to be able to see the graph correctly. Other candidates were clearly tabulating values and plotting points. This is not expected when the instruction is 'Sketch'. The resulting graphs were often a poor shape and not smooth.

(d) (i) Candidates found this part of the question challenging to explain. It was necessary to interpret the position of the poles and it was not sufficient to say *h* = 0 only. A clear explanation that both poles were on the ground at this point was necessary. Some candidates did make comments that clearly indicated this. Some candidates offered comments suggesting the poles were 'touching' the ground. These were not acceptable without further comment as the poles were always touching the ground. Some candidates confused the explanation needed in the next part with this part, making comments which related to $d = 0$ rather than $h = 0$. In the weakest responses, candidates simply described the poles for other values of d and offered comments such as 'the poles are diagonal' for example, or they confused the posts and the poles. Some candidates made no attempt to answer.

(ii) Again, candidates found this part of the question quite challenging to explain. It was necessary to state a reason that suggested why the model was not valid using the context of the task. Some candidates were able to offer sensible reasons based on there being no space in between the posts for the poles to be placed or based upon the poles both being vertical and therefore not crossing. A few candidates seemed to have a reasonable understanding of what was happening but were unable to offer a complete reason. For example, some candidates suggested that the poles would no longer be leaning on the posts without interpreting what that meant. Some candidates confused the explanation needed in the previous part with this part, making comments which related to $h = 0$ rather than $d = 0$. In weaker responses, candidates confused the posts and the poles, or commented only that 'the triangle would not exist', or commented that d could not equal 0, without any interpretation of what that meant in the context of the task. Some candidates were clearly still working with $h = 4$ in this part. Some candidates made no attempt to answer.

Question 4

In this question both of the poles are 15 metres long.

(a) A reasonable number of candidates stated the correct model. Some candidates offered a correct expression without the subject h, which was not condoned. Some candidates did not extend the square root over enough of the expression to show that they intended the whole expression to be grouped. This was not accepted. A few candidates omitted the $\frac{1}{2}$. Some candidates did not use 15^2. In these cases, 7.5^2 was sometimes seen, as was the miscopy from the calculator of 255. A few candidates simply restated the previous model. Some candidates did not have a model for h in terms of d. In the weakest responses, candidates offered purely numerical answers. Some candidates made no attempt to answer.

(b) Given information about the height at which the poles cross, candidates needed to find the distance between the posts. A good number of candidates earned the mark for finding the distance to be 9 metres. There were two communication marks in this part of the question. There were two approaches that were equally successful. In the first approach, candidates used the model to either draw sketch-graphs, indicating the relevant point of intersection, or used algebraic substitution and rearrangement. A few candidates earned both the communication marks available using the model. A small number sketched identifiable graphs. Not all of these indicated the point of intersection. More candidates who used the model used the algebraic approach. Most of these substituted $h = 6$ first and showed that step. Many of these candidates, however, omitted to show the key difference step, $d^2 = 225 - 12^2$ or $\sqrt{225 - 12^2}$, and therefore only earned one of the two communication marks. In the second approach, candidates used the similarity of the triangles to scale the lengths they needed and offered a sufficiently detailed and accurate calculation using Pythagoras' theorem. A reasonable number of candidates who used the similar triangles earned both communication marks. More commonly, candidates earned one of the two marks only, often for a calculation justifying the use of 12 or 7.5 or a diagram showing the 6 together with 12 or 7.5. A few candidates omitted this justification and earned the mark for the key difference step, as already described, or for $\left(\frac{1}{2}d\right)^2 = 7.5^2 - 6^2$ or $\sqrt{7.5^2 - 6^2}$.

Question 5

In this question one of the poles is 20 metres long and the other is 15 metres long.

(a) In this part of the question, candidates needed to derive several given algebraic relationships using a previous result. Candidates who had a good understanding of the model usually made the expected connections between the relevant parts of the question. In weaker responses, candidates were unable to make the correct connections from one part to the next and were therefore unable to use them in an appropriate way.

(i) Like **Question 3(a)(ii)**, candidates needed to use similar triangles to complete two statements using *h*, *b* and *c*. A reasonable number of candidates did this successfully. Other candidates found this too challenging. A few candidates were able to enter *b* as the denominator in the first statement but were unable to complete the second successfully. Common unacceptable completions of the second statement included $\frac{b-c}{b}$, $\frac{c-h}{c}$ or $\frac{c-h}{b}$. Some candidates made no attempt to answer.

(ii) Candidates needed to use the previous part of the question to justify the given result. Those who had not stated the correct expressions in the previous part could not be credited here as they had no basis for their answer. Candidates needed to form the sum $\frac{x}{d}+\frac{d-x}{d}$, simplify it to at least $\frac{d}{d}$ or $\frac{x+d-x}{d}$, and state the answer 1, to be credited. A few candidates formed $\frac{x}{d}+\frac{d-x}{d}$ = 1 but either then offered no simplification step or multiplied both sides by *d*, ending with *d* = *d*. This was not condoned.

(iii) Candidates needed to use the previous part of the question to rewrite the result from that part in terms of *h* and *d*. It was, again, essential for candidates to show enough detailed and correct method to demonstrate that they understood how to derive the relationship. A small number of candidates were fully successful. These candidates started with correct statements of Pythagoras' theorem in an unsimplified form, such as $b^2+d^2=20^2$ and $c^2+d^2=15^2$ and rearranged each of these to correctly derive $b=\sqrt{400-d^2}$ and $c=\sqrt{225-d^2}$. These could then be substituted into the expression from the previous part. A small number of candidates did not conclude the solution correctly, either using a square root that was too short to be convincing or making a numerical slip such as writing 400^2 for 400 or 255 for 225. Some candidates were partially credited for stating $b^2+d^2=20^2$ or $c^2+d^2=15^2$. A few other candidates were partially credited for $b=\sqrt{20^2-d^2}$ and $c=\sqrt{15^2-d^2}$. Candidates who stated $b=\sqrt{400-d^2}$ and $c=\sqrt{225-d^2}$ only, without deriving them, or who drew arrows indicating that each denominator was *b* and *c*, without showing this, were not credited.

(iv) Candidates needed to take great care with brackets, square roots and numerical values in this part of the question to be credited. A reasonable number of candidates correctly wrote the model from the previous part with *h* as the subject. Candidates who knew the correct process, were sometimes penalised for incorrect mathematical form or for slips in copying values such as 225. A few candidates did not work with the complete model and offered disconnected and incomplete responses. Some candidates made no real attempt to answer. Presentation in this part of the question was often poor.

(v) Some excellent graphs were drawn once again. A few candidates drew graphs of the correct shape but which were not sufficiently close to the *h*-axis or the intercept at 15 on the *d*-axis. In weaker responses, once again candidates drew graphs that had a clear maximum point, or started from the origin, or had completely incorrect curvature, or were linear, or had ruled sections, for example. More candidates made no attempt to draw any kind of sketch.

(b) In this part of the question, candidates needed to use *d* = 8 in the model given in **part (a)**.

(i) Some candidates offered acceptable answers to this part. Candidates needed to state their answer to preferably 3, and certainly no more than 4, significant figures. Candidates who quoted answers to more than 4 figures were not awarded the mark. It was also necessary for candidates to state the units of their answer here in order to be credited. Many candidates offered an acceptable value but omitted the units. Some candidates offered an overly accurate value with units, others offered various incorrect values or made no attempt to answer.

(ii) A reasonable number of candidates were successful in this final part of the task. Candidates needed to use the model to find particular values of *b* and *c* using expressions from **part (a)**. Again, candidates needed to state their answer to preferably 3, and certainly no more than 4, significant figures. Candidates who quoted answers to more than 4 figures were not credited. In this part, the omission of units was condoned. Some candidates offered overly accurate values. Other candidates offered various incorrect values, some of which were negative, or made no attempt to answer.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/62
Investigation & Modelling (Extended)

Key messages

In this paper, candidates need to know how to solve equations using a graphic display calculator in a way that will gain communication marks, usually by showing the relevant intersection of graphs.

Organising work on the page needs some more attention and candidates should realise that such work is being considered for communication marks.

The models in this paper take the form of equations and should be written as such and not as expressions.

In a *Show that…* question each step should be shown in detail and the final statement must be reached and stated correctly.

General comments

Algebraic skills, such as expanding brackets and substituting in formulas, were generally strong.

The work with sequences was also well done and candidates were able to find several connections in the patterns given.

The use of the formula for the quadratic equation was popular and the large majority of candidates showed good understanding of its use.

In spite of the challenge in the modelling task many good answers were seen. While modelling, candidates should always have the context in mind. In that way they have a good chance of noticing whether an answer is realistic.

Comments on specific questions

Investigation: The core and shell of linear sequences

Question 1

(a) Almost all candidates filled in the correct values for the core and shell of the sequence.

(b) The large majority of candidates had no difficulty in showing the correct steps to calculate F for the given sequence. A few omitted the subtraction sign.

Question 2

(a) Popular linear sequences were 1, 2, 3, 4, 5 and 2, 4, 6, 8, 10. Nearly all candidates wrote a correct linear sequence, except those who made an arithmetic slip.

(b) Candidates had little difficulty in calculating F for their sequence. Some did not show that it was a square as required. It is possible that these candidates did not understand what to do from the wording of the question, even though a separate command was given.

Question 3

(a) Only very few candidates wrote $a + 7d$ instead of $a + 6d$ for the 7th term of the general linear sequence.

(b) There were good algebraic skills seen in finding the expression for F by expanding brackets. The most common error occurred during the subtraction of the expansion for the shell when $-\left(a^2 + 6ad\right)$ became $-a^2 + 6ad$. For communication, candidates were expected to show the brackets and not just the expansions.

Question 4

(a) A correct table was seen from almost every candidate, although one or two put $a + 8d$ at the bottom of the second column, imagining a column sequence of 1, 2, 4, 8. There was not enough information for candidates to assume that the F column formed a sequence and so communication was expected showing how to calculate one of the remaining F expressions. A great number of candidates did not gain these communication marks. Candidates are advised that, if there is a large working space under the table before the number of marks, then more is expected than just the table entries.

(b) This was an open-ended question where candidates had to find all the sequences possible when F was 36. Very many approaches were seen. Candidates should always remember that good communication also means showing good organisation of one's work on the page and two of the five marks in this question were for communication. Some candidates were very good in this respect and were able to show clear and complete reasoning to find the sequences. Others tried out ideas without approaching the problem in a logical manner.

The most popular, and often the clearest approach, was to take $(kd)^2 = 36$ and with $k = 2$, for instance, solve $(2d)^2 = 36$ to give $d = 3$, after which a suitable sequence can be written down. Several candidates, who used this approach, did not account for the fact that a sequence of positive integers was required and also solved, for instance $(5d)^2 = 36$, which gives decimal terms in the sequence.

Of the four sequences possible, 1, 2, 3, …, 13 was the one that was absent most often, probably because $F = (6d)^2$ was beyond the last row of the table in **part (a)** and so $(6d)^2 = 36$, giving $d = 1$, was not considered.

A few candidates described how to find the sequences without concluding by writing them out as finite sequences as required.

Question 5

(a) To find the number of terms in the sequence when $F = 100d^2$ it was necessary to realise that k was 10. This was a key communication mark and was usually noted by the many who wrote $100d^2 = (10d)^2$. From patterns in the table in **Question 4(a)** candidates could then see that a calculation of $2 \times 10 + 1$ gave the number of terms. Many candidates were successful but a sizeable number calculated $2 \times 100 + 1$ instead, after taking $k = 100$.

(b) (i) Many candidates realised that by writing $F = d^4$ as $F = (dd)^2$ then k and the first d in the brackets were the same. From patterns in the table in **Question 4(a)** the answer for the number of terms, n, was then found as $n = 2d + 1$. A few candidates were also successful in realising that $k = \frac{n-1}{2}$ and rearranged this to give the required formula. The common, but unhelpful approach, was to try to get somewhere by writing $F = \left(d^2\right)^2$. A frequent incorrect answer was $n = 2d^2 + 1$ arising from $d^4 = d^2 d^2 = kd^2$.

(ii) Candidates who were successful in **part (i)** were usually successful here and found that the difference of the 11-term sequence had to be 5. A few candidates also deduced this from the last row of the table in **Question 4(a)**. For a correct sequence 1, 6, 11, 16, 21, …, 51 was by far the most popular choice.

Modelling: Hammer throwing

Question 6

(a) Candidates had to calculate the circumference of the circle made by the hammer. The large majority of candidates did this correctly, with almost all showing the substitution in the formula. An answer to the nearest millimetre was not considered appropriate in this context. A few candidates gave an exact answer with π in it. For an actual measurement, this form is unsuitable and so was not given credit here.

(b) A good number of candidates knew that, to find the speed V in metres/second, you multiply the circumference by the number of turns in one second. Many candidates could have gained this mark if they had written V = at the start of the model. Several wrote $V = \frac{11.3V}{1}$ which is unusual but was condoned.

There were also a significant number who wrote $V = N$, probably from reading N (turns) in one second and simplifying $\frac{N}{1}$. $V = \frac{N}{11.3}$ was also seen several times.

Unlike in **Question 6(a)**, writing an exact formula such as $V = 3.6\pi N$, is acceptable for a model.

Question 7

(a) Nearly all candidates found the correct vertical speed of the hammer using the given formula. Some candidates could have improved their mark by remembering to give the correct units. Correct units are often credited as showing good communication.

(b) (i) Only a few incorrect answers were seen for the distance the hammer travelled in x seconds at 10m/s.

(ii) For the hammer released at a height of 2 metres, most candidates correctly added 2 to their previous answer. A few interpreted the situation as requiring 2 to be subtracted.

(c) (i) As in **Question 6(b)** many candidates did not start their model with H = and so could not gain the mark for this question. Quite a few candidates spoilt their work by changing the coefficient of x^2 so that it was positive and the algebraic function then looked to them more like the familiar quadratic form.

(ii) The easiest method to find when the hammer hit the ground was to use the graphic display calculator to sketch the graph of the model and find the intersection with the horizontal axis.

Most candidates instead preferred to write a quadratic equation. Many of those then wrote the answer without showing how they had calculated it. There were many who used the quadratic formula, which was in fact given two pages further on. Of those, a few made errors in the substitution.

A few explained that they had used their graphic display calculator but did not draw the relevant graph to gain credit for communication. Candidates are reminded that using an in-built solver receives no credit.

The model is not precise. So an answer in milliseconds for the time it takes for the hammer to hit the ground is inappropriate and was not credited.

Question 8

(a) The key information is that the horizontal speed is $0.7V$ and it was expected that this information would be clearly stated. Several candidates just replaced 10 in the previous equation by $0.7V$ here without saying why. A few candidates stated that the distance was $0.7Vx$ and this was accepted.

(b) (i) This was a challenging question, in spite of which there were in fact a good number of candidates who managed the algebra well. It required using the quadratic formula, where the coefficient of *b* was an expression in *V*. Some candidates, however, omitted the *V*. Most substituted the values of *a*, *b* and *c* correctly into the given quadratic formula for the first mark but then did not know how to proceed further. A common error when substituting was to write $0.7V^2$ rather than $(0.7V)^2$.

Some tried to work their result round to the final answer without showing the necessary common factors that made this possible.

A very efficient method, used by several candidates, was to divide the initial equation by 0.7. With this method, care had to be taken that 2 ÷ 0.7 was left as an exact fraction throughout.

(ii) Most candidates understood that a negative value would result because $V < \sqrt{V^2 + 80}$. A few candidates spoilt their work by writing either $V < \sqrt{V^2} + \sqrt{80}$ or $V < V^2 + 80$. Some candidates preferred to write their reason in words and this was accepted. Those who wrote that the numerator was negative were really just repeating the question.

Question 9

(a) (i) Most candidates gave the correct answer. Several candidates confused *V*, the speed of the hammer, and *S*, its horizontal component. These candidates divided 20 m/s by 0.7 instead of multiplying.

In spite of the instruction to use 0.7 a few candidates knew that a more accurate value would be cos45°. This was condoned since these candidates were considering the context. However, in general, candidates are strongly advised not to deviate from the instructions.

Some candidates did not read the information that the vertical and horizontal speeds were the same and used Pythagoras' theorem and the vertical speed instead of $V\sin A$ as instructed.

A few candidates calculated $20\sin 0.7$.

(ii) In this part, the instruction to use the model given in **Question 8(b)(i)** was a requirement for a communication mark. Credit just for the final answer was still given even if this instruction was not followed. For instance, a few preferred to use a quadratic equation again, something that had already been tested.

The model gave the time in seconds for the hammer to land. Many candidates thought it gave the distance and so a final answer of 2.99 metres was seen often. Candidates should always keep the context in mind in this paper: in this case they might have realised that such a distance was far too small for a hammer throw.

A few candidates gave the exact distance, which, similarly to **Question 6(a)**, is not an appropriate measurement.

A sizeable number of candidates substituted, in error, their horizontal speed from **part (a)(i)** into the model given in **Question 8(b)(i)**. The subsequent use of their horizontal speed to find the horizontal distance was then given partial credit provided multiplication by their speed was seen.

A few candidates rounded early and gave an answer of 42 m. In this context the distance the hammer travels horizontally would be measured more accurately, correct to the nearest 10 cm being expected here.

(b) This question was left unanswered by many. However there were also a good number of candidates who showed that multiplication by $0.7V$ led almost immediately to the required answer. The common incorrect working was to multiply by just V without giving a justification for the denominator becoming 20.

(c) (i) The question expected candidates to use the model, given in the previous part, to find the release speed for the record throw of 82.98 metres. Fully correct answers were rare, and most candidates seemed unaware of how to solve an equation using the graphing facility on the calculator. This may have been because there was not a specific instruction to draw the graph of the model, as has often been the case in previous papers. It is also possible that candidates actually did the graphing on the calculator but did not show the graphs. Some candidates admitted taking their answer from the in-built solver, the use of which is not allowed and so not credited.
There were many candidates who attempted to solve the equation algebraically. The combination of terms and the square root made this particularly difficult and most either did not finish the algebra or wrote errors in squaring the sum of two terms or attempting to take the square root of the sum of two terms.

(ii) A large number of candidates, if they had an answer to the previous part, gained credit here. A better mark would have been scored by some if they had communicated the division that they had typed into their calculator.

CAMBRIDGE INTERNATIONAL MATHEMATICS

Paper 0607/63
Investigation & Modelling (Extended)

Key messages

This paper awards marks specifically for clear and precise communication of mathematics. Therefore, it is essential to provide full reasons and steps in working to achieve full marks.

Candidates should always follow any instruction to use a previous part. Such instructions are intended to aid the candidate in attaining full credit.

General comments

Successful candidates had good algebraic manipulation skills including solving simultaneous equations and quadratic equations. They were able to use their previous knowledge of graphs, functions, powers, asymptotes and limits and give their answers to an appropriate degree of accuracy.

Candidates need to remain mindful of the context of the modelling throughout the modelling task. In this paper, it is about length of fish measured in centimetres, so long decimal answers are not appropriate. Fish do not decrease in length as they get older and they do not grow at the same rate for their whole lives.

The investigation was, on the whole, answered better than the modelling. Candidates need to be made aware that the investigation builds and therefore they need to remember, and often use, what they have discovered earlier on in the investigation.

Several questions in the modelling task were not even attempted by many candidates, so centres need to spend more time on the modelling and to encourage better use of time within the exam as the modelling is worth as many marks as the investigation.

Certain skills are regularly tested in the modelling sections and should be practiced so that candidates are prepared. These include: making and solving simultaneous equations, models leading to quadratic curves, lines of regression, sketches and comparisons of the different models found.

Although not detailed graphs, sketches need to be the correct shape. Any maximums or points where the graphs cross the axes should have scale communicated. If more than one graph is sketched, then they must identify which is which.

Comments on specific questions

Investigation: Number Diamonds

Question 1

This question was completed very well by almost all candidates showing an understanding of the basics of the investigation ahead.

(a) The question required candidates to fill in the bottom row of the pyramid. Nearly all candidates could do this correctly.

(b) (i) Almost all candidates could fill in the missing value by following the examples above.

(ii) Almost all candidates could complete the statement by following the given examples.

(c) (i) Nearly all candidates were able to follow the patterns and complete the table correctly.

(ii) This question required the candidates to generalise the pattern they had noticed in the table and combine the stages into one expression using *R*. The best answers used algebraic notation for the numerator with brackets only i.e., $R(R + 1)$ not $R \times (R + 1)$ and it should be noted that $R \times R + 1$ does not give the same value and is therefore incorrect.

Question 2

This question was about finding a number in the pyramid using its position in the row and the last number of the row before.

(a) Most candidates were able to complete this statement.

(b) A few candidates were able to show the required formula by replacing *R* by $R – 1$ in the expression found in **Question 1(c)(ii)** and adding *k* where *k* was the position in the row. So, *R* becomes $R – 1$ and $R + 1$ becomes $(R – 1) + 1 = R$. Many candidates were using numbers as an example rather than showing that it was true for all *R*.

(c) Some candidates found $R = 27$, but this only got them one mark. Clear communication was required to show how this number had been reached. Using the formula from **Question 2(b)** with $R = 27$ and $k = 11$ only counted as a check and did not gain marks. Some candidates scored a mark for writing down this formula with 11 and 362 substituted in. The remaining two marks were for forming a quadratic and showing how you solved it.

Question 3

This question was about making diamonds from the numbers in the pyramid.

(a) Most candidates could identify the similar diamonds and complete the statements. For the full 3 marks, candidates were required to draw clearly one of the diamonds on the pyramid.

(b) (i) This question required the candidates to realise that the diamond being considered was the smallest diamond possible, with vertices very close together in position within the row and in consecutive rows. If $b = N(p + 1, p)$ then *c* would be the next number along so $c = N(p + 1, p + 1)$ and *d* would be on the row below that which is $p + 2$. Some candidates could work this out.

(ii) Candidates were required to substitute $R = p + 1$ and $k = p$ into the formula given in **Question 2(b)** to get an algebraic expression for *b* and similarly substitute $R = p + 1$ and $k = p + 1$ to get an expression for *c*. They then had to add these expressions together to get $b + c$ and manipulate the algebra to get $p^2 + 3p + 1$. A few candidates could do this.

(iii) Some candidates were able to put $p^2 + 3p + 1$ equal to 701 for one mark. Some of these could solve the equation to get $p = 25$ for a second mark, but communication of how it was solved was required in order to get a third mark. Then $p = 25$ had to be substituted into all the expressions in *p* and $a = N(25, 25)$, $b = N(26, 25)$, $c = N(26, 26)$ and $d = N(27, 26)$ evaluated using the formula given in **Question 2(b)**. A few candidates gained full marks.

Section B Modelling: **Fish Growth**

Question 4

This question is about finding a line of regression for young kingfish.

(a) Candidates had to plot accurately the last two pairs of values from the table. Most candidates could do this accurately.

(b) (i) A few successful candidates knew how to find a line of regression using their graphic display calculator and what an appropriate degree of accuracy was. They also remembered to include *L* = to make it a model. Many candidates tried to find the line of best fit instead.

(ii) To gain the mark, candidates had to mention both the increase in length and that it was per year. The question required an answer that showed understanding of the context and not a description of what a gradient is. Some candidates could do this.

(iii) The best answers mentioned the word birth, showing a good understanding of the context and that c represented the length of the fish when it was born. Some candidates were able to explain this.

Question 5

Some successful candidates realised that older fish grow more slowly than younger fish and the data therefore did not follow the line of regression found in **Question 4(b)(i)** for younger fish.

Question 6

This question required candidates to develop a model by creating and solving a pair of simultaneous equations using data from the table.

(a) Candidates needed to make two equations by substituting $x = 10$ and the corresponding value of $L = 94$ from the table in **Question 4** into $L = ax^2 + bx + 2$ and also $x = 20$ and the corresponding value of $L = 122$ from the table in **Question 5**. The resulting equations should not still contain x. Candidates who had subtracted 2 and evaluated 10^2 and 20^2 making $92 = 100a + 20b$ and $120 = 400a + 20b$ found it easier to solve their equations in **part (b)**.

(b) Candidates could solve their equations using a substitution or an elimination method as long as they communicated clearly how they got to their values for a and b. Candidates had to then write down the whole model $L = -0.32x^2 + 12.4x + 2$, not just give the values of a and b. Some candidates could do this.

(c) Candidates had to substitute $x = 14.5$ into the model and to gain two marks they had to show this substitution. Most candidates who had found a model in **part (b)**, understood what was required of them in **part (c)**.

Question 7

This question used a model with a limit as kingfish do not continue growing forever.

(a) One mark was gained for showing the substitution of $x = 0$ into the model. If 10^0 was correctly evaluated as 1 then most candidates were able to find the correct length. It was important to consider an appropriate degree of accuracy as fish would not be measured to several decimal places of a centimetre.

(b) (i) This required candidates to use their knowledge from the syllabus to know that as x increases, 10^{-kx} decreases. Some candidates knew this.

(ii) As x increases and 10^{-kx} approaches zero, 3.2×10^{-kx} approaches zero so $1 + 3.2 \times 10^{-kx}$ approaches 1 and $\dfrac{123}{1 + 3.2 \times 10^{-kx}}$ approaches 123. A few candidates were able to explain that the denominator gets closer to one.

(c) For one mark, candidates were required to substitute $x = 9$ into the formula given in **Question 7(a)** and then equate the formula to 89 or sketch L. For a second mark they had to show how they solved their equation or show $L = 89$ on their sketch. A mark was also given for finding k correct to 3 significant figures.

Question 8

This question involved candidates sketching both models and deciding which was the better model.

(a) Candidates were required to sketch a quadratic passing close to the origin with a scale indicating the maximum. Some candidates could do this.

(b) Candidates were required to sketch a graph that did not start near the origin, with an asymptote at $L = 123$. A communication mark was given for the labelling of at least one of the two graphs to show which was which. Some candidates labelled their sketches.

(c) Candidates were required to identify Mayuko's model as the better one as Irene's model shows length decreasing which within the context means the fish decreasing in length as they get older. A few candidates were able to identify why Mayuko's model was the better one.