INTERNATIONAL MATHEMATICS

Paper 0607/01
Paper 1 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus coverage, be able to apply formulae and show all necessary working clearly. All working needs to be shown to enable candidates to access method marks in case their final answer is wrong. This will also help the candidates' checking of their own work. This is vital in two-step problems, in particular with algebra and more complex questions towards the end of the paper.

General comments

The questions that presented least difficulty were **Questions 2**, **3**, **4**, **5(a)**, **6(a)(ii)**, **7(a)** and **(b)**, **9(a)** and both parts of **10(a)**. Those that proved to be the most challenging were **Questions 8**, **9(b), 11(b)(ii)** and **(c)** and **12(b)**. In general, candidates attempted the vast majority of questions rather than leaving them blank. The questions that received the most number of blank responses were all parts of **Question 8** on graphs of functions which many candidates find a demanding topic. There were also questions where candidates had some freedom to choose their answers to show they understood the concepts being tested but this freedom can unsettle less confident candidates.

Comments on specific questions

Question 1

Many candidates did well with this opening question. Wong answers often seen to **part (a)** included 8580, 8600, 857.2 and 72. Similarly, wrong answers to **part (b)** included 8570, 572, 85.7.

Answers: **(a)** 8570 **(b)** 8600

Question 2

Nearly all candidates got this question correct.

Answer: Subtraction sign

Question 3

Like the previous question, this was done well with most candidates getting at least one mark for correctly working out two of the values.

Answer: 5^2, 3^3, 2^5 in order

Question 4

This was very well done with most drawing the correct line of symmetry. Candidates should be reminded that they should use a pencil and ruler for this type of question to be certain of their accuracy.

Question 5

Occasionally in **part (a)**, candidates only found a quarter of the given value. Even if **(b)(i)** was wrong, **(b)(ii)** was often correct which seems to indicate that not all candidates treated the two parts as connected. Some thought that **part (b)(ii)** was the percentage equivalent to the fraction in **part (b)(i)** so the common wrong answer of $\frac{1}{3}$ was sometimes followed by 33.3%. With this type of question it is worthwhile candidates underlining Stefan and fraction in **part (b)(i)** and Tomas and percentage in part **(b)(ii)** so they answer with the right information in the correct form.

Answers: **(a)** 90 **(b)(i)** $\frac{1}{4}$ **(ii)** 75%

Question 6

Candidates were better at finding the modal score than the range. Some candidates confused the range with the mode or median and the mode with the mean. Candidates need to remember that the range is a single value not a statement such as, 66 to 72 or the expression, 72 – 66. For the mode, some candidates gave all the scores that occurred more than once. Candidates did less well finding the mean shoe size. The most common error was to add the four different shoes sizes and divide by four giving an answer of 4.5 instead of realising the information in the table was another way of expressing the data from a list such as that used in **part (a)**.

Answers: **(a)(i)** 6 **(ii)** 71 **(b)** 4.1

Question 7

Many candidates answered **parts (a)** and **(b)** correctly but some only got one part correct. There were a few candidates who gave different angles than the ones specified in the questions showing that they were not confident with the topic, notation used in the question or that they need to take more care to identify the correct angle. Sector was the most common wrong answer to **part (c)** closely followed by circumference.

Answers: **(a)** 90° **(b)** 90° **(c)** Chord

Question 8

As previously stated, this question was the one that candidates were most likely to omit, with **part (a),** about asymptotes, the one that was missed out by over a quarter of all the candidates. The order of answers did not matter and the equivalent answers of the axes' names were also accepted. Many answered with co-ordinates, often involving +4 and –4, with and without brackets, or $y = x$ and $y = -x$, the equations of the lines of symmetry of the graph. The most common wrong answer for the domain was zero and for the range, 1. An interval was required for both answers, not discrete values. The sketch in **part (c)** was done better than in previous sessions but the most common incorrect answer was a sketch of $y = f(x - 1)$. Those that tired to translate $f(x)$ correctly moved the line up by one unit at the y-axis but did not use the whole of the correct domain.

Answers: (**a)** $x = 0, y = 0$ **(b)(i)** $-2 \le x \le 1$ **(ii)** $0 \le f(x) \le 2$

Question 9

Candidates were more successful with the probability in **part (a)** than the expected frequency required in **part (b)**. It was perfectly acceptable for the probability in **part (a)** to be given as a decimal or percentage as a particular form was not asked for here. It is sensible to only use a decimal or percentage if the answer is an exact value; otherwise it is best to give the answer as a fraction or in the form that any probability is given in the question. A few gave the expectation of a pencil being chosen instead of a pen. Some seemed to change the question in **part (b)** as they answered with the probability of choosing a pen a second time with or without replacement of a pen chosen the first time.

Answers: **(a)** $\frac{12}{15}$ **(b)** 20

Question 10

Both parts of **(a)** were done very well with many candidates gaining all the available marks. **Part (b)** was less well done. This part was unusual with candidates having a free choice of the values they gave as answers as long as they fulfilled the condition in the question. Many candidates got to $a < 2.75$, but this was not enough to gain any marks.

Answers: **(a)** 7 **(b)** 3 **(c)** Any two integers less than or equal to 2

Question 11

Candidates were reasonably successful with finding the midpoint in **part (a)** but found **part (b)**, the gradient of *AB* and then the equation of *AB*, more difficult. This is a topic area that candidates find challenging with many not knowing, in particular, what form the equation of a line should take. Some substituted for the gradient in the general equation of a straight line but not for the constant. Some did not realise they had to calculate the constant and instead used a value chosen from the given co-ordinates. Like in the previous question, **part (c)** gave the candidates a chance to pick any value for the constant term to substitute in the equation of the line to show they understood about parallel lines. Some changed the value of the gradient, another signal that they did not understand the connection between parallel lines and their equations. This was a difficult concept for many and this was one of the parts on the paper most likely to be omitted by candidates.

Answers: **(a)** (3, 2) **(b)(i)** 3 **(ii)** $y = 3x - 7$ **(c)** $y = 3x + c$, where c is not equal to the constant in **(b)(ii)**

Question 12

A common error was to go too far and try to write down the value of the angle, $\tan^{-1}\left(\frac{12}{9}\right)$, rather than answer the actual question. With questions that are only one mark, the answer must be completely correct for the mark to be awarded. It could be seen that some candidates had mixed up the trigonometric ratios or picked the wrong one and some chose the wrong angle to use. These ratios must be learnt in conjunction with a diagram that candidates can adapt to any triangle used in the paper. Only a small number omitted these two parts.

Answers: **(a)** $\frac{12}{9}$ **(b)** $\frac{12}{15}$

INTERNATIONAL MATHEMATICS

Paper 0607/02

Paper 2 (Extended)

Key message

Candidates need to 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 need to know the key values of trigonometric ratios as set out in the syllabus.

General comments

Candidates were reasonably well prepared for the paper and demonstrated very good algebraic skills. However, many candidates did not know the exact value of cos 30°. Many candidates lost marks through careless numerical slips, particularly with negative numbers and simple arithmetic operations. Candidates should set out their working clearly and not merely write a collection of numbers scattered over the page. This is particularly true when solving geometric problems. Candidates should remember to leave their answers in their simplest form, as specified on the front of the examination paper.

Comments on specific questions

Question 1

Although many candidates scored full marks there was a significant minority who added the two given equations. Some candidates tried solving these equations by substitution and although some were successful the majority of these candidates lost marks by numerical slips.

It is important that candidates realise that there is more than one approach to solving simultaneous equations and choosing the most appropriate method, depending on the question, they will be rewarded in terms of both marks and time.

Answers: $x = 3$, $y = -1$

Question 2

(a) Candidates showed a good understanding of Venn diagrams with many scoring full marks. However, a significant number of candidates correctly found the value of the intersection of the two sets and thought that this was the required answer.

(b) This part proved to be a good discriminator. The common mistake on the first diagram was to omit the region outside of the two circles. On the second diagram, candidates excluded the region defined by the intersection of the two sets.

Answer: **(a)** 4

Question 3

There were many fully correct answers to this question. The common mistake was to find 20% of 15 and subtract this answer from $15.

Answer: $12.50

Question 4

Although there were many correct answers, a significant number of candidates thought that opposite angles of a parallelogram add up to 180°. Many candidates did not make their working clear and as such could only be awarded three marks or zero.

There were some excellent solutions where the candidate clearly explained the angles that they were finding before arriving at a final answer.

Answer: 44°

Question 5

(a) Candidates should always leave their answers in their simplest form. The majority of candidates gave the correct answer, but a significant number left their answer as $3\sqrt{8}$.

(b) This part discriminated well between candidates. Although there were many correct answers, a number of candidates multiplied throughout by $\sqrt{2}$ or by $\sqrt{2}-1$.

A number of candidates who correctly eliminated the surd in the denominator to find an expression of $4+3\sqrt{2}$, then did not write down the values of p and *q.*

Answers: **(a)** $6\sqrt{2}$ **(b)** 4, 3

Question 6

(a) This part was answered better than part **(b)**. Candidates were able to demonstrate their algebraic skills and many fully correct answers were seen.

(b) This question proved to be too demanding for all but the best of candidates. The two common incorrect answers were $3p^3$ and $9p^9$.

Answers: **(a)** $6y^5$ **(b)** $3p^9$

Question 7

(a) This part of the question was well answered.

(b) Candidates must use the correct mathematical terminology if they are to score full marks. The transformation is a translation. Candidates should give the numerical value as a column vector.

Answers: **(a)** 4, 90 **(b)** Translation, $\begin{pmatrix} 0 \\ -4 \end{pmatrix}$

Question 8

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

(b) It was pleasing to see many fully correct answers to this part of the question. There were a number of different approaches that led to the correct answer.

Answers: **(a)** 2 **(b)** $\frac{9}{16}$

Question 9

This question was a challenge to the candidates. Fully correct answers were rarely seen.

Many candidates thought that the length of the diagonal of the base was 1 unit and hence gave an angle of 45°. Some candidates who started the question correctly and found a value of tan x, subsequently spoiled their answer by giving an incorrect exact value for *x.*

Answer: $\frac{1}{\sqrt{2}}$ or $\frac{\sqrt{2}}{2}$

Question 10

Candidates who knew the exact value of cos 30° normally scored full marks; however, these candidates were in the minority.

Answer: $6\sqrt{3}$

Question 11

(a) Although many candidates gave the correct answer, there were an equal number who gave the correct magnitude of the vector with an incorrect sign.

(b) Many candidates were able to score this mark as it was a follow through from their previous answer.

Answers: **(a)** $-\frac{2}{3}\mathbf{q}$ **(b)** $\frac{1}{2}\mathbf{p}-\frac{2}{3}\mathbf{q}$

Question 12

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

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

(c) This part proved to be challenging with candidates giving their answer as any of $12+x$, $x-12$ or $\frac{1}{12-x}$, as well as the correct answer.

Answers: **(a)** 11 **(b)** $35 - 3x$ **(c)** $12 - x$

INTERNATIONAL MATHEMATICS

Paper 0607/03

Paper 3 (Core)

Key Message

It is important that candidates show relevant working throughout the paper as they have a responsibility to communicate their methods.

The paper is set on the whole syllabus and full coverage is therefore required.

General comments

The overall standard of work was good. There were some excellent high scoring scripts in which full and accurate working was seen. There is still a number of candidates who need to realise that they could gain more marks by showing their working. Writing answers alone is a risky strategy and there are occasions where correct answers without working may not be awarded full marks. Candidates also need to be aware of the accuracy required in the answers and the implications this has for the working. When an answer is to 3 significant figures, candidates must work with at least 4 significant figures or hold values in their calculators.

The use of the graphics calculator continues to improve. Some candidates need to be aware of the syllabus requirements in this area, most particularly in the interpretation of graphs and in statistics.

All candidates finished the paper and almost all the candidates were able to attempt all or most of the questions.

Comments on specific questions

Question 1

(a) Almost all candidates completed the bar chart correctly.

(b) The majority of candidates were able to choose and simplify the correct ratio. A few gave the unsimplified ratio and a few had decimals in their answer.

(c) (i) The correct probability was given by most candidates and it was not necessary to reduce the fraction. A few candidates used the total number of items as the denominator instead of the number of candidates.

(ii) The correct probability was given by most candidates and it was not necessary to reduce the fraction even with an answer of 1. As in part **(i)**, a few candidates used the total number of items as the denominator instead of the number of candidates.

Answers: **(b)** 10 : 7 : 3 **(c)(i)** $\frac{35}{50}$ **(ii)** $\frac{50}{50}$

Question 2

(a) Almost all candidates were able to successfully complete this ratio question, which required the use of ratio to calculate an amount of money. This amount of money was given in this "show that" question.

(b) This part required candidates to use a ratio to calculate an amount of money. This was very successfully answered.

(c) The difference between the answers to parts **(a)** and **(b)** was usually correctly found.

(d) Calculating a value as a percentage of another value was well answered.

Answers: **(b)** \$504 **(c)** \$28 **(d)** 2%

Question 3

(a) Almost all candidates were able to complete the probability tree correctly. A few candidates need to learn that each pair of probabilities on the branches must have a sum of 1.

(b) The calculation of the probability of two combined events was more challenging. Many candidates were successful in multiplying the two appropriate fractions. A number of candidates need to understand that the probabilities must be multiplied, not added.

(c) This part proved to be more discriminating than part **(b)** since two products needed to be added. There were some good answers with full and clear working. A number of candidates need to be more aware of when to multiply and when to add as there was some rather confused working seen in several scripts.

Answers: **(b)** 0.06 **(c)** 0.62

Question 4

(a) The midpoint of an interval was correctly found by most candidates.

(b) The calculation of the mean proved to be more challenging. The question expected the use of the graphics calculator. A large number of candidates need to understand that products of midpoints and frequencies are to be added and then divided by the number of values (in this case the number of candidates i.e. 60). A few candidates added up the frequencies and divided by 6. Others used the interval widths instead of the midpoints. There were also those who did not use the graphics calculator and had to do a lot of working for only 2 marks. Several candidates gave a 2 significant figure answer and several gave the answer of 65.6 instead of 65.7.

(c) There was more success in finding the two values to complete the cumulative frequency table.

(d) The completion of the cumulative frequency curve was generally well done, with accurate plotting of four points and a smooth curve going through these points. A large number of candidates earned full marks while a few made a plotting error or drew a curve which did not pass through the plotted points.

(e) The reading of the median from the graph proved to be more searching and more mis-reads of the scale were seen in this part. A number of candidates understood that the median was the middle value but gave the mid-value of the cumulative frequency rather than reading from this value.

(f) The inter-quartile range proved to be more challenging than the median and similar errors to those described in part **(e)** were repeated. This part was also omitted by quite a number of candidates, indicating a need to be more practised in using a cumulative frequency graph rather than just being able to draw one. About one third of those with a correct cumulative frequency graph were successful in this part.

Answers: **(a)** 10 **(b)** 65.7 **(c)** 23 and 44 **(e)** 65 to 69 **(f)** 31 to 35

Question 5

(a) (i) This part required the area of a square base of a cuboid and only about half the candidates were successful. The height of the cuboid was given together with a diagram. A large number of candidates multiplied the length of the base by the height. The cuboid was a box and candidates need to be able to deal with this type of context and interpret the information carefully. It appeared that since two values were stated in the stem of the question, these two numbers had to be multiplied.

(ii) Many more candidates found the volume of the box correctly, largely through re-starting the question and not multiplying their answer to part **(a)** by the height.

(b) (i) The area of the circle was generally well answered. Candidates should use the calculator value of π and be aware that any numerical approximation, especially 3.14, will probably give an answer outside the accepted accuracy.

(ii) The division into 360° to find the sector angle was also well answered.

(iii) The area of the sector proved to be more challenging but many candidates answered this correctly. Some divided their part **(i)** by 16 and some multiplied their part **(i)** by $\frac{22.5}{360}$.

(c) This part tested the ability to deal with lengths of similar figures and was well answered by about half of the candidates. The context of the box probably made the question more challenging and a number of candidates did omit this part of the question. Others used areas or volumes rather than simply the ratios of the lengths and heights.

Answers: **(a)(i)** 900 cm^2 **(ii)** 4500 cm^3 **(b)(i)** 707 cm^2 **(ii)** 22.5° **(iii)** 44.2 cm^2 **(c)** 24 cm

Question 6

(a) (i) Almost all candidates were able to give the time 20 minutes later than 07 45.

(ii) This part required the calculation of a speed in kilometres per hour from a distance in kilometres and a time in minutes. This was successfully answered by many candidates. Others needed to be more aware of dealing with the change from 20 minutes into hours and to maintain accuracy. Those who divided by 0.3 or 0.33 earned a method mark, if they showed their working, but their answer was not the required exact answer. A good number of candidates realised that if the distance in 20 minutes was 3 kilometres and 20 minutes goes into 1 hour exactly 3 times then the speed must be 3 x 3 = 9 km/h.

(b) Almost all candidates were aware that distance had to be divided by speed to find the time and 1 divided by 4 was usually seen as 0.25. Many candidates then added 15 minutes to 07 45 to give the correct answer. A number of candidates added 25 minutes to give 08 10 as their answer and a few other candidates gave their answer as 15 minutes or 0.25 hours and not the time of the day.

(c) The stronger candidates successfully changed the time into hours and multiplied by the speed to find the correct distance in kilometres. Others repeated the problems with minutes and hours and 25 minutes was often seen as 0.25 hours. Candidates should also be able to realise if their answer fits the context of the question and not leave answers such as 750 km as the distance from home to school.

(d) Almost all candidates were able to determine which of the times of the day was the earliest.

Answers: **(a)(i)** 08 05 **(ii)** 9 km/h **(b)** 08 00 **(c)** 12.5 km **(d)** Ana

Question 7

(a) (i) Almost all candidates correctly stated that the transformation was a reflection and most gave the correct mirror line. A few gave $y = 7$, rather than the correct answer of $x = 7$, and a few gave co-ordinates of a point.

(ii) As in part **(i)** almost all candidates stated the correct name of the transformation, i.e. translation, and many gave the correct vector. Quite a number of candidates either gave an incorrect sign or mixed up the x and the y. A few did not give their answer as a vector.

(b) Many candidates drew the correct reflection in the y-axis. A few reflected in either the x-axis or in another vertical line. A small number translated the object shape instead of reflecting it.

Answers: **(a)(i)** reflection, $x = 7$ **(ii)** translation, $\begin{pmatrix} -8 \\ -6 \end{pmatrix}$

Question 8

(a) The next two terms of this linear sequence were found by almost all candidates.

(b) As to be expected, the nth term proved to be much more discriminating and candidates needed to connect the difference between the terms as being the coefficient of n. A common answer was $n - 3$ because the common difference was –3. Quite a number of candidates did not attempt this part.

Answers: **(a)** 16, 13 **(b)** $31 - 3n$

Question 9

(a) Many candidates gave the correct name of the polygon. Candidates are expected to have a good knowledge of the vocabulary in the syllabus.

(b) The sum of the angles of the pentagon was usually correctly answered, often with candidates knowing this result. Others showed the working leading to the correct answer.

(c) Four angles of the pentagon were given and most candidates succeeded in calculating the fifth angle.

Answers: **(a)** Pentagon **(b)** 540° **(c)** 105°

Question 10

(a) The six factors of 12 were correctly stated by most candidates

(b) The Venn diagram was successfully completed by the majority of candidates. A few placed an element in more than one subset and a few carelessly missed an element from the universal set.

(c) (i) Almost all candidates recognised the part which was the intersection between A and B and many gave the correct number of elements. Candidates do need to understand the difference between the number of elements and a list of the elements as many gave the actual three elements.

(ii) The same comment as part **(i)** applies here. There was the added challenge of recognising the intersection between a set and the compliment of a set as the success rate in this part was lower than in part **(i)**.

(iii) The compliment of the union of the two sets was found to be more easily identified but again the problem described in part **(i)** also applies here.

Answers: **(a)** {1, 2, 3, 4, 6, 12} **(c)(i)** 3 **(ii)** 1 **(iii)** 5

Question 11

(a) Almost all candidates recognised that this was a Pythagoras calculation and many were completely successful. Some candidates needed to be more familiar in recognising which side is the hypotenuse as they treated the unknown side as this longest side, overlooking the position of the right angle from the given information about tangents.

(b) Candidates demonstrated the need to be more practised in right-angled triangle trigonometry and to identify which ratio to use. There was the added challenge of finding an angle and then multiplying it for the final answer. There were some very good answers and some partially correct answers which gained some marks as working was seen. Quite a large number of candidates did not attempt this question.

(c) The length of an arc proved to be one of the most discriminating parts of the whole examination and only a small number of candidates were fully successful. A large number of candidates omitted this part and many others calculated a chord length using trigonometry.

Answers: **(a)** 54.5 cm **(b)** 131° **(c)** 57.0

Question 12

(a) About half of the candidates gave a good sketch of the given parabola. There did seem to be an improvement in curve sketching with many of the candidates drawing the curve in good proportion to the axes given. Without the basic skills of curve sketching, this type of question results in a serious loss of marks. It must be emphasised that the equations must be typed in very carefully and the "window" is available from the values on the axes. Candidates with good sketches usually went on to earn good marks in the rest of this question.

(b) Many candidates with a correct sketch gave the two correct zeros. A few candidates needed to recognise that these zeros were where the graph crossed the x-axis and not the y-axis.

(c) The maximum point was recognised by candidates who had a sketch with a maximum. Some of these candidates needed to give an answer to the required accuracy and this is not found by tracing along the curve. Candidates are also expected to recognise when an answer is exact even when the calculator may give a value which is not quite exact, such as –1.499999 in this case.

(d) There was a greater success in sketching a straight line.

(e) This part required the two graphs to be on the calculator so that the points of intersection could be found. Again, candidates must understand that accuracy must be to at least 3 significant figures unless exact or otherwise stated. There were some accurate answers given and there were others that were either inaccurate or to only 2 significant figures.

Answers: **(a)** –1.5, 4 **(c)** (1.25, 15.125) **(e)** –1.27, 2.77

Question 13

(a) (i) This expansion of brackets and collection of like terms was correctly answered by the majority of candidates, demonstrating good skills in basic algebra.

(ii) There was a high success rate in this indices question, again indicating good basic skills in algebra.

(iii) Many candidates also demonstrated good ability in this division of indices question although the success rate was a little less than in the multiplication question. Candidates need to know all the rules of indices and so understand that $r^6 \div r^3$ is not r^2.

(iv) The squaring of $6t^4$ proved to be more challenging. About half of the candidates succeeded. Many others were correct with one part and answers $6t^8$ and $36t^6$ were quite common. This part proved to be the most discriminating in question 13.

(b) Most candidates demonstrated the ability to extract common factors and there were many fully correct answers with all three common factors outside the pair of brackets. Many candidates gave a correct partially factorised answer and earned some credit for this. Only a small number of candidates demonstrated the need to understand the concept of factorising.

(c) This transformation of formula question was well answered by many candidates. A re-arrangement of terms and a division was required and this was understood by the majority of candidates. A small number of candidates demonstrated the need for more practice in this topic and to realise that the rules applied in solving equations are the same as those needed here.

Answers: **(a)(i)** $4x + 3$ **(ii)** $15p^7$ **(iii)** $\frac{3}{2}r^3$ **(iv)** $36t^8$ **(b)** $6pq(2p + 3)$ **(c)** $\frac{r - 2pm}{n}$

INTERNATIONAL MATHEMATICS

Paper 0607/04

Paper 4 (Extended)

Key message

Candidates must show all relevant working to gain full marks on this paper.
The paper covers the whole syllabus and so full coverage is needed.
Candidates should be fully experienced in using a graphics calculator.

General comments

The overall standard was good with most candidates showing good mathematical communication. The use of the graphics calculator was generally good as almost all candidates were able to produce good sketches and were then able to proceed with further part questions. Candidates had adequate time to complete the paper and almost all candidates were able to attempt all or most of the questions. Questions meeting with success were on percentages, average speed, transformations, trigonometry, Pythagoras, simple mensuration, statistics, curve sketching and some applications, co-ordinates and straight line equations, sequences and probability. Challenging questions included bearings, map scale with area, harder mensuration, domain and range, algebraic re-arranging, showing a geometrical result, similar areas, logarithms and constructing and re-arranging an algebraic formula.

Comments on specific questions

Question 1

(a) (i) This decreasing year by year percentage question was generally well done with many candidates using the efficient method of multiplying by 0.92^5. Some candidates calculated the values for each year but were usually equally successful. A few candidates increased by 8 % each year or divided by 1.08^5 and a small number of candidates demonstrated the need to know when to use a "compound interest" calculation as opposed to a "simple interest" one.

(ii) This part requiring the number of steps to reach a value was quite well done. Many candidates used a trial and improvement approach although stronger candidates did use logarithms. A graphics calculator approach was rarely seen. The question asked "how many **more** years" and candidates need to read instructions and questions carefully and not overlook the word "**more**".

(b) (i) The division of distance by time was applied by most candidates. There was the need for the 15 minutes to be converted into hours and this proved to be an extra challenge to some candidates. A few candidates gave an answer to 2 significant figures but were able to earn the method mark if relevant working was seen.

(ii) The rate of using fuel was often correctly answered. Again, a number of candidates gave a 2 significant figure answer and candidates need to apply the 3 significant figure or exact rule unless a question indicates otherwise.

Answers: **(a)(i)** \$5272.65 **(ii)** 4 **(b)(i)** 72.3 km/h **(ii)** 8.38 *l* / 100 km.

Question 2

(a) (i) Almost all candidates drew a correct reflection. A few drew this in the *y*-axis instead of the *x*-axis.

(ii) Almost all candidates drew a correct rotation using the answer to part **(a)** as the object. A few candidates used the original object.

(iii) Most candidates were able to describe the transformation, especially those who had earned good scores in **(i)** and **(ii)**.

(b) Almost all candidates recognised this image as an enlargement. The centre of enlargement and the scale factor proved to be challenging. In the case of the scale factor -2 was often seen instead of $\frac{1}{2}$.

Answers: **(a)(iii)** reflection, $y = -x$ **(b)** enlargement, centre (0, 2), scale factor $\frac{1}{2}$

Question 3

(a) Most candidates applied the cosine rule for an angle correctly. A few calculated one of the other angles in the triangle and a few of these candidates went on to calculate the correct angle using the sine rule.

The challenging part of this question was to subtract the angle found from 179° in what was intended to be a straightforward bearing question. Many candidates revealed a need for more understanding and practice with bearings.

(b) This question required candidates to calculate an area on a map with a given scale. Most candidates used the correct formula for the area, using two sides and the included angle. Only a few candidates were able to deal with the scale. Many tried to use the 10 000 000 or its square rather than converting the scale into 1 cm represented 100 km and then write the two sides in centimetres before calculating the area.

Answers: **(a)** 147° **(b)** 4.52 cm^2

Question 4

(a) (i) This Pythagoras calculation, with hypotenuse given, was carried out correctly by the majority of candidates.

(ii) The volume of the cone was almost always calculated correctly. Candidates should use the value of π provided in their calculator. Other more approximate values of π will not necessarily give answers in a required range.

(b) (i) The opening out of the curved surface of the cone into a sector of a circle proved to be one of the paper's more discriminating questions, even though the area was given and had to be "shown".

The stronger candidates did realise that the area of the sector was simply the area of the curved surface of the cone. Some candidates used the given area to find the sector angle and then used this angle to find the area of the sector. A number of candidates omitted this part indicating a need for more practice with this type of context question.

(ii) The angle of the sector met with more success since candidates could use the area given in part **(i)**.

Answers: **(a)(i)** 7.21 cm **(ii)** 653 cm^3 **(b)(ii)** 185°

Question 5

(a) (i) The median from the given cumulative frequency graph was usually correctly stated.

(ii) The lower quartile from the given cumulative frequency graph was usually correctly stated.

(iii) The inter-quartile range from the given cumulative frequency graph was usually correctly calculated.

(iv) The 90th percentile from the given cumulative frequency graph was usually correctly stated.

(v) The required reading of a cumulative frequency was almost always correct.

(b) (i) Most candidates were able to complete the frequency table from the cumulative frequency graph.

(ii) The calculation of the mean from the grouped frequency table was generally well done. A number of candidates did not use the statistics facility on the graphics calculator and had a lot of work to do for 2 marks. A few candidates need to be more familiar with using mid-values multiplied by their corresponding frequencies.

(iii) The frequency densities were generally well done, suggesting an improvement in a reasonably challenging topic.

Answers: **(a)(i)** 20 **(ii)** 16 **(iii)** 9 **(iv)** 29 **(v)** 180 **(b) (i)** 60, 50 **(ii)** 20.125 **(iii)** 2.67, 12, 5

Question 6

(a) Very good sketches were produced by most candidates. This topic continues to improve as candidates are becoming aware of the marks available from a good sketch.

(b) The value of f(0) was usually correct.

(c) The one answer to f(x) = 0 was also usually correct.

(d) The candidates are now very strong at recognising vertical asymptotes and almost all candidates recognised this one. The horizontal asymptotes continue to be more challenging and candidates do need some more practice with the graphics calculators to locate such lines. Increasing the domain on the calculator is a useful approach if the horizontal asymptotes are not obvious with the given domain.

(e) This question asked for the range for a given domain and this was a more discriminating part. Candidates need to consider end values, turning points and asymptotes to be able to find such ranges and many candidates found this to be very challenging. A few gave fully correct answers and many were partially correct.

(f) (i) The sketch of the straight line was correct for most candidates.

(ii) The two solutions of f(x) = g(x) were often correct and to the necessary accuracy. Some candidates appeared to trace to the points of intersection and did not give sufficiently accurate answers and some probably had accurate values but chose to write them down to 2 significant figures.

(iii) The re-arrangement of f(x) = g(x) into a quadratic equation proved to be quite searching with candidates omitting certain stages of the process. As the answer was provided, all steps had to be seen for full marks.

(iv) This part was to test candidates' ability to recognise the exact value of a discriminant and there were many correct answers to this different type of question. Some candidates did not connect the question with the discriminant and either attempted to use their answers to part **(ii)**, which did not usually lead to the exact value, or did not attempt this part.

Answers: **(b)** – 1.5 **(c)** 1.5 **(d)** $x = -2$, $y = 2$ **(e)** $-1.5 \le f(x) \le 1.3$ **(f)(ii)** – 3.54, 2.54 **(iv)** 37

Question 7

(a) Most candidates correctly calculated the length of the line joining two points with the co-ordinates given.

(b) Many candidates also correctly found the equation of the line through the same two points. A few candidates were less familiar with finding the gradient and then finding the constant term, using $y = mx + c$.

(c) (i) This request for the equation of the perpendicular line was often correctly answered. A few candidates appeared to lack the knowledge about perpendicular gradients and a few others had a constant term not equal to zero, although the line was through the origin.

(ii) The co-ordinates of the point of intersection was answered successfully by candidates who had the correct equations in parts **(b)** and **(c)(i)**.

Answers: **(a)** 5.66 **(b)** $x + y = 7$ **(c)(i)** $y = x$ **(ii)** (3.5, 3.5)

Question 8

(a) The *n*th term of this decreasing linear sequence was often correctly found, with the majority of candidates connecting the difference of – 4 to be the coefficient of n. A few candidates gave the answer $n – 4$.

(b) This part required the *n*th term of an exponential sequence and this was also quite well answered. A few candidates gave a power of 2 in terms of n which gave a term just before or just after the *n*th term, earning partial credit.

(c) This question simply required candidates to recognise the numerator of n^2 and the denominator of $n + 3$. Many candidates gave the correct answer, almost intuitively while some candidates, who were perhaps more familiar with the standard linear and exponential sequences, found this question more challenging. A number omitted the question and a number worked out the differences.

(d) This cubic sequence saw mixed responses, ranging from answers written down without working to answers obtained by using differences and four equations. Some candidates spotted the *n*th term without the need to set down any working and some good solutions were seen when candidates compared the given sequence with n^3 and noticed that the difference was in fact n.

Answers: **(a)** $25 – 4n$ **(b)** $3 \times 2^{n-1}$ **(c)** $\frac{n^2}{n+3}$ **(d)** $n^3 – n$

Question 9

(a) Almost all candidates completed the probability tree correctly.

(b) This probability required the sum of two products and many candidates were successful. A few candidates found only one product and a small number of candidates displayed the need to have a greater understanding of when to add and when to multiply probabilities.

(c) This question required candidates to describe the combined event which had a given probability and the majority of candidates gave the correct answer to this rather unusual question.

Answers: **(b)** $\frac{48}{60}$ **(c)** Fine weather but Alex does not go to the beach.

Question 10

(a) This circle geometry question was a "show that" type with the numerical answer given. Candidates need to be aware that such questions require detailed working and reasons. In this case a circle property and an angle sum of a triangle were required. Many candidates scored part marks in this question, angles in the same segment reason often being omitted from answers.

(b) (i) Almost all candidates gave the correct worded answer.

(ii) Most candidates were able to apply the ratios of sides of similar triangles and reach the correct answer.

(iii) The ratio of areas was answered correctly by many candidates. There were candidates who realised that all that was required was the squaring of a ratio used in part **(ii)**. Many candidates found the two areas and then divided them. A number of candidates overlooked the instruction for a 2 decimal place answer.

Answers: **(a)** $x + 3x + 6x = 180$, $x = 18$, angles in the same segment **(b)(i)** similar **(ii)** 3.00 **(iii)** 0.86

Question 11

(a) Almost all candidates sketched the correct shape of $y = 2\log_a x$. The candidate's graph needed to cut the x-axis at the same point as the given graph of $y = \log_a x$ and most candidates overlooked this property. A small number of candidates did not appear to be aware that the y-axis is an asymptote.

(b) This equation involving logarithms was a very discriminating question and many candidates needed more understanding of how to apply the laws of logarithms. There was a mark available for any law correctly applied and many candidates were awarded this mark. Only a few candidates were able to reach the final answer successfully. Full marks were only awarded if some correct working was seen.

(c) Similar comments to those for part **(b)** also apply to this exponential equation. This question could also have been successfully done using the graphics calculator and a sketch would have sufficed for the working. As in part **(b)** full marks required some working and an answer correct to 4 significant figures.

Answers: **(b)** 1.74 **(c)** 2.861

Question 12

(a) This question asked for a formula for the total area of a rectangle and a semi-circle and a diagram was provided. This was more challenging than anticipated suggesting that many candidates, with very good manipulative skills were less practised in building up formulae or expressions from a context situation. There were many correct answers. A surprising number of candidates gave $5x \times 2x$ as $10x$ and this made part **(b)** almost impossible, as one term was $10x$ and the other term included x^2.

(b) This part required the re-arrangement of the formula in part **(a)** and the marks were awarded for x^2 to be taken out as a factor from 2 terms, a division by a pair of brackets containing two terms and then a square root of an expression not containing an x. It is clear that success depended on good answers to part **(a)** with both areas containing an x^2. The stronger candidates succeeded and showed very good algebraic skills. Many candidates only earned the mark for taking a square root and many other candidates either gained no marks or omitted this part.

(c) This one mark answer was a correct answer only as it was decided not to follow through poor expressions in parts **(a)** and **(b)** but to make it a reward for correct expressions.

Answers: **(a)** $A = 10x^2 + \frac{1}{2}\pi x^2$ **(b)** $x = \sqrt{\frac{2A}{20+\pi}}$ **(c)** 4.16

Question 13

(a) (i) This question was to factorise a quadratic expression where the coefficient of x^2 was not 1. Many candidates answered this correctly. There were candidates who gave answers containing fractions and these were not accepted and there were answers with sign errors.

(ii) This part required the addition of two algebraic fractions and the denominator of one fraction was the quadratic expression in part **(i)**. The denominator of the other fraction was a factor of the quadratic expression in part **(i)**. The stronger candidates realised this and showed very good working and arrived at the simplest fraction correctly. Many of the candidates who had a correct answer to part **(i)** did not connect it with the factors in part **(i)** and ended up with a correct single fraction but not in its simplest form. Candidates need to be aware that when a question is labelled in parts in this way, there is likely to be a connection to be used. A small number of candidates demonstrated the need for much more understanding and practice of this type of algebraic skill.

(b) This part required the factorising of a numerator and a denominator of an algebraic fraction and then reducing it to its lowest terms. There were many correct answers from candidates able to factorise a difference of two squares and to factorise by grouping. As in part **(a)** there were candidates demonstrating the need for more practice in factorising. A large number of candidates earned part marks for factorising one part of the fraction correctly.

Answers: **(a)(i)** $(2x+1)(x-1)$ **(ii)** $\dfrac{8x+5}{(2x+1)(x-1)}$ **(b)** $\dfrac{p-5q}{1-t}$

INTERNATIONAL MATHEMATICS

Paper 0607/05

Paper 5 (Core)

Key Messages

Candidates need to remember that this paper should be seen as a single investigation. This means that candidates will often need to use information from earlier questions when answering later questions.

General Comments

To do well on this paper a candidate needed to be able to manipulate algebraic expressions, to understand the difference between an expression and an equation, and to know what simplification means in algebraic terms.

Candidates are beginning to look for connections between the individual questions and go back to check and change answers when they have worked through later questions. This is a welcome improvement on the previous work on these investigation papers.

Comments on Specific Questions

Question 1

Most candidates realised that in order to show this result, the total of 108 needed to be included in their answer as well as identifying 27 as the fifth term.

Question 2

(a) (i) This question was well answered with most candidates able to follow, and use, the method given. As in all the following numerical questions candidates should be encouraged to check their answers and to check that what they are entering into the calculator is also correct.

Answer: 684, 1096, 1780, 2876.

(ii) It was good to see the total of the first six terms given, rather than just the addition sum. Good communication would be to see both of these as well as the division sum before the answer.

Answer: 4

(b) (i) Most candidates followed the instruction of not rounding their answers. Some obviously thought this meant they should give their answers to one decimal place. This is another question where it is beneficial to be in the habit of checking both answers and what is put into the calculator.

Answer: 21.42, 38.32, 59.74, 98.06

(ii) Again well answered and many candidates showed good communication skills. Some candidates with the correct answer here went back to amend their answer to **Question 2(a)(ii)**.

Answer: 4

(c) (i) There were some interesting sequences chosen for this question and very few errors with using negative numbers. Common choices were to make the sequence in **Question 1** into a sequence of negative numbers and a negative Fibonacci sequence. The few arithmetical errors might have been avoided by checking.

(ii) Again well answered and many candidates showed good communication skills. Some candidates with the correct answer here went back to amend their answers to **Question 2(a)(ii)** and **2(b)(ii)**.

Answer: 4

(d) Candidates should be encouraged to write a description of what they discover during an investigation. Many found it difficult to explain in words what had happened numerically in the preceding questions.

Answer: sum of first six terms = fifth term multiplied by four

Question 3

Candidates should be encouraged to look for connections between the separate questions in an investigation. The forming of the algebraic sequence in **Question 3** followed the same pattern as the numerical sequences in **Questions 1** and **2**, which many candidates did not notice.

(a) Candidates should be able to add algebraic terms and most were able to do this once they had realised that the previous two terms needed to be added together as in the numerical sequences in the previous questions. Quite a common error was adding the four q terms on the working side to give $4q$ and therefore following this with an answer of $3p + 4q$.

Answer: $p + 2q \;\; + \;\; 2p + 3q \quad | \; 3p + 5q$

(b) The follow through mark from the answer in part **(a)** allowed many candidates to gain this mark.

The interpretation of 'Simplify your answer' sometimes meant answers were in the factorised form of $4(2p + 3q)$. Much more common was an answer of $2p + 3q$ indicating the importance of understanding the meaning of 'simplify' and that $8p + 12q$ is not equal to $2p + 3q$, so that one is not the simplified version of the other. Here the simplification was going from $p + q + p + q + p + 2q + 2p + 3q + 3p + 5q$ to $8p + 12q$.

Answer: $8p + 12q$

(c) Candidates need to understand the difference between an equation and an expression. Many had correct expressions, yet did not connect them as an equation.

Candidates also needed to see the link between the questions within the investigation. The fifth term was given in part **(a)** and the sum was the answer to part **(b)**. The link of four had been found four times in the previous **Questions 1** and **2**.

A fairly common mistake was to divide or cancel $8p + 12q$ by $2p + 3q$ giving $4p + 4q$ as the result, either not noticing or not using the link of four as in the previous questions.

Answer: $8p + 12q = 4(2p + 3q)$

Question 4

(a) (i) (ii) This question went back to numerical work and these questions were well answered. Evidence of checking by working backwards from the answer was seen very occasionally here and should be encouraged to be used wherever possible.

Answer: **(i)** 71, 115, 186, 301 **(ii)** 11

(b) (i) The follow through from **Question 3(a)** allowed more candidates to gain these two marks.

Some candidates need to realise that this paper is one whole investigation so that they see the connection between the numerical sequences in **Questions 1** and **2** leading to the same pattern in the algebraic sequences in the following questions. These candidates looked for a different pattern in **Question 4** and, for example, followed on from the fourth and fifth terms with $3p + 4q$ then $4p + 5q$ etc.

Answer: $5p + 8q$, $8p + 13q$, $13p + 21q$, $21p + 34q$

(ii) As in **Question 3(b)** candidates misinterpreted the 'Simplify' instruction and frequently gave $5p + 8q$ as their answer, having correctly factorised $55p + 88q$ to $11(5p + 8q)$.

Answer: $55p + 88q$

(iii) As in **Question 3(c)** candidates need to understand the difference between an equation and an expression. Some had correct expressions, yet did not connect them as an equation.

Candidates also need to see the link between the questions within the investigation. Some of them had worked out the correct expressions in part **(ii)** but did not use them in part **(iii)**.

Answer: $55p + 88q = 11(5p + 8q)$

Question 5

(a) The follow through from **Question 4(b)(i)** enabled many candidates to gain these two marks.

The same observations about pattern spotting and using the connections between questions apply here. Those candidates who had found a new pattern in **Question 4(b)(i)**, i.e. following on from fifth and sixth terms of $4p + 5q$ then $5p + 6q$, continued this pattern despite not finding a constant or sensible factor to connect the sum of the first ten terms and the seventh term.

Answer: $34p + 55q$, $55p + 89q$, $89p + 144q$, $144p + 233q$

(b) As in **Questions 3(b)** and **4(b)(ii)** candidates showed the same misunderstandings of 'Simplify your answer' and of dividing in algebra.

Answer: $377p + 609q$

(c) Candidates who had found an equation in either of **Question 3(c)** or **4(b)(iii)** were able to make an attempt at finding this multiple, although a correct answer was dependant on at least a correct sum in part **(b)**.

Answer: 29

(d) As in part **(c)** and throughout an investigation, candidates need to look for links between the different questions. Many candidates did not attempt this last question probably because they did not have satisfactory answers to earlier questions or because they had no time left. Candidates should be encouraged to try all the questions and to make sure they have enough time to do this.

Answer: $377p + 609q = 29(13p + 21q)$

Communication

Communication shown in this investigation was very good, particularly in showing how the answer to **Question 3(b)** was obtained.

Answer: In one of **3(b)**. **4(b)(ii)**, **5(b)**, **5(c)**.

INTERNATIONAL MATHEMATICS

Paper 0607/06

Paper 6 (Extended)

Key Messages

Although the Investigation and the Modelling sections are each divided into a series of separate questions to guide the candidates, candidates need to treat each section as one whole question. Candidates should look for connections between questions and refer and check back as they work through the section, amending previous incorrect answers, where necessary, when they have done more work on a section.

General Comments

To do well on this paper candidates needed to be able to manipulate algebraic expressions in the Investigation and to use logarithmic graphs in the Modelling problem.

To score full marks in the Investigation it was necessary to understand the difference between an expression and an equation, and to know what simplification means in algebraic questions.

To score full marks in the Modelling problem it was necessary to know the limitations of using graphs/models to predict answers.

Comments on Specific Questions

Section A Investigation: Sum of Sequences

Question 1

Most candidates realised that in order to show this result, the total of 108 needed to be included in their answer as well as identifying 27 as the fifth term.

Question 2

(a) (i) (ii) Most candidates followed the instruction of not rounding their answers in part **(i)**. This is one of the questions where it is beneficial to be in the habit of checking both answers and what is put into the calculator.

Answers: **(i)** 21.42, 38.32, 59.74, 98.06 **(ii)** 4

(b) (i) (ii) Some interesting sequences were seen here. Most candidates used sequences that were familiar to them such as using negative signs with either the Fibonacci sequence or the sequence given in **Question 1.**

As in part **(a)(ii)** arithmetical errors in part **(b)(ii)** might have been avoided by careful checking.

Answer: **(ii)** 4

Question 3

(a) This was usually well answered, with evidence of checking and correcting wrong answers here. An answer of $3p + 4q$ was also quite common.

Answer: $p + 2q$ + $2p + 3q$ | $3p + 5q$

(b) This caused little difficulty with a follow through for the answer in part **(a)** allowing most candidates to gain this mark.

The interpretation of 'Simplify your answer' led to answers in the factorised form of $4(2p + 3q)$. This also led to answers of $2p + 3q$ indicating the importance of understanding the meaning of 'simplify'. Candidates should realise that $8p + 12q$ is not equal to $2p + 3q$, so that one is not the simplified version of the other. Here, the simplification was going from $p + q + p + q + p + 2q + 2p + 3q + 3p + 5q$ to $8p + 12q$.

Answer: $8p + 12q$

(c) Candidates need to understand the difference between an equation and an expression. Many had correct expressions, yet failed to connect them as an equation.

Another common mistake was to divide or cancel $8p + 12q$ by $2p + 3q$ giving $4p + 4q$ as the result. If candidates were to check their results they would realise that $(2p + 3q)(4p + 4q)$ does not equal $8p + 12q$.

Answer: $8p + 12q = 4(2p + 3q)$

Question 4

(a) This was well answered with the follow through from **Question 3(a)** allowing more candidates to gain these two marks.

Some candidates need to realise that this is one whole investigation so that they see the connection between the numerical sequences in **Questions 1** and **2** leading to the same pattern in the algebraic sequences in the following questions. These candidates looked for a different pattern in **Question 4** and, for example, followed on from the fourth and fifth terms with $3p + 4q$ then $4p + 5q$ and so on.

Answer: $5p + 8q$, $8p + 13q$, $13p + 21q$, $21p + 34q$

(b) As in **Question 3(b)** candidates answered this well and showed the same misunderstandings of 'Simplify your answer' and of dividing using algebra.

Answer: $55p + 88q$

(c) As in **Question 3(c)** candidates need to understand the difference between an equation and an expression. Also, those candidates who treated this as a whole investigation and not a series of separate questions, benefitted here by going back to **Question 3(c)** and adjusting both their answers.

Answer: $55p + 88q = 11(5p + 8q)$

Question 5

(a) This was well answered with follow through from **Question 4(a)**. The same observations about the pattern spotting apply here.

Answer: $34p + 55q$, $55p + 89q$, $89p + 144q$, $144p + 233q$

(b) As in **Questions 3(b)** and **4(b)** candidates answered this well and showed the same misunderstandings of 'Simplify your answer' and of dividing in algebra.

Answer: $377p + 609q$

(c) Many candidates made a good attempt at this question and discovered that twenty nine multiplied by the ninth term equalled the sum in **Question 5(b)**. Many gave their answer as the ninth term (or $13p + 21q$), so a further reading of the question before the final answer is written down should be encouraged.

Answer: 29

(d) Those candidates who treated this as a whole investigation were able to use the links between the questions to show the connections here.

Answer: $377p + 609q = 29(13p + 21q)$

Question 6

Candidates should be encouraged to plan their time carefully to ensure that they have time to finish the investigation within the 45 minutes advised for this section, as a lack of time may have been the reason that this last question was not attempted by them all. Whilst many candidates realised that this was a conclusion to this stage of the investigation and brought forward their answers to earlier questions in an attempt to find an answer for the 18 terms, some started looking for new patterns within the numbers given in this question.

Answer: 11 times 7^{th} term, 29 times 9^{th} term, 76 times 11^{th} term

Communication

Communication shown in this investigation was very good, particularly in showing how the answers to **Questions 3(b)** and **4(b)** were obtained.

Answer: In one of **3(b)**, **4(b)**, **5(b)**, **5(c)**.

Section B Modelling: The Earth's Temperature

Question 1

It is important that candidates can use a graphical calculator correctly but it is equally important that they can also draw graphs accurately themselves.

Some candidates who made an incorrect choice in part **(b)(i)** lost the remaining five marks in **Question 1**. Others recovered from part **(iii)** onwards or gained a mark in part **(iv)** and some in part **(vi)** because of the follow through from part **(v)**.

(a) The ten points were accurately plotted by most candidates. Many candidates need to practice drawing a smooth curve <u>through</u> all their plotted points and to avoid this looking more like a curve of best fit.

(b) (i) Most candidates successfully identified this as an exponential function. A basic knowledge of the shapes of functions made this quite an easy task given the alternatives the candidates could choose. Candidates should know how to test functions on their calculator using simple substitutions for the unknown letters. Some candidates realised that they had made a mistake here when they reached part **(iii)** and recovered. Some of these candidates came back to part **(i)** and changed their answer.

Answer: $T = aN^b$

(ii) This question was well answered. Careful reading of the question is very important. Some candidates did further work with their equations although the question said 'write down'; however they were not penalised for this. A few candidates used 1900 and 1940 instead of 'the values of *N* and *T* ' for these years.

Answer: $0.03 = a\ 40^b$, $0.1 = a\ 80^b$

(iii) Some excellent answers were given here, showing how the equation could be derived, often by quite complicated substitution between the equations as well as the more straight forward division of one equation by the other. At this stage some candidates realised that they had chosen the wrong function for part **(i)** and went back to change their answer to part **(i)**, although few also remembered to change their answers to part **(ii)**.

(iv) Candidates should be aware that all the questions in the modelling section are related to each other. Here was a chance to gain a mark by using the equation given in part **(iii)**. Some candidates managed to recover a mark here having not scored earlier in part **(b)**.

The mark for this question was most commonly lost for showing only 1.736 which was the answer of 1.73696559… truncated to 3 decimal places. When accuracy to 2 decimal places is required for an answer then candidates should show accuracy to at least 3 decimal places in their working, so it was necessary to see 1.737 if only 3 decimal places were given.

(v) Again, candidates need to be aware of the connections between the questions and part questions. A correct function chosen in part **(i)** and a pair of values from part **(a)** were all that were needed to find the value of *a*.

Candidates should also take care when using standard form numbers on their calculator. Errors were made in rewriting the standard form number as an ordinary number or in copying down only the number between 1 and 10.

Answer: $(4.88\ldots \text{ to } 4.95\ldots) \times 10^{-5}$

(vi) Some candidates managed to successfully substitute their answer to part **(v)** into their model for *T*. Some candidates started with 0.06 = … and need to be aware that they should do the calculation first and be looking for an answer that will correct to 0.06; since even with the correct value for *a* and the correct model, saying 0.06 = 0.06… is insufficient.

Answer: $T = (4.9 \times 10^{-5}) \times 60^{1.74}$

Question 2

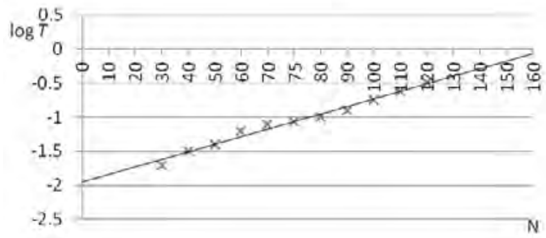
(a) (i) Most candidates were able to gain both marks here. Candidates should check that they know how to round correctly as a few rounding errors were seen; the most common of which was rounding up all the time, e.g. –0.74472… being rounded to –0.75.

Answer: −1.52, −1.40, −1.10, −1.00, −0.74

(ii) (iii) The ten points were again plotted accurately by most candidates who showed competency in reading various scales.

Candidates should know that the line of best fit is a straight, ruled line passing through the mean point, as well as that it follows the trend of the plotted data points but does not join them.

Answer:



(iv) Most candidates realised that their line of best fit needed to be extended to $N = 160$. Most of these candidates were able to read the log *T* value correctly from this point using the given scale. Candidates should also be clear that they have read the value of log *T* from the graph and not the value of *T*; many candidates gave the log *T* value as their answer, omitting to find the antilog to give an answer for *T*.

Answer: Follow through from the candidate's line of best fit, correct to 1 decimal place.

(b)(i) A variety of good methods were used to answer this question, including linear regression on the graphical calculator, the substitution of two points from the line of best fit and reading and using the *y*-intercept from the line of best fit. Candidates should be aware that if they are using two points to find the gradient they should choose two points that are on their line of best fit and not two points from the table unless their line goes through these points.

Answer: m = 0.006… to 0.018… c = –2.4… to –1.7…

(ii) Most candidates who had answers to part **(i)** were able to substitute them into their model with $N = 160$. Most of these candidates found a value for log T. Candidates should know, however, that they need to antilog this value to obtain an answer for T, as requested. Many candidates did not realise this.

Answer: Follow through with the values of m and c from part **(ii)** with $N = 160$ in their model, correct to 1 decimal place.

(iii) Crucial to the whole process of prediction is the validity of extrapolation. Very few candidates made this point. Most candidates compared their two predictions although a comparison was not asked for. Candidates should read the question carefully and should be aware of the limits of using graphs and models to extrapolate answers.

Answer: Comment on 2020 being outside the range of the given data.

Communication

Communication in this modelling section was good and is improving. Those candidates who understood how to use logs were able to write out the equations they were using to get their answers in **Question 1(b)(iv)** and **(v)**. e.g. $b = \log_{0.5} 0.3$ and $a = 0.03/40^{1.7...}$. The illustrated substitution of two points or m and c in **Question 2(b)(i)** or **(ii)** also demonstrated good communication. Note that if using the graphical calculator, e.g. for linear regression in **Question 2(b) (i)**, then it is necessary to state this to earn the communication mark.

Answer: In one of **1(b)(iv)**, **1(b)(v)**, **2(b)(i)**, **2(b)(ii)**.