INTERNATIONAL MATHEMATICS

Paper 0607/01

Paper 1 (Core)

Key Message

To succeed in this paper, candidates need to have completed full syllabus coverage and be confident working without a calculator. Clear methods need to be shown in order to ensure that method marks can be awarded if the final answer is incorrect.

General comments

As in previous papers for this syllabus most candidates were generally well prepared and were able to make an attempt at the majority of questions. The standard of presentation was very good and most candidates attempted to show working when the answer could not be written straight down. Generally candidates were able to carry out calculations without the aid of a calculator. **Questions 1, 2, 3(a), 5(a), 7(a) and 9(a)** were answered particularly well. Candidates found **Questions 4(a), 4(b), 10(c), 11(b)** and **12(b)** more challenging.

Comments on specific questions

Question 1

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

(b) This part was also answered well with just a small number of candidates giving an answer of 4.32×10^5.

Answers: **(a)** 43 000 **(b)** 4.32×10^4

Question 2

(a) Virtually all candidates answered this part correctly. Some gave the answer as $\sqrt{25}$ which was awarded the mark.

(b) Most candidates understood that it is essential that the calculation is carried out in the correct order. There were a small number of candidates who worked out 10 + 8 first and so gave an incorrect answer of 9.

Answers: **(a)** 5 **(b)** 14

Question 3

(a) The majority correctly calculated $\frac{3}{4} \times 44$ to give the cost of a child's ticket. Most then went on to give the correct answer but some left $33 as the answer and a few gave the answer as the cost of tickets for one adult and one child or for two adults and two children.

(b) (i) This part was answered well. Some candidates gave an incorrect answer of 3 hours 30 minutes.

(ii) Virtually all candidates used the formula speed = distance ÷ time and made an attempt to calculate 1000 divided by their answer to **(b)(i)**, which earned the method mark. About half of those who had the correct time were able to carry out the division correctly by writing the time as 2.5 or $2\frac{1}{2}$. Some wrote the time as 150 minutes, which would have given the speed in km/minute, but were not able to make any progress with the division. For those who had an incorrect answer to **(b)(i)** there was a follow through mark available for carrying out the division correctly but as the calculation was usually more difficult only a very small number of candidates earned this mark.

Answers: **(a)** 121 **(b)(i)** 2 h 30 min **(b)(ii)** 400

Question 4

(a) Candidates found this part difficult. It is necessary to understand the concept of a range in this algebraic context rather than in a statistical context and it was quite common to see an answer of 6, probably coming from 6 – 0 or from 3 – (–3). Some candidates copied down $-3 \le x \le 3$ as their answer.

(b) This part also proved difficult. Those candidates that understood that a translation is required often used $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ rather than $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ and others used $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$. A number of candidates drew a single straight line.

(c) Many candidates correctly wrote down the name of the transformation as a translation which was sufficient to earn one mark. In order to earn the second mark the translation had to be described using a vector and many of those that attempted to do this gave an incorrect vector such as $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ or $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$.

Answers: **(a)** $0 \le f(x) \le 6$ **(b)** Correct diagram **(c)** Translation $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$

Question 5

(a) This was answered very well with most candidates able to write down the correct probability. A small number gave $\frac{4}{10}$ as the answer.

(b) The majority of candidates identified the correct method and carried out the calculation correctly. A few calculated the number of discs that are blue and a small number gave an answer of $\frac{3}{10} \times 100 = 30$.

Answers: **(a)** $\frac{6}{10}$ **(b)** 18

Question 6

In order to make r the subject of the formula three steps are required, namely to multiply both sides by 2, to divide both sides by 3π and to take the square of both sides. One method mark was given for each of these steps. Quite a number of candidates carried out all three steps correctly to score full marks. Some were able to earn two marks by giving an answer such as $r = \sqrt{\dfrac{A+2}{3\pi}}$ for an incorrect first step but two subsequent correct steps. Other examples scoring two marks were $r = \dfrac{\sqrt{2A}}{3\pi}$, consisting of two correct steps, followed by an incorrect step and $r = \sqrt{2A - 3\pi}$, consisting of one correct step, one incorrect step and one correct step. Some candidates gave just one correct step, which was usually the first step.

Answer: $r = \sqrt{\dfrac{2A}{3\pi}}$

Question 7

(a) This was answered very well with nearly all candidates giving the correct three elements. A small number used the set $A' \cap B$ giving an answer 15, 20.

(b) (i) A few candidates did not attempt this part, but most gave the correct answer. Some did not understand the notation and so gave an answer such as 1 or 2.

(ii) This part was also answered well. Virtually all candidates giving an incorrect answer attempted to list the elements rather than giving the number of elements.

(iii) This was answered very well. A few candidates gave {2, 3, 7, 11, 15, 20} the answer for $A \cup B$.

Answers: **(a)** 11, 15, 20 **(b)(i)** A **(b)(ii)** 4 **(b)(iii)** 11

Question 8

(a) The majority answered this correctly. Some candidates gave an answer of –4 coming from either $2^1 - 5 = 1 - 5 = -4$ or $2^0 - 5 = -4$.

(b) About half of the candidates gave the third and fourth terms as 3 and 11 respectively and went on to correct a correct answer of either 8 or –8. Many wrong answers were as a result of not using 2^n correctly with $2^3 = 6$ and $2^4 = 8$ leading to an answer of 2 being the most frequent.

Answers: **(a)** –3 **(b)** 8

Question 9

(a) This was answered particularly well with very few incorrect answers.

(b) This was answered quite well. A number of candidates reached the correct answer but then carried out 'false' cancelling, such as dividing both the 5 in the numerator and the 15 in the denominator by 5 to give $\dfrac{12x+y}{3}$. This scored one mark.

(c) Candidates found this part difficult. Most attempted to use –3 or 5, or both, as part of an inequality, although some had at least one incorrect inequality. Common incorrect answers were $-3 \geq x \leq 5$, $-3 \geq x \geq 5$, $x \leq -3$ and –3, 5.

Answers: **(a)** $x(3 + 13x)$ **(b)** $\dfrac{12x+5y}{15}$ **(c)** $-3 \leq x \leq 5$

Question 10

(a) The majority of candidates answered this correctly. Some candidates calculated the scale factor as 3 and assumed that the angle is also multiplied by 3 and so gave an answer of 42°.

(b) This was answered well with most candidates correctly calculating the scale factor as the first step. A few gave this as the answer but most went on to give 2 × 3 = 6. A few candidates wrote down an equation, such as $\frac{PR}{2} = \frac{1.5}{0.5}$ and used this to calculate *PR*.

(c) Very few candidates were able to identify the correct pair. The various incorrect pairings included *C* and *D*, *A* and *E* and *B* and *E*.

Answers: **(a)** 14° **(b)** 6 **(c)** *A* and *D*

Question 11

(a) Quite a number of candidates used the standard equation of a straight line in the form $y = mx + c$ to write down the correct answer. Others omitted this part or gave an incorrect answer such as 5 – 1 = 4.

(b) Some candidates were able to deduce that the gradient is the same as for the line $y = 5x - 1$ and also that the value of c is 3, to score full marks. Some candidates earned one mark either by giving an equation with the correct gradient but an incorrect intercept, such as $y = 5x - 3$ or by giving an incorrect gradient with the correct intercept, such as $y = \frac{1}{5}x + 3$.

Answers: **(a)** 5 **(b)** $y = 5x + 3$

Question 12

(a) Some candidates attempted to draw the lines of symmetry on the diagram with about half giving the correct response. Incorrect answers given included 0, 1 and 6.

(b) This was also answered correctly by about half of the candidates. The most common incorrect answer was 4. Some candidates associated the order of rotational symmetry with an angle rather than a number, leading to an answer of 90° or 180°.

Answers: **(a)** 3 **(b)** 2

INTERNATIONAL MATHEMATICS

Paper 0607/02

Paper 2 (Extended)

Key Message

To succeed in this paper, candidates need to have completed full syllabus coverage and be confident working without a calculator. Clear methods need to be shown in order to ensure that method marks can be awarded if the final answer is incorrect.

General comments

All candidates appeared to have sufficient time to attempt all questions on this paper. Clear, organised working was shown on most papers and the majority of candidates wrote legibly. Method marks could be awarded for correct working seen even when the answer was incorrect. Most candidates used the spaces provided for their working out with few candidates submitting supplementary sheets. Candidates demonstrated a sound, broad knowledge of topics tested on this paper. It was noted, however, that in several questions candidates overlooked strategies that make numerical work on a non-calculator paper more manageable. In a number of questions errors seen were from incorrect processing of negative numbers.

Comments on specific questions

Question 1

This question was very well answered. Occasionally a candidate gave only the partially factorised answers of $3(xy - 2yz)$ or $y(3x - 6z)$.

Answer: $3y(x - 2z)$

Question 2

(a) This was well answered by the majority of candidates. Errors seen included $\frac{250}{1000}\times 100$ to give 25%. Also seen was 2 kg = 200 g followed by further errors to give 2.5%, or 2000 ÷ 250 = 8%.

(b) Candidates did not display confidence with this question. Some started correctly by linking 46 and 115% but then abandoned this approach. It appeared that candidates had difficulty dealing numerically with 46 ÷ 1.15 and hence decided their initial statement must be incorrect. Correct working was then replaced by the incorrect 10% = 4.6, 5% = 2.3 concluding with the previous test score being 39.1.

Answers: **(a)** 12.5% **(b)** 40

Question 3

(a) This question was answered well.

(b) Many candidates were able to recall that speed = distance/time and wrote $\frac{1.4}{24}$. Some candidates subsequently progressed to $\frac{1.4}{0.4}$ but a significant number were unable to correctly convert 24 minutes into 0.4 hours and incorrectly wrote $\frac{1.4}{0.24}$ or equivalent. Numerical errors were made by candidates who attempted $\frac{1.4}{24}$ followed by multiplication by 60. Some candidates who correctly wrote $\frac{1.4}{0.4}$ did not recognise the equivalence to $\frac{14}{4}$ and hence made errors in their attempt to divide by a decimal.

Answers: **(a)** 08 13 **(b)** 3.5

Question 4

This question proved to be one of the most challenging on the paper. Errors occurred in dealing numerically with 3.24 ÷ 4 and also with the powers of 10. In particular, more attention should be paid to negative indices and the index rules. Errors included adding the indices, multiplying the indices and in many instances dealing carelessly with negative numbers. Candidates who correctly reached 0.81×10^{-7} did not always continue to convert to standard form, or incorrectly concluded with 8.1×10^{-6}.

Answers: 8.1×10^{-8}

Question 5

(a) The most efficient approach to this question was to recognise that $\cos x = \frac{p}{8}$ and many candidates did begin in this way. Solving the subsequent equation $\frac{2\sqrt{2}}{3} = \frac{p}{8}$ highlighted difficulties with manipulating fractions and surds. Errors such as $p = \frac{16\sqrt{2}}{24}$ and $\frac{2\sqrt{2} \times 8}{3}$ leading to $\frac{2\sqrt{16}}{3}$ were seen. Some candidates attempted to use Pythagoras Theorem after establishing that the third side of the triangle was $\frac{8}{3}$ and whilst some were successful, this inefficient method offered more opportunity for numerical and algebraic manipulation errors. Candidates who correctly reached $\frac{\sqrt{512}}{9}$ did not always simplify their answer. Weaker candidates assumed the question must involve the angles 30°, 60° or 45°.

(b) Many candidates correctly deduced that the *y* co-ordinate was 3. Finding the *x* co-ordinate was more problematic, with answers of 90° and 180° seen. The *x* and *y* co-ordinates were reversed by some candidates.

Answers: **(a)** $\frac{16\sqrt{2}}{3}$ **(b)** (45, 3) or $\left(\frac{\pi}{4}, 3\right)$

Question 6

(a) Many correct answers were seen. Some clumsy notation was evident, with candidates attempting to write $\left(\frac{1}{3/2}\right)^3$ instead of moving directly to $\left(\frac{2}{3}\right)^3$ and this sometimes led to the incorrect notation of $\frac{1}{3^3/2}$ or $\frac{1}{3/2^3}$. Occasionally this was recovered to get $\frac{8}{27}$ but the errors $\frac{2}{27}$ and $\frac{8}{3}$ were also seen. Other errors came from misunderstanding the meaning of a negative index. For example, $\frac{-27}{-8}$ was seen and, after $\frac{27}{8}$ as a first step, $\frac{\sqrt[3]{27}}{\sqrt[3]{8}}$ then followed.

(b) Many candidates confidently wrote $\log 2^3 - \log 4^2$ as a correct first step. Occasionally the errors $2^3 = 6$ and $4^2 = 8$ then followed. The most common error was to progress from log 8 – log 16 to $t = 2$, or less commonly $t = -2$. Candidates need to be more rigorous with notation. For example, it was common to see $\frac{\log 2^3}{\log 4^2}$ instead of $\log\frac{2^3}{4^2}$. In addition, a final incorrect answer of $t = \log\frac{1}{2}$ was seen too often.

Answers: **(a)** $\frac{8}{27}$ **(b)** $\frac{1}{2}$

Question 7

(a) Many candidates gave a fully correct answer. It should be noted, however, that following a statement such as $y = \frac{k}{\sqrt{x}}$, candidates must evaluate k and then incorporate this value of k into the equation connecting y and x, to write $y = \frac{12}{\sqrt{x}}$ in the answer space. This is necessary to demonstrate their understanding that $y = \frac{12}{\sqrt{x}}$ for all values of y and x. Some candidates wrote separately that $y = \frac{k}{\sqrt{x}}$ and $k = 12$ but then stated, for example, $y = 3$ as their answer. Other errors included incorrect initial statements such as $y = k\sqrt{x}$, $y = \frac{k}{x^2}$ and $y = \frac{1}{\sqrt{x}}$.

(b) Most candidates understood to use the ‘equation’ they had found in part **(a)**.

Answers: **(a)** $\frac{12}{\sqrt{x}}$ **(b)** 2

Question 8

Many candidates were not confident with the algebraic manipulation of $1-\frac{1}{x-1}$ to a single fraction. Some recognised the need for a common denominator of $x - 1$ and correctly wrote $\frac{x-1}{x-1}-\frac{1}{x-1}$ but then made errors whilst dealing with negative numbers leading to $\frac{x}{x-1}$ or $\frac{x+2}{x-1}$. Other candidates correctly reached $\frac{x-2}{x-1}$ but then spoiled their answer by cancelling the xs to get $\frac{-2}{-1} = 2$. Weaker candidates began with $\frac{0}{x-1}$ or $\frac{0}{x}$.

Answers: $\frac{x-2}{x-1}$

Question 9

(a) (i) Many correct answers were given. The errors $\begin{pmatrix}-3\\-5\end{pmatrix}$ and $\begin{pmatrix}5\\3\end{pmatrix}$ were also seen as well as errors coming from numerical slips.

(ii) Many correct answers were seen. Errors occurred from the incorrect manipulation of negative numbers or confusion over whether to add or subtract the components of $\begin{pmatrix}-3\\4\end{pmatrix}$ to/from the co-ordinates of *B*. For example, (–4, 1) and (4, 7) were common incorrect answers.

(b) Many correct answers were seen. The error $\mathbf{p} - \dfrac{\mathbf{r}}{2}$ was seen. Candidates should be encouraged to write $\overrightarrow{OM} = \overrightarrow{OP} + \overrightarrow{PM}$ as a first step.

Answers: **(a)(i)** $\begin{pmatrix}3\\5\end{pmatrix}$ **(ii)** (–2, 1) **(b)** $\mathbf{p} + \frac{1}{2}\mathbf{r}$

Question 10

(a) This question was very well answered with many fully correct answers given. Some candidates did not simplify fully giving $\sqrt{32} = 2\sqrt{8}$ instead of the required $4\sqrt{2}$.

(b) Many candidates recognised the correct method and attempted to multiply the numerator and denominator by $\sqrt{2}-1$ or $1-\sqrt{2}$. Answers of $\dfrac{1-\sqrt{2}}{-1}$ and $\dfrac{\sqrt{2}-1}{1}$ were accepted but candidates should be encouraged to continue to reach $\sqrt{2}-1$. Some candidates made errors such as $\dfrac{1}{\sqrt{2}+1} \times \dfrac{\sqrt{2}-1}{\sqrt{2}-1} = \dfrac{\sqrt{2}-1}{4-1} = \dfrac{\sqrt{2}-1}{3}$. Weaker candidates attempted to rationalise by multiplying the numerator and denominator by $\sqrt{2}$ or $\sqrt{2}+1$.

Answers: **(a)** $4\sqrt{2}$ **(b)** $\sqrt{2}-1$

Question 11

(a) This question was answered well.

(b) Many correct answers using the area scale factor of 4 or $\dfrac{1}{4}$ were seen but the error 56 ÷ 2 = 28 was very common. Other candidates attempted to use the lengths 4.5 and 9 to get the area scale factor $\left(\dfrac{4.5}{9}\right)^2$ but did not recognise the equivalence to $\left(\dfrac{1}{2}\right)^2$ and subsequently made numerical errors when squaring 4.5 or multiplying or dividing 56 by 4.5^2 and 81.

Answers: **(a)** 9 **(b)** 14

Question 12

(a) Many correct answers were seen. Errors that were seen included $\frac{3}{5}$ and $\frac{3}{5}\times\frac{3}{5}=\frac{9}{25}$.

(b) Many fully correct solutions were seen. A significant number of candidates surprisingly followed correct procedures for finding the probability of two beads of the same colour to get $\frac{17}{35}$ instead of giving the required solution to take one white and one black bead. Other candidates showed correct intention to do $\frac{2}{5}\times\frac{3}{7}+\frac{3}{5}\times\frac{4}{7}$ but were unable to multiply/add fractions correctly. Numerical difficulties were caused when unnecessarily trying to use a common denominator of 35 to multiply fractions. Some candidates mixed up addition and multiplication writing for example $\frac{2}{5}+\frac{3}{7}\times\frac{3}{5}+\frac{4}{7}$ or $\frac{2}{5}+\frac{3}{7}+\frac{3}{5}+\frac{4}{7}$ and were not alerted even when achieving probabilities greater than 1. $\frac{2}{5}\times\frac{3}{7}\times\frac{3}{5}\times\frac{4}{7}$ was also seen. A few candidates gained some credit for correctly calculating $\frac{3}{5}\times\frac{4}{7}$ to get $\frac{12}{35}$ as their answer.

Answers: **(a)** $\frac{6}{20}$ **(b)** $\frac{18}{35}$

INTERNATIONAL MATHEMATICS

Paper 0607/03

Paper 3 (Core)

Key Message

To attain high marks in this paper, candidates need to possess a good knowledge of the whole syllabus. They should show all the relevant working in their answers and use an appropriate level of accuracy. This needs to be supported by efficient use of a graphics calculator in the way outlined in the syllabus

General comments

The overall performance of candidates was generally good, continuing the improvement seen last year. There were many very good scripts which showed good methods and accurate answers, with several candidates reaching a level suggesting that they would probably have performed reasonably well at the extended level. The paper was accessible for most candidates and there was sufficient time to attempt all questions. There is always adequate working space with each question and almost all candidates found this to be the case. The use of supplementary sheets for working should be strongly discouraged.

The use of a graphics calculator was much improved as will be indicated in the comments on specific questions. In spite of the above comment about scripts showing good methods, there was a large number of candidates who simply wrote down answers. This loses the opportunity to be awarded possible method marks when an answer is incorrect, sometimes from miscopying from a calculator. The need for appropriate accuracy was a challenge to a number of candidates, particularly in **Question 8**.

Comments on specific questions

Question 1

(a) This simple subtraction question was extremely well done.

(b) This simple percentage calculation was also well done.

(c) This ratio question was usually well done. The challenge to a few candidates was to divide the given amount by the sum of the two parts.

(d) The calculation of the sector angle in the pie chart was usually correctly answered. A few candidates divided by 360 and multiplied by 1000.

(e) The probability was usually correct. A few candidates overlooked the instruction about giving the answer as a fraction in its lowest terms.

Answers: **(a)** 375 **(b)** 15% **(c)** 270 **(d)** 54 **(e)** $\frac{9}{20}$

Question 2

(a) The co-ordinates of the point of intersection between the given line and the *y*-axis were usually correctly stated. A few candidates found a challenge in the order of the co-ordinates and a few others seemed to find dealing with the given equation a challenge.

(b) The same comments apply to this part requiring the co-ordinates of the point of intersection between the given line and the *x*-axis.

(c) The gradient of the given line proved to be a challenge to many candidates, probably because the line was not in the form $y = mx + c$.

(d) The midpoint of the line connecting the two points in parts **(a)** and **(b)** was usually correct, although occasionally the co-ordinates were reversed.

(e) The vector, in column form, from the origin to the midpoint in part **(d)** was often correctly stated. A number of candidates seemed to be unaware of this topic in the syllabus and omitted this part.

Answers: **(a)** (0, 3) **(b)** (8, 0) **(c)** $-\frac{3}{8}$ **(d)** (4, 1.5) **(e)** $\begin{pmatrix} 4 \\ 1.5 \end{pmatrix}$

Question 3

(a) The total area of the cross-section of an L-shaped prism was well answered by most candidates.

(b) (i) Most candidates demonstrated their knowledge that the volume of a prism is area multiplied by length. Many multiplied by 5 instead of 500 when the word "metres" was printed in bold.

(ii) The conversion from cubic centimetres into cubic metres proved to be a challenge to almost all candidates, with most dividing by 100. A few candidates multiplied by 100.

(c) The total cost of wood was usually correctly answered by multiplying by the length of each piece of wood and by the cost of one metre. A few candidates overlooked the length of the pieces of wood.

Answers: **(a)** 432 cm^2 **(b)(i)** 216 000 cm^3 **(ii)** 0.216 cm^3 **(c)** $9450

Question 4

(a) The negative value of a variable in this substitution was a challenge to many candidates. Otherwise the question was well answered.

(b) This straightforward simultaneous equations question was correctly answered by most candidates.

(c) The indices question was well answered by many candidates, whilst being challenging to others. All but a few candidates did have a number and a power of x as their final answer.

(d) The linear equation containing two pairs of brackets was found to be more demanding, especially dealing with the negative sign in front of the second pair of brackets. The re-arrangement of terms was more successful.

(e) This was a more discriminating indices question and many candidates gave $2^4 + 2^4$ as 2^8. Others reached 16 + 16 but did not reach 2^5.

Answers: **(a)** 56.25 **(b)** $x = 2$, $y = 6$ **(c)** $6x^8$ **(d)** 6 **(e)** 5

Question 5

There were more candidates using the statistics functions on their graphics calculator than in previous examinations, and the success rate in parts **(b), (c)** and **(d)** were higher.

(a) The mode was almost always correct.

(b) The mean was also usually correct and the absence of working indicated appropriate use of the calculator. A few candidates did work out the mean manually, often with success. A few weaker candidates ignored the frequency.

(c) Similar comments apply to this part asking for the median.

(d) Similar comments apply to this part asking for the lower quartile.

(e) The range was usually correctly answered. A few candidates gave their answer as 1 to 5, instead of 4 and a few others gave the range of the frequencies.

Answers: **(a)** 1 **(b)** 2.15 **(c)** 2 **(d)** 1 **(e)** 4

Question 6

(a) This straightforward parallel line angle question was almost always correctly answered.

(b) This circle property question was more challenging, although there were many fully correct answers. A number of candidates did not apply the angle between a tangent and a radius property.

(c) This question required finding the sum of the angles of a hexagon and then finding the value of five equal angles. The question proved to be straightforward to some candidates and challenging to others. Several candidates gave the angle sum as $6 \times 180^\circ$ and a few used 360° for the sum. The stronger candidates were fully successful.

Answers: **(a)** 70° **(b)** $y = 30°$, $z = 60°$ **(c)** 116°

Question 7

(a) The calculation using Pythagoras was usually successful. Several candidates demonstrated the need to recognise which side was the hypotenuse as they added the two squares.

(b) The area of the triangle was also usually correctly answered, with candidates recognising the base and height with the right-angle between them. A few candidates used the two given sides as base and height.

(c) Candidates were instructed to use trigonometry and this proved to be very helpful. Many found a correct ratio and went on to find the angle successfully. The choice of which trigonometric ratio to use proved to be challenging for some candidates.

Answers: **(a)** 24 cm **(b)** 120 cm^2 **(c)** 22.6

Question 8

(a) The sketch of the parabola was very well done. This was perhaps a slightly easier graph to sketch than in previous sessions, but there appeared to be a large improvement in the use of the graphics calculator. A few candidates gave a sketch which suggested that the ranges of x and y, given on the diagram, may not have been used.

(b) The use of the minimum point from the calculator appeared to be more frequent than in previous examinations. A few gave the x co-ordinate as e.g. 1.999.., instead of 2.

(c) The line of symmetry appeared to be less well known, with candidates not connecting this with the x co-ordinate of the turning point.

(d) The straight line graph was usually correctly sketched.

(e) Most candidates appeared to know how to find the co-ordinates of the two points of intersection, using the appropriate function on their calculator. The question asked for answers correct to 3 decimal places and, whilst many candidates did do this successfully, this requirement was often overlooked or taken as 3 significant figures. There were some candidates appearing to use the trace facility of the calculator.

Answers: **(b)** (2, – 8), **(c)** $x = 2$ **(e)** (0.392, – 2.825), (5.108, 11.325)

Question 9

(a) The five parts of this question required simple knowledge of types of numbers as well as giving answers as probabilities. The probability aspect of the question caused little difficulty and only a few candidates appeared to have the need to know more about number properties, namely odd, prime, factor, multiple and power. A few candidates did not realise that 3 is a multiple of 3.

(b) The inequality signs were understood by many candidates and the correct list of integers was stated. A few candidates overlooked the inclusive inequality sign and a few others demonstrated the need for a greater understanding of inequalities.

Answers: **(a)(i)** $\frac{5}{9}$ **(ii)** $\frac{4}{9}$ **(iii)** $\frac{3}{9}$ **(iv)** $\frac{3}{9}$ **(v)** $\frac{2}{9}$ **(b)** 7, 8, 9

Question 10

(a) The context of this simple interest question proved to be quite demanding as candidates needed to realise that it was in fact about simple interest. A few candidates subtracted the interest from the principal because of the question indicating that interest was “removed” each year. Also “each year” caused a number of candidates to use compound interest.

(b) Many candidates treated this part as simple interest, overlooking the words “each year” in the stem, again indicating the challenges of context as opposed to straightforward interest questions.

Answers: **(a)** \$500 **(b)** \$19.06

Question 11

(a) Most candidates correctly interpreted the top of the pizza as a circle and calculated the area.

(b) Most candidates divided their answer to part **(a)** by 6 for the area of the top of one slice.

(c) The length of the curved edge of one slice proved to be more challenging, probably because candidates were not asked for the circumference to start this part.

(d) This challenging part required the calculation of a percentage profit. There were many fully correct answers. The most searching part of the calculation was the choice of denominator in a fraction and the selling price was frequently seen here. A less frequent error was to give the price of one slice as a percentage of the cost price of the whole pizza.

Answers: **(a)** 707 cm^2 **(b)** 118 cm^2 **(c)** 15.7 cm **(d)** 37.5%

Question 12

(a) This simple probability, requiring the subtraction from 1, was almost always correctly answered.

(b) (i) The tree diagram was often completed correctly. The challenge was to realise that the probabilities remained constant as there was a “large” number of plants indicated in the stem. A number of candidates did treat the problem as a “without replacement” type and their values could earn credit in parts **(ii)** and **(iii)**.

(ii) This combined probability question, requiring one product of probabilities, was quite well answered. It is a demanding part of the syllabus and a number of candidates appeared to add two probabilities or gave an incorrect answer without any working.

(iii) This was a more challenging part, requiring the addition of two products of probabilities. The comments in part **(b)(ii)** apply here. Another answer seen was from the use of only one of the two products.

Answers: **(a)** $\frac{4}{5}$ **(b)(ii)** $\frac{1}{25}$ **(iii)** $\frac{8}{25}$

Question 13

(a) The only acceptable word for this transformation was “translation” and most candidates did give this. “Translocation” was seen less frequently than in previous examinations. Only a handful of candidates gave a combined transformation. The vector was often correct but less successful as a result of the reverse vector being given. Most candidates did use correct notation.

(b) The word “reflection” was correctly stated by all but a few candidates. The correct line of reflection, $x = -2$ was usually stated, although a number did give it as $y = -2$.

Answers: **(a)** Translation, $\begin{pmatrix} -3 \\ -2 \end{pmatrix}$ **(b)** Reflection, $x = -2$

INTERNATIONAL MATHEMATICS

Paper 0607/04
Paper 4 (Extended)

Key message

To succeed in this paper candidates should:

- have a full understanding of the whole syllabus
- be fully experienced with multi-step questions
- be able to communicate by showing working, to necessary or appropriate accuracy, and giving reasons whenever necessary
- make full use of the graphics calculator

General comments

Most candidates were able to reach a good level in this paper and should have found the experience a positive one. Good communication skills were seen, with methods usually clear to follow together with good accuracy. The 2 hours 15 minutes was more than sufficient time for candidates to complete the paper. Most candidates demonstrated a good coverage of the syllabus and an increasingly efficient use of the graphics calculator, especially in the area of statistics. The questions proving to be challenging involved percentage change, changing of units, reasoning with mathematical vocabulary, ranges of functions, set notation and solving a quadratic inequality. More details will be found in the comments on specific questions. Topics on which questions were generally well answered were statistics, ratio, mensuration, trigonometry, curve sketching and transformations.

Comments on specific questions

Question 1

(a) This question requiring the total of frequencies in a table was almost always correctly answered.

(b) The median of the data in the table was also almost always correctly answered.

(c) The mean was also usually successfully found.

(d) The upper quartile was usually correct.

(e) The range was usually correct although a few candidates gave 0 to 6 instead of 6.

(f) The mode was almost always correctly stated.

More candidates than in previous examinations appeared to use their graphics calculator for the relevant parts of this question. There were some long methods seen and candidates should be guided by the number of marks for each particular part. When there is only one mark, little or no working will be expected.

Answers: **(a)** 50 **(b)** 2 **(c)** 1.88 **(d)** 3 **(e)** 6 **(f)** 1

Question 2

(a) (i) This writing of a ratio in its simplest form was very well answered.

(ii) The calculation of an amount of money, using ratio, was also well answered.

(iii) This simple interest question was usually correctly answered, although a few candidates only gave the interest when the question was asking for the total amount.

(iv) The amount in a compound interest situation was well answered.

(v) This question required candidates to compare a simple interest investment with a compound interest investment and proved to be more challenging, even though there was nothing more complicated than in parts **(iii)** and **(iv)**. Most candidates chose their own amount for both investments, the best choice being the principal in part **(iv)**. There were also the excellent solutions which simply showed that 1.0395^2 is greater than 1.08. Candidates need to be able to interpret this type of question and choose an appropriate strategy.

(b) (i) This annual percentage decrease question was well answered.

(ii) This part followed part **(i)**, requiring the number of years for the original amount to reach a given lower amount. The expected method was for candidates to use logarithms or use a sketch of an exponential function. Many candidates used logarithms but few used the graphical approach. There were also many candidates who simply multiplied by the percentage factor until they reached the required value. All methods were generally successful and most candidates were aware that an integer answer was required.

Answers: **(a)(i)** 1.5 **(iii)** 129.60 **(iv)** 86.44 **(b)(i)** 19 440 **(ii)** 9

Question 3

(a) (i) The volume of a solid made up of a cylinder and a hemisphere was well answered and most candidates appeared to use the given formulae in the question paper. A few candidates did not divide the volume of a sphere by 2. The requirement to give the answer to the nearest cubic centimetre was often overlooked.

(ii) Converting units of volume proved to be a real challenge with most candidates dividing the cubic centimetres by 100 when changing into cubic metres.

(iii) The mass of the solid was successfully found by almost all candidates. The follow through answers gained full credit even though the masses of the wooden solid were unrealistic. It is an area where candidates should think about how sensible their answer might be.

(b) This question required the calculation of the surface area of the same solid and the cost of painting this total surface. The challenge was to decide on how the total surface was made up and calculate each part. The curved surface of the cylinder was usually correctly calculated. The curved surface of the hemisphere was also usually correct although, as in part **(a)(i)**, a few candidates treated this as a sphere. The circular base of the cylinder was occasionally omitted and a few candidates included the circle where the two shapes were connected. The final answer required the total area to be multiplied by 0.15 and divided by 100 to give the answer in dollars. There was also the demand for an answer to the nearest cent. Candidates needed to read such instructions carefully and not lose marks unnecessarily by giving answers in other units or to other accuracies. The only acceptable final answer was 1.40. The answer frequently seen was 1.4, which was not to the nearest cent.

Answers: **(a)(i)** 1947 **(ii)** 0.001947 **(iii)** 1.60 **(b)** 1.40

Question 4

(a) This question gave the angle of a regular polygon and candidates had to find the number of sides. The efficient way was to find the exterior angle and divided it into 360 and this was frequently seen. A large number of candidates thought they needed to use the sum of the interior angles and so needed to set up an equation in *n*. This is an example of a situation where candidates should look closely at the information given and think about possible strategies and choose an efficient approach. The two methods were generally successful although those using an equation had quite a lot to do for 2 marks. There were a number of candidates who did not attempt this question.

(b) (i) This was a calculation of an angle using two isosceles triangles. Most candidates were successful and the best strategy, frequently seen, was to put the various angles into the diagram and support this by a little working in the answer space.

(ii) This part required candidates to explain why two lines were not parallel and it proved to be much more challenging. There were several possibilities for finding an appropriate pair of angles and the matching parallel line property. The largest challenge was to use mathematical vocabulary and there was also the more general challenge of explaining some mathematics rather than simply applying it.

(c) (i) This required the use of the angle at the centre of a circle and was usually correctly answered.

(ii) This was a more discriminating question, requiring the use of angles in the same segment and an isosceles triangle. There were many correct answers as well as quite a number of omissions.

Answers: **(a)** 72 **(b)(i)** 58 **(c)(i)** 75 **(ii)** 12

Question 5

(a) This part expected to see the use of the $\frac{1}{2}ab\sin C$ formula and this was usually the case and also usually correct. A few candidates found the perpendicular height using $7\sin 40$ and were usually successful, although there is the risk of approximating in the working when splitting a straightforward calculation into two steps.

(b) This was a straightforward cosine rule question to calculate a side and most candidates gained full marks. A small number of candidates did not take the square root at the end of the calculation. A number of candidates gave their final answer as 5, presumably thinking that the answer should be an integer.

Answers: **(a)** 16.9 **(b)** 4.98

Question 6

(a) The sketch of the graph of a function is very important for the whole question and candidates must accept that great care should be applied when typing in the function and when setting up the axes. This function required brackets around the denominator and most candidates did do this and produced excellent sketches. Those without correct sketches can not expect to collect many marks in a question of this type.

(b) The three asymptotes were frequently correctly stated.

(c) The range of a function continues to be a challenging topic and this question proved to be no exception. A small number of candidates gained full marks. The domain was occasionally given as the answer and other attempts included those with inaccurate values, probably from tracing along the curve. This part was also often omitted.

(d) This question required the range of $|\mathrm{f}(x)|$ and only those candidates who had succeeded in part **(c)** had much chance of success here.

(e) (i) The second sketch was usually correct.

(ii) Most candidates correctly gave the *x* co-ordinates of the two points of intersection, clearly recognising that these gave the solutions to the equation.

(iii) This required candidates to use the point of intersection above the *x*-axis and discard the other answer from part **(e)(ii)**. This part was a little less successful than part **(e)(ii)**.

Answers: **(b)** $x = -2, x = 3, y = 0$. **(c)** $f(x) \le -0.64,\ f(x) > 0$ **(d)** $f(x) > 0$
(e)(ii) 0.225, 4.08 **(iii)** 4.08

Question 7

(a) Set notation proved to be a challenge for many candidates and few candidates gave all four symbols correctly. The empty set and union symbols were the most successful whilst the subset and member of symbols were often incorrect or not attempted.

(b) The listing of elements of the four sets was more successful, suggesting that candidates were more able to recognise and use given notation than to be able to produce required notation.

Answers: **(a)(i)** $\in$ **(ii)** $\subset$ **(iii)** ϕ **(iv)** $\cup$ **(b)(i)** $\{t, u, v, w, x\}$ **(ii)** $\{t, w\}$
(iii) $\{l, m\}$ **(iv)** $\{n, t, u, w, y\}$

Question 8

(a) (i) The straight line was usually correctly sketched.

(ii) This second straight line was also usually correctly sketched.

(b) The co-ordinates of the point of intersection of the two lines in part **(a)** were usually correctly stated.

(c) This part required candidates to calculate the area enclosed by the two lines and the line $x = 0$. Many candidates realised that the base of the required triangle was the difference between the *y*-intercepts of the two lines and the height was the *x* co-ordinate of the point of intersection in part **(b)**. This usually led to the correct answer from a straightforward method. A few candidates took the line $x = 0$ to be the *x*-axis.

(d) This question on the equation of a perpendicular line was more discriminating and the stronger candidates were able to show their ability here. These candidates showed a correct gradient and then used the point of intersection from part **(b)**. The challenge of this question appeared to be to be able to correctly use the information from previous parts. A surprisingly frequent error was to write the perpendicular line as $y = -\frac{1}{x} + c$ rather than $y = -x + c$. Another error was to use the *y*-intercept of one of the two given lines and overlook the point of intersection.

Answers: **(b)** (0.75, 1.75) **(c)** 0.375 **(d)** $y = -x + 2.5$

Question 9

(a) The mean from the frequency table of continuous data was usually correctly found and most candidates appeared to use their graphics calculator. The number of candidates carrying out the full calculation appears to be reducing. A few candidates who did not use their graphics calculator revealed the lack of use of mid-values by some using class interval boundaries and some even using class interval widths.

(b) The histogram was generally well answered with most candidates demonstrating knowledge of frequency density. One real challenge of this question was to use the vertical scale correctly since one small square represented 0.05.

Answers: **(a)** 330

Question 10

(a) The quadratic equation was given in the form $c + bx + ax^2 = 0$ and this proved to be challenging. Many candidates correctly used a = – 1, b = – 3 and c = 6 and many others re-arranged the equation into the form $ax^2 + bx + c = 0$. There were some good graphical solutions and these were more helpful for the next part of the question.

(b) The inequality proved to be very challenging, especially for those who had used the formula in part **(a)**. Candidates tended to expect the range to be between the two values found in part **(a)** and this included quite a number of candidates who had used a sketch in part **(a)**. It is worth noting that inequalities are often best solved by using a graphics calculator as candidates have the possibility of a much more visual approach.

Answers: **(a)** – 4.37, 1.37 **(b)** $x \le -4.37$, $x \ge 1.37$

Question 11

(a) This numerical compound function question was usually correctly answered. A few candidates found an answer in terms of *x*.

(b) This part involved the algebra of a compound function and there were many correct answers. The final answer had a factor of 2 and quite a number divided their answer by this factor without leaving it in front of a pair of brackets. Notation can still be a challenge to some, especially those who interpreted g(f(*x*)) to be g(*x*)f(*x*).

(c) The inverse of a linear function was usually correctly answered with the re-arranging of a formula approach being the most successful.

(d) (i) The same comment as for part **(a)** applies here.

(ii) Most candidates successfully found f(f(*x*)) and put it equal to f(*x*) and went on to arrive at the correct answer. The easier approach of simplifying the equation to f(*x*) = *x* was rarely seen.

Answers: **(a)** 19 **(b)** $4x^2 + 14x + 14$ **(c)** $\frac{x-3}{2}$ **(d)(i)** 13 **(ii)** – 3

Question 12

(a) (i) The description of the single transformation was usually correct. A few candidates took this transformation to be a rotation, rather than a reflection.

(ii) The description of the stretch was more challenging with a number of candidates describing the transformation as an enlargement. The other point of note in the case of stretches is that the invariant line must be stated as invariant. “Parallel to” or “in the direction of” do not indicate invariant and such wording is not accepted.

(b) The rotation was usually correctly drawn. A small number of candidates used the origin as the centre of rotation instead of the given (1, – 1).

Answers: **(a)(i)** reflection, $y = -x$ **(ii)** stretch, *y*-axis invariant, factor 3.

Question 13

(a) (i) The expression, in terms of *x*, for the time taken was often correctly stated.

(ii) The “show that” type of question is always found to be challenging and this part was certainly a good discriminator. There were many excellent answers, with each step correct and all the algebraic processes clearly shown. Many candidates omitted this part and many others solved the quadratic equation thinking that this would show it to be true.

(b) The factorising of the quadratic was quite well done, often by candidates who had omitted part **(a)(ii)**.

(c) The use of the positive root from part **(b)** was often correct. There were problems with giving an answer in minutes and a few candidates used the negative root from part **(b)**, conveniently changing it into a positive root.

Answers: **(a)(i)** $\dfrac{10}{x+3}$ **(b)** $(x-12)\,(x+1)$ **(c)** 40

Question 14

(a) (i) Candidates could sketch the translated graph either by using their graphics calculator or by using their knowledge of transformations of functions. There were many good sketches and these helped in the next part. There were also some inaccurate sketches and many candidates overlooked the third branch to the right of $x = 150°$.

(ii) This description of the single transformation was quite well answered. Most candidates used the word translation and many gave a correct column vector. A few gave the displacement as $\begin{pmatrix} -60 \\ 0 \end{pmatrix}$ or as $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$, 2 being the number of squares on the diagram.

(b) The two exact answers were often seen, demonstrating a good knowledge of special values. A number of candidates only gave the obvious answer of 60°, overlooking the other possibility in the given range.

Answers: **(a)(ii)** translation, $\begin{pmatrix} 60 \\ 0 \end{pmatrix}$ **(b)** – 120, 60

INTERNATIONAL MATHEMATICS

Paper 0607/05

Paper 5 (Core)

Key Messages

As the whole of this paper is an investigation candidates should be encouraged to look for links between the questions and parts of questions.

In all answers candidates should be encouraged to give full explanations and show all their ideas and working out.

General Comments

The work on sequences and number patterns was much improved. This now needs to be extended to finding the n^{th} term, particularly for simple quadratic sequences.

The questions and answers are often linked to previous questions and answers throughout the paper; so it would be appropriate to study links between sequences as well as links between the sequences and their practical applications.

Marks are given for the clear and precise communication of mathematics. This is improving and it should be noted that this is not necessarily for 'Explain…' or 'Show that ….' types of questions: It is often for clarity in diagrams or working out shown.

Comments on Specific Questions

Question 1

Almost all candidates were able to answer this question correctly.

Answer: Parallel

Question 2

This question involved the drawing of four diagrams having read the stem and looked at the diagrams at the beginning. It was usually well answered. It was necessary to show understanding of parallel and non-parallel lines crossing. It is important that candidates take enough time to read most carefully the information given in the stem of a question.

Some candidates introduced an extra line when they could not make the four lines cross at the required number of points. Others drew the required number of crossing points but without parallel lines so further crossing points could be made by extending the lines either on the script or off the page.

A number of drawings had arrows on all lines whether parallel or not. It is important that candidates not only understand the definition of parallel lines, as given at the start of the paper, but that they also understand the notation.

Question 3

(a) Many candidates answered parts **(b)** and **(c)** correctly although they found it difficult to explain this in words in part **(a)**. Most made a good attempt and phrases such as 'not parallel to the other four lines' were quite acceptable. Candidates should be encouraged to give as full an explanation as they can when asked to explain in words.

(b) and (c) Very good answers; candidates succeeded in drawing five lines showing 10 crossing points clearly.

Answers: **(a)** cross all lines **(c)** 10

Question 4

Another well answered question. Candidates were obviously used to looking for patterns in number sequences and applied their knowledge to complete the missing numbers of crossing points in the table. Also, some candidates who had not achieved in **Question 3** did go back to **Question 3** to review their answers in the light of their answers to **Question 4**. Candidates should be encouraged to look for links between the questions.

Answer:

Number of lines	1	2	3	4	5	6	7	8	9
Maximum number of crossing points	0	**1**	3	6	**10**	15	**21**	28	**36**

Question 5

(a) Most candidates, who are obviously well trained in looking for patterns in sequences of numbers, were able to answer this question correctly.

(b) Again, candidates' sound knowledge of sequences enabled them to realise that they needed to substitute the value of 8 for n in the formula given in part **(a)**. Candidates need to be aware that the words 'show that' indicate as full a response as possible, i.e. show all the working out.

(c) The correct answer was often seen but not always accompanied by much, if any, working out. Often the working out consisted of substituting 120 for n in the formula despite having the correct answer for **(a)**. Again, candidates should be encouraged to look for links between questions and even part questions. Candidates should also be encouraged to show all attempts of working out even if they are using a 'trial' method. Marks are awarded for communicating mathematics clearly and precisely and sometimes a series of trials may be sufficient for this mark.

Answers: **(a)** number of lines **(c)** 16

Question 6

(a) (i) This part was answered well with most candidates succeeding in drawing a diagram with 11 clearly separate regions.

(ii) This was usually well answered with the most common error being simply a miscounting of the regions.

(b) This part was usually well answered although candidates did not tend to go back at this point if they correctly answered 11 regions for 4 crossing points here but had not answered 11 regions for part **(a) (ii)**.

(c) This was a 'show that' question that needed the candidates to notice a connection between the number of lines and the maximum number of regions in the table in part **(b)**. Few candidates were successful in achieving a correct answer here. This suggests that candidates may need to be trained to look for patterns between the rows in a table as well as between the cells on a row.

(d) (i) Candidates struggled with finding this formula whether they used the given formula in **Question 5** to help them or not. The implication here is that candidates need more practice with simple quadratic sequences and with finding the n^{th} term in both linear and quadratic sequences.

(ii) Without an answer to part **(i)** candidates were unable to successfully complete this part of the question. Candidates knew what to do for part **(ii)** and some substituted 6 into any formula that led to an answer of 22.

Answers: **(a)(ii)** 11
(b)

Number of lines	1	2	3	4	5	6	7
Maximum number of regions	2	4	7	**11**	16	22	**29**

(d)(i) $\frac{1}{2}n^2 + \frac{1}{2}n + 1$

INTERNATIONAL MATHEMATICS

Paper 0607/06

Paper 6 (Extended)

Key Messages

Even when results can be found directly from the calculator candidates should be aware that method and working out often need to be seen to achieve full marks and especially to achieve communication marks.

Candidates should understand that in a modelling task one must relate the mathematics to the context.

Candidates need to be more proficient in graphing using a graphics calculator and know the implications caused by using discrete or continuous data.

General Comments

A good range of performance was seen across both tasks, although the modelling task caused more difficulties for many candidates. The good use of a graphics calculator would help advance modelling.

The difference method is an efficient way of finding formulae for sequences in this course.

Explanations are improving and communication is better, but lack of method shown or working out remains a concern and a reason for the loss of marks.

Comments on Specific Questions

Section A – Investigation (Straight Lines)

Question 1

This question was answered correctly by most candidates.

Answer: Parallel

Question 2

The four diagrams were usually correct. It was good to see rulers being used by most candidates. The arrows were often drawn on all lines, including lines that were not parallel nor were meant to be parallel. Candidates understood the definition of parallel lines as given in **Question 1** but were unsure about the use of the arrows. Some diagrams had to be discounted because, had the lines been continued, they would then have crossed at more points than the question asked for. There were a few answers with too many lines in some diagrams. Candidates should be able to use notation correctly as well as understanding what it means.

Question 3

(a) Most candidates were able to answer part **(b)** correctly but in part **(a)** some could not explain how the fifth line should be drawn. Answers such as 'not parallel to any of the other lines', which implied this fifth line had to cut the other four lines, were acceptable. Some candidates did also point out that it should not cut at previous crossing points, but few were as clearly specific as this. Candidates should be encouraged to explain fully in words at every point of an investigation.

(b) (i) This diagram was drawn well showing a good understanding of the problem.

(ii) This answer was usually correct.

Answers: **(a)** cross all lines **(b)(ii)** 10

Question 4

(a) Most candidates correctly worked out the connection in this sequence of maximum number of crossing points. Some, who had made an error in **Question 3(b)** went back and changed their answer to part **(b)(ii)** and some did not. Candidates should be encouraged to look back at previous questions and answers and look for links between them.

(b) Very few candidates noticed that this pattern was caused by the adding of different combinations of odd and even numbers. Of those that did notice this many did not explain in sufficient detail to show why this pattern occurred. This question tested more abstract reasoning than looking at a pattern and needed more thought than **Question 3**. Candidates should expect to have to think about the question even though the answer or part of the answer appears to be given to them.

Answer: **(a)**

Number of lines	1	2	3	4	5	6	7	8	9
Maximum number of crossing points	0	**1**	3	6	**10**	15	**21**	28	**36**

Question 5

(a) Candidates used a variety of methods to obtain this formula for a simple quadratic sequence. Many stumbled in their working but eventually managed to find the correct formula often by using trial and improvement. More practice on the chosen method, and in particular the difference method, would be helpful to give the candidates confidence to use it without making mistakes and to follow it through to the end.

(b) Most candidates knew what to do and showed their working clearly. Some ignored the statement ‘Use your formula …’ even though they had found a formula in part **(a)**. In a question with this wording the marks are awarded for working that shows evidence of doing what the question asks, i.e. using the formula previously worked out.

(c) Many candidates could not work their formula backwards to find n, although they did manage to obtain the correct answer, often either by extending the table or by trial and improvement. For some it was the problem of working with a quadratic with coefficients of $\frac{1}{2}$ and for others, who were using a format such as $\frac{1}{2}n(n-1)$, the problem was in not seeing the quadratic equation. Practice in recognising and working with such quadratic equations would always be useful for investigations.

(d) A variety of methods could be used here and many candidates were confident in how to approach this but could not go further having equated their formula to 590. Others would have done well to consider the instruction about showing working as in some cases the method used was not apparent. Again candidates need to practice with quadratic equations that result from applications using sequences.

Answers: **(a)** $\frac{1}{2}n^2 - \frac{1}{2}n$ **(c)** 16

Section B – Modelling (A Swing)

Question 1

(a) Plotting points accurately was successfully completed by most candidates. Many candidates might need to be reminded that (0,0) should also be plotted when it is in a set of values in the table.

(b) The majority of candidates managed to pick out the point that represented a length that did not conform to the pattern of the others. It was obvious most candidates were looking for a smooth, continuous relationship between the points.

(c) (i) Most candidates were able to draw a smooth curve joining their plotted points. Unfortunately some drew an extra part to the curve including the point at 2.3 seconds that they had just found as incorrect in part **(b)**. It is possible that this was because they drew in the curve when answering part **(a)** although this part only asked for the plotting of the points. Some candidates were expecting a linear relationship and drew a straight line through their points, which often included the point at 2.3 seconds but did not include (0, 0). It was clear from the context of this task that this graph must pass through (0, 0) and that it could not be a straight line of regression. Candidates should be aware that relationships do not often follow a linear relationship.

(ii) A well answered question and some candidates appeared to go back and improve their answers to the previous parts of **Question 1** when they realised, at this point, what they should have done. Some answers fell outside the range and where the candidate had not drawn a graph they lost more marks. Candidates should be encouraged to look back and check answers on a regular basis throughout this paper.

Answer: **(b)** 2.3 seconds **(c)(ii)** 1.9 to 2.1 seconds

Question 2

(a) Many candidates used their calculators to check these models although some of those who had drawn a straight line in **Question 1** chose the linear relationship here. Many candidates chose the quadratic model which did not fit their graph in **Question 1** and suggests a lack of knowledge of the general shape of curve families. Candidates should be familiar with various general curve equations and their graphs.

(b) (i) A variety of methods could have been used here and many were. Only the best candidates were able to find b using a deductive algebraic argument. Many candidates could not follow through their chosen method, e.g. solving simultaneous equations in b, and switched between methods in an effort to show that $b = \frac{1}{2}$, or jumped to this answer without enough working shown. Many candidates found a value for a first and used this to find b. Those who found the value for a in part **(ii)** needed to show working for this or two substitutions in part **(i)**. Candidates should know a variety of methods for solving simultaneous equations and be able to use an appropriate method for the equations and situation given. To their credit, some candidates who had chosen the wrong model in part **(a)** did go back to part **(a)** and change their answer when they could not get $b = \frac{1}{2}$ in their chosen model in this part.

(ii) This question was answered better than part **(i)** even though the answer was not given. It required a straight forward substitution for T, L and b and the only problem that arose was in the use of the power. Some candidates worked with the equivalent of $(aL)^{\frac{1}{2}}$ and some treated $L^{\frac{1}{2}}$ as $\frac{1}{2}$ of L. Some candidates did not follow the accuracy instruction. These are standard misconceptions that might need more emphasis in the classroom.

(iii) Most candidates did not 'Rewrite your model …', but they did substitute correctly with $L = 250$. Candidates should be in the habit of writing out their model before working on it whether requested to do so or not.

(c) (i)(ii) Most candidates achieved well here because they took note of the stem – 'Use your model …'. Candidates should be encouraged to show working even when using their calculator.

Answers: **(a)** $T = aL^b$ **(b)(ii)** 0.2 **(c)(i)** 400 **(ii)** 2

Question 3

(a) Most sketches were good. Candidates should be encouraged to pay attention to the detail of their graphs on their calculator. Many graphs did not go from (0, 0) and many did not match the shape on the given scales. It was expected that candidates would realise that (0, 0) satisfied the equation even if resolution on the graphics calculator did not show this. Some candidates calculated and plotted points, which is not necessary for a sketch and implied they were attempting this task without a graphics calculator. Candidates should be encouraged to take a sketch from their calculators whilst applying context to that sketch.

(b) (i) Many candidates realised that the length L in metres is equal to $100L$ centimetres but then they did not substitute $L \div 100$ into the original formula. Of those that did do this most forgot about the square root so could not get to 0.5 but only to 0.02.

(ii) From those candidates who had kept going to the end of this paper there were some valid attempts at this comparison. Candidates should know what to look for when comparing models and should realise that a pair of comparable values is not sufficient to compare whole models. With graphics calculators candidates should be able to look at the graphs together.