MATHEMATICS (US)

Paper 0444/11
Paper 1

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to apply formulae and to give answers in the form required. Candidates are reminded of the need to read the question carefully, focussing on key words and instructions.

General comments

Candidates must check their work for sense and accuracy as there were answers in context that were unlikely, for example in **Questions 3**, **14** and **21**. Candidates must show all working to enable method marks to be awarded. This is vital in multi step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks in for example, **Questions 16**, **17**, **19**, and **21**. Candidates must take note of the form or units that are required, for example, in **Questions 2**, **7**, **19** and **21(b)(ii)**. It is worth noting that candidates should use HB pencils and a straight edge for diagrams such as **Questions 22** and **24**.

The questions that presented least difficulty were **Questions 6**, **10**, **14**, **18(b)** and all parts of **22**. Those that proved to be the most challenging were **Questions 2, 3, 13(a)**, **21(b)(i)**, and some parts of **23**. Candidates attempted virtually all questions except that parts of **Question 23** were sometimes left blank.

Comments on specific questions

Question 1

This question was reasonably straightforward and a large majority gave the correct answer. Incorrect answers were usually missing a zero, typically, 7020. Sometimes 17 020 or 1720 were seen as candidates confused seventy with seventeen. Occasionally 720 000 was seen due to confusion of the effect of the thousands.

Answer: 70 020

Question 2

The most common incorrect answers were $\frac{-25}{5}$, $\frac{5}{-2}$ and –25 showing that many did not understand indices.

Answer: $\frac{1}{25}$

Question 3

The first problem for many candidates was the interpretation of 5×10^{-2} and then to realise that changing this to 0.05 made it easier to work with, finishing by multiplying by 100. Those that gave an incorrect answer often did not change the scientific notation and then did not know what to do with it giving incorrect answers such as 5×10^{-200} or 500×10^{3}. Other answers that were incorrect, for example, 500mm did not make sense in this context and candidates could have realised that 100 sheets of paper are unlikely to be half a meter in height.

Answer: 5

Question 4

This rules of indices question was not handled very well with answers such as $5x^2$, 32 (2^5) seen and the most frequent incorrect answer was x^7.

Answer: x^{10}

Question 5

Candidates should not leave this type of question blank as there is a limited choice of what the answer could be but they should remember to only leave one answer. Translated was the most commonly chosen incorrect answer but other words not from the list, such as rotated, were seen.

Answer: Congruent

Question 6

There were two correct answers that candidates could choose. However, if candidates gave two answers they both had to be correct to get the mark. Very occasionally, candidates gave a number not on the list.

Answer: 31 or 37

Question 7

Candidates found these two parts of about equal difficulty with slightly more being successful with part **(a)**. Incorrect answers included 2345.71 (moving the decimal point to give four numbers in front of it), giving the incorrect number of significant figures or truncating the value to 23.45 With part **(b)**, the most common incorrect answer was to give the number to the nearest integer. Some looked at the right-hand end of the number, disregarding the decimal point, giving their answer as 70. Others who knew the answer was 20, gave instead, 20.0000 by putting a zero in place of each original digit.

Answers: **(a)** 23.46 **(b)** 20

Question 8

Some tried to combine the terms giving $8mn^2$ or $140mn$ showing that they had no understanding of what factorise meant and that only like terms can be combined. Some started well but made numerical errors. Some who partially factorised the expression, taking one or two factors outside the bracket, such as $2n(6n – 2m)$ or $4(3n^2 – mn)$, gained a mark.

Answer: $4n(3n – m)$

Question 9

Candidates often confuse greatest common factor (GCF) with least common multiple (LCM) and that was the case here with 3150 or 18 900 being frequent incorrect answers. Some used a factor tree but had decimal numbers not integers on the branches. There was a mark for answers of a common factor 2 or 3. The GCF has to be lower than the original numbers (or equal to one of them).

Answer: 6

Question 10

This question was answered very well. To earn the mark in part **(a)**, Chicago had to be stated and not the temperature, –10. Some candidates chose Helsinki or Moscow, the other cities with negative temperatures. In part **(b)**, the temperature in Helsinki had got warmer by 4 °C so incorrect answers were often a combination of a 7 and a 4 with the signs incorrect, giving positive or negative 11.

Answers: **(a)** Chicago **(b)** –3

Question 11

This algebra question was answered better than **Question 8** and most errors occurred when candidates combined terms after they had correctly expanded the expression, giving answers like $22y^2x$ as their final answer or made numerical slips in the initial multiplication. What was slightly different about this question was that when the brackets were multiplied out, two of the terms cancelled ($14x$ and $-14x$).

Answer: $21y + xy$

Question 12

This was well answered by candidates, correctly substituting the values of –2 and 2 into the given function.

Answer: 13 … ... –7

Question 13

Answers to part **(a)** of $\begin{pmatrix} 2 \\ 5 \end{pmatrix}$ or $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ showed that some candidates either did not realise they should be going from *P* to *Q*, not the other way around, or did not know which co-ordinate is at the top in a vector and which way is the positive direction. Candidates were more successful with part **(b)** especially considering this has a vector and a co-ordinate to deal with. Candidates could locate point *R*, apply the vector and then give the co-ordinates of point *S*.

Answers: **(a)** $\begin{pmatrix} -2 \\ -5 \end{pmatrix}$ **(b)** (4, 2)

Question 14

This was a different type of conversion question to that often seen as candidates were asked to find an exchange rate but this did not seem to cause many problems at all. Firstly, candidates had to recognise which exchange rate they needed – in this case how many pesos to one dollar. Next, looking at the amounts of money, Manuel has numerically more pesos than dollars so for each dollar he gets more than one peso so candidates had to divide 4500 by 250. If candidates reversed the division then the answer of 0.05 recurring cannot be correct in this context.

Answer: 18

Question 15

By far the most common incorrect answer came from not understanding that using relative frequency is a way of getting a probability from data, so the actual number 21 was often seen. For some, the word 'estimate' caused problems. This does not mean guess but rather use the relative frequency of birthdays in the sample to predict how many have April to June birthdays in a larger population. In part **(b)**, candidates were often correct even when they were wrong in part **(a)**.

Answers: **(a)** $\frac{21}{50}$ **(b)** 210

Question 16

Some candidates treated the cube root as meaning multiply by 3 giving $3 \times \sqrt{64} = 24$ instead of 4. However, there were many that earned 1 mark for getting as far as $\frac{4}{36}$ but then not cancelling far enough or making arithmetical slips.

Answer: $\frac{1}{9}$

Question 17

Questions of this type are often problematic for many candidates and this question was no exception. Only a few candidates gained a mark for a correct first step and many gave just an answer without any workings. The first step is to either multiply out the brackets or to divide by t so that v can be isolated. It is important that each step is shown separately so any method marks can be awarded.

Answer: $\frac{2s - 5t}{t}$

Question 18

In part **(a)**, quite a number interpreted the multiplication sign as an x resulting in an algebraic expression. While –20 was seen a number of times (from adding 3 and 2 then multiplying by –4), most who understood this question, on order of operations, gave the correct answer. The last parts were answered very well.

Answers: **(a)** –5 **(b)(i)** $3 \times (5 + 2) + 2 = 23$ **(ii)** $12 \div (4 + 2) = 2$

Question 19

There were some candidates who showed complete and convincing working. A few candidates made arithmetical errors, which should have been picked up when checking. A small number worked only with the given fractions and omitted to take account of the 1 in front of the $\frac{2}{3}$. The answer was asked for as a mixed number in its simplest form but some left their answer as $\frac{50}{21}$.

Answer: $2\frac{8}{21}$

Question 20

There are various methods to solve systems of linear equations and candidates should be aware that sometimes, depending on the structure of the equations, one method might be quicker or involve less places for arithmetic slips to spoil good method. The simplest approach to these equations was to multiply the first by 2 and add the two equations to eliminate y. Candidates should check their values in both equations.

Answer: [x =] 2, [y =] –7

Question 21

This type of question has not got scaffolding to lead candidates through the calculation so they must decide where to start and the method to be used. In part **(a)**, the first step is to divide the shape into its component parts, work out the relevant perimeters and then remember to combine everything. For the square section, candidates had to remember not to include the fourth side and similarly with the triangle, not to include the base. Often, candidates did not take account of one or other of these points so answers were seen that included 510 or 270 (3 sides of the square) or 150 (sloping sides of the triangle). For part **(b)(i)**, most candidates used the ratio correctly in effect saying, 2 : 3 is the same as h : 90 so $h = \frac{2}{3} \times 90$. However, others incorrectly used $\frac{2}{5} \times 90 = 36$. There is another method that can be used, Pythagoras' theorem, but without a calculator, this is prone to arithmetic errors – the full method to the square root of $75^2 - 45^2$ gained a mark even if the accuracy was not correct. With the area calculation, there was less of a problem than with part **(a)** as the area of the whole square was needed and likewise with the triangle so more candidates gained some marks here. This could be done separately or to treat the whole board as two trapezoids giving (in cm^2) $\frac{45}{2} \times (90 + 90 + 60) \times 2$, which cancels down to 45×240. The last step was to give the answer in m^2 not cm^2. The conversion is easiest done at the start by converting all the cm lengths into m, which will also ensure that this step is not forgotten at the end but candidates do have to contend with multiplication of decimals. If this conversion is done at the end, candidates have to remember to divide by 10 000 not 100 as the answer is an area not a length. Candidates should check their answer makes sense in context – a notice board with lengths around 1 m will mean the area is also around 1 m^2 but answers such as 8550 or 20 700 were seen. An answer of 10 800 gained some marks as only the conversion was omitted.

Answers: **(a)** 420 **(b)(i)** 60 **(ii)** 1.08

Question 22

For many candidates this was their best answered question as a whole. The point plotting was accurate in general in part **(a)**. Candidates generally are more comfortable with positive correlation which is shown here. Besides the incorrect negative, candidates gave other answers such as numbers, increasing, rising and single point in part **(b)**. Sometimes a question will ask candidates to describe the relationship and this is when the answer needs the connection between the two variables but that is not the case with this question. There were some excellent lines of best fit in part **(c)** but some candidates simply joined up the points. Some lines were too short and a commonly occurring misconception was for candidates to force their line to start at the 'origin' or in this case, (0, 25). Again, 'estimate' caused a problem in part **(d)**. This does not mean guess, it means 'use a mathematical method to find out' and in this case the method is reading from the line of best fit when the time is 5.5 hours.

Answers: **(b)** Positive **(d)** 33.5 to 37.5

Question 23

Taking this question as a whole, candidates found it the most challenging on the paper. In part **(a)(i)**, candidates needed to square –3 then subtract 2 giving 7. Some gave −11 (writing −3 squared as –9) or 4 (-3^2 is 6). For part **(a)(ii)**, $7p$ is substituted into the function. The common error here was for candidates to forget to square either the 7 or the p. In part **(b)**, candidates either could find the answers from the graph or they did not know what to look for at all. This question is about understanding various aspects of functions. When $x = 1$, $y = -3$ so that means a is −3. Candidates should check this by picking another point, for example (2, −1.5). The value of b is the upper end of the domain. The range is the values on the y-axis, from −6 to −1.

Answers: **(a)(i)** 7 **(ii)** $49p^2 - 2$ **(b)(i)** -3 **(ii)** 3 **(iii)** $-6 \ldots -1$

Question 24

To gain full marks, all the construction arcs had to be visible. Some drew the arcs for the first part but then did not go on to draw the perpendicular bisector. Many did not appear to have a straight edge or compass. Some drew arcs but then didn't draw the relevant lines. However there were some fully correct diagrams.

MATHEMATICS (US)

Paper 0444/21
Paper 2

Key messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae, show all necessary working clearly and use efficient methods of calculation. They should be encouraged to spend some time looking for the most efficient methods suitable in varying situations.

Candidates should be aware that they would not be required to carry out complex calculations involving decimals or multiplying by π on a non-calculator paper.

General comments

The level and variety of the paper was such that candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as there was no drop in the response rate for the last few questions.

Candidates showed good number work in **Questions 4** and **7**, and a good understanding of simplifying indices in **Question 1**.

Candidates particularly struggled with the volume scale factor in **Question 11**, similar triangles in **Question 13**, trigonometric graphs in **Question 17** and the area problem **Question 19**. Only the most able candidates dealt with the proportion **Question 9**, the problem solving co-ordinates **Question 12**, vectors in **Question 18** and simplifying algebraic fractions in **Question 22**.

Comments on specific questions

Question 1

The majority of candidates obtained the correct answer to this question. Where an incorrect answer was given, it was usually x^7.

Answer: x^{10}

Question 2

Most candidates recognised the need to multiply but this caused many problems. Many showed a conversion from scientific notation into ordinary form before multiplying, and errors usually stemmed from this. 4 to various powers of 10 were given as an answer. Some were multiplying 8 and 10^{-3} by 500. The other error was to leave the answer as $4\,000 \times 10^{-3}$ after making an efficient start with this method.

Answer: 4

Question 3

Many candidates could give the number to 4 significant figures in part **(a)**, with an equal number who could not, often confusing with 4 decimal places and just repeating the number in the question. The other commonly seen answer was 23.45. Fewer candidates were able to give the value to the nearest 10 where 23, 20.0(0…) and 23.5 (perhaps mistaking ten with tenth) were commonly seen. Candidates should remember not to include trailing zeros on a rounding question as this caused a large number to lose the marks in one or both parts of the question.

Answers: **(a)** 23.46 **(b)** 20

Question 4

There were very few incorrect answers seen to this question. In part **(a)**, –10 was occasionally seen alone or Moscow was selected. If part **(b)** was incorrect, it was usually –11.

Answers: **(a)** Chicago **(b)** –3

Question 5

Many candidates were able to fully factor the expression and some gained 1 mark for a partial factor, with 2n being the most common factor. There was a large proportion that did not understand the meaning of the question and attempted to combine or 'simplify' the terms, leading to answers such as $8nm^3$, $8nm^2$ and $8m^2$.

Answer: $4n(3n - m)$

Question 6

The most able candidates could find the correct indices but the majority struggled, with answers commonly $\pm 8, \frac{1}{4}, \frac{1}{8},$ or 4 in part **(a)** and ±5 in part **(b)**.

Answers: **(a)** –4 **(b)** $\frac{1}{5}$

Question 7

The majority of candidates were able to employ the correct method in this fraction addition. The most common loss of marks was because the answer was not given correctly as a mixed number, where $\frac{50}{21}$ and $1\frac{29}{21}$ were often seen. The answer $1\frac{7}{10}$ was commonly seen by those who did not have the necessary skills.

Answer: $2\frac{8}{21}$

Question 8

The most able candidates were successful in their interpretation of the information and could go on to give the correct expressions. Many were able to give rt for the top row, with the amount of success then falling in turn for the next two expressions. It was fairly common to see candidates introducing their own variables, s and b for square and blue and using these within the expressions. It was also common to see r being subtracted or as a denominator in the last two expressions.

Answer: rt, $(1 - r)t$, $(1 - r)(1 - t)$

Question 9

Candidates struggled to write down a correct relationship as a starting point in this question, and as a result were carrying out a variety of incorrect calculations with the numbers given. An answer of $\frac{3}{8}$ was common as a result of omitting the square root from the relationship. $\frac{1}{6}$ was fairly common due to the value of *p* going from 4 to $\frac{1}{4}$, as were answers of $\frac{1}{4}$ and 24.

Answer: 1.5

Question 10

The majority of candidates scored at least one mark on this question but there was obvious confusion over what was required. There were many candidates who left more than one region unshaded and did not label their region R. Candidates could gain part marks if an incorrect region was identified, as it demonstrated some understanding of each inequality. A common incorrect region given was the one to the left of the correct region or to leave the whole of $1 \leqslant y \leqslant 2$ unshaded.

Question 11

This was a topic which was not well understood, proving to be one of the most challenging questions on the paper. The majority of candidates simply used a linear scale factor resulting in an answer of 38.4. Others who misinterpreted the question were using the formula for the volume of a cylinder and performing lots of long calculations involving π. Other, simpler incorrect methods commonly seen involved various subtractions of the given values.

Answer: 60

Question 12

Candidates struggled with this problem solving question and only the most able could make a correct start. It was common to see calculations and equations using the numbers from the question in an incorrect way. The most common and most successful approach was to write down a calculation for the slope of the line using the points given in the question and equate this to 5. Many gained part marks for a correct start and then made subsequent errors in rearrangement or simplifying. Where candidates chose to consider the slope calculation, it was common to see $\frac{23-8}{k-x}$ not equated to 5 which did not gain any marks. A common error in this approach was to write $5 = \frac{k-x}{23-8}$. A less common approach was to write down two equations based upon the information given in the question and then solve these simultaneously. Some of these attempts led to full marks being awarded. However there were again errors in algebraic rearrangement which meant that only part marks were gained.

Answer: $k - 3$

Question 13

Very few candidates could deal with this question, mainly due to the fact that they didn't recognise the shape as two similar triangles and so had no strategy to begin answering the question. This resulted in many simply giving one of the lengths of the larger triangle, most commonly 5. There were many statements seen involving trigonometry and Pythagoras' theorem, and $\sqrt{18}$ was often seen after $3^2 + 3^2$.

Answer: 3.75

Question 14

Successful candidates approached this by calculating the interior angles of the octagon and triangle and subtracting them from 360. Very few realised that adding the exterior angles of the octagon and triangle would give *x*. There were some numerical errors involved in the multiplication and division to find the interior angle of the octagon but method marks were awarded for those who showed clear working. The majority of incorrect answers stemmed from the confusion between interior and exterior angles of the octagon, with the interior angle often labelled as 45. Other misconceptions were to label the interior angle of the octagon as 120 or to assume a line of symmetry, taking *x* as equal to the interior angle of the octagon.

Answer: 165

Question 15

Part **(a)** was much better attempted than part **(b)** and many scored 1 mark by dealing with one of the surd values. $5\sqrt{5}$ was seen far more often than $2\sqrt{5}$, which was often given as $5\sqrt{2}$. The most common error here was to think that it was equivalent to $\sqrt{145}$ and give this as the answer or try and work out the numerical value of it. Very few candidates gained any marks in part **(b)**, mainly due to the fact that they were just trying to square each number rather than realising that it would result in 4 terms. There were many 2s seen from a correct square of $\sqrt{2}$ but this was usually combined with one other incorrect term such as $2\sqrt{9}$ or $4\sqrt{9}$ or just the final correct numerical term, 12. Another commonly seen answer was $(2\sqrt{5})^2$.

Answers: **(a)** $7\sqrt{5}$ **(b)** $14 + 4\sqrt{6}$

Question 16

The four different parts to this question were answered with very varied success rates. The vast majority of candidates gained the marks in parts **(a)** and **(d)** but far fewer in the other two parts of the question. Although many did state 'positive' in part **(b)**, there were a greater number who did not know how to describe correlation, and answers such as directly/inversely proportional, linear, increasing or a sentence describing the relationship were commonly seen, alongside a fairy high proportion of blank answer spaces. In part **(c)**, many did produce a good line of best fit but there was also a large proportion who did not gain this mark because they either joined the points, started the line at 0 hours, drew a curve or obviously drew a freehand line.

Answers: **(b)** Positive **(d)** 33.5 to 37.5

Question 17

In part **(a)** there were a reasonable number of candidates who could give $\frac{1}{2}$ as the amplitude but very few could find the period, often stating $\frac{x}{3}$ or $\cos\frac{x}{3}$. Part **(b)** was very poorly attempted and candidates had no strategy to know where to begin. 2 and 0 were common responses. Occasionally they used the vector as co-ordinates to substitute into the equation and the quadratic formula was often quoted. There was a high proportion of blank answers for both parts.

Answers: **(a)** $\frac{1}{2}$, 1080 **(b)** –3, 5

Question 18

A reasonable number of candidates were able to give the correct answer in part **(a)** but there were many who gave incorrect multiples of **a** or **b**, most commonly $3\mathbf{a} + 2\mathbf{b}$ $(\overrightarrow{OE})$, or $3\mathbf{a} + \mathbf{b}$. Equivalent vectors such as $\overrightarrow{AF}$ were also seen. Part **(b)** was the most successful part of the question and part **(c)** the most challenging with a whole variety of responses, the incorrect ones usually involving just one point, such as *F* and *G*.

Answers: **(a)** $2\mathbf{a} + \mathbf{b}$ **(b)** *D* **(c)** $\overrightarrow{CF}$ and $\overrightarrow{BG}$

Question 19

Very few candidates scored more than 1 mark for this question; this was almost always for $\frac{60}{360} \times \pi \times 10^2$.

The vast majority did not appreciate that $\frac{1}{2}ab\sin C$ could be used for the area of the triangle and often attempted to split *ADC* into two, followed by Pythagoras' theorem or trigonometry to attempt to calculate the lengths of the base and height. Many used the expression they were trying to reach as a starting point and were multiplying the brackets out. This is the type of question where candidates should be encouraged to spend some time considering the most efficient methods available to them before leaping in to calculations. There appeared to be many guesses to the values of *p* and *q* with no working, and a significant number of candidates did not feel able to make any attempt at the question.

Answer: $\frac{100}{3}$, –50

Question 20

Any errors in part **(a)** appeared to come from candidates looking for patterns in the table. Otherwise it was well answered with the majority filling in the correct values. Many also found the most likely score in part **(b)**. The most likely score of 3 on each spinner was the source of some errors, leading to 6 as a common answer. The word 'total' in the question appeared to prompt a number of candidates into adding up various rows and columns of the table. Many candidates found the correct probability in part **(c)(i)** or gained 1 mark for a correct denominator if the numerator was incorrect. A common incorrect denominator was 36, no doubt due to the values on the spinner ranging from 1 to 6. A large number were also able to gain the mark in part **(c)(ii)**.

Answers: **(b)** 7 **(c)(i)** $\frac{7}{25}$ **(ii)** 0

Question 21

Part **(a)** was carried out successfully with many gaining full marks. The value of *u* was generally found correctly and sometimes a mark was awarded for labelling another relevant angle on the diagram. Part **(b)** involved a circle theorem which fewer were familiar with. Many gained a mark for making a first correct step of writing angle *FOG* as 150. This often led to the answer that *p* was also 150. Some candidates made incorrect assumptions about the diagram, often adding a right angle where it looked remotely like one.

Answer: **(a)** 35, 110 **(b)** 75

Question 22

The final question on the paper was found challenging with only the more able candidates making a reasonable attempt. In part **(a)** 1 mark was more commonly awarded than 2 for factorising the numerator to $x(x – 3)$ even if they did not spot the difference of two squares in the denominator. Those who did not score were generally 'cancelling' the x^2 from the numerator and denominator of the fraction, leading to an answer of $\frac{x}{3}$. Very few had a strategy for combining the 2 fractions in part **(b)**. Those who did make a correct start often gained 2 marks if the process was completely correct but then made errors in multiplying out the brackets or combining the terms. There was sometimes confusion over what should be multiplied, for example, multiplying each fraction by 2 or 3 from the numerators, or finding the correct denominator but not multiplying the numerators. There was a large number who simply added the terms in the numerator and denominator.

Answers: **(a)** $\frac{x}{x+3}$ **(b)** $\frac{8x+7}{(x-4)(2x+5)}$

MATHEMATICS (US)

Paper 0444/31
Paper 3

Key Messages

To be successful in this paper, candidates had to demonstrate their knowledge and application of various areas of mathematics. Candidates who did well consistently showed their working out, formulas used and calculations performed to reach their answer.

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Candidates generally showed their workings and gained method marks. However many candidates were unable to gain marks in the 'show' questions (**2(a)(i)** and **5(b)**) if they used the value they had to show from the beginning. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed and emphasise that in show questions candidates must not start with the value they are being asked to show.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. This was particularly evident in **Question 5(vi)(a)** and **(b)** where answers were often given to 2 significant figures only with no working out shown. These candidates gained no marks as answers need to be to at least 3 significant figures and with no working out no method marks could be awarded either.

The standard of presentation was generally good; however candidates should be reminded to write their digits clearly and to make clear differences in certain figures. Similarly many candidates overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite.

There was evidence that most candidates were using the correct equipment.

Areas which proved to be important in gaining good marks on this paper were; using ratios, finding fraction and percentages of an amount, forming and solving linear equations, transformations, calculating averages from a frequency table, calculating angles and drawing a pie chart, identifying parts of a circle and use of circle theorems, using Pythagoras' theorem and trigonometry to find missing lengths of a right-angled triangle, accurate plotting of co-ordinates and points on graphs, calculating the slope of a straight line, use of time in 24-hour format, calculate speed and time, find and use the expression for the *n*th term of a sequence, measure and draw bearings on a scale diagram, calculate using money and compound interest. Although this does not cover all areas examined on this paper, these are the areas that successful candidates gained marks on.

Comments on Specific Questions

Question 1

(a) This question was attempted by nearly all candidates with the majority correctly giving the time. Common errors were to include pm in their answer, i.e. 17 35 pm, or 18 35.

(b) (i) Most candidates successfully added 16 minutes to their time in part **(a)**. The most common wrong answer was 17 47, which was the time the bus left the railway station.

(ii) Candidates found reading the table more challenging with fewer candidates correctly identifying the next bus arriving at the theatre at 18 40. More commonly candidates gave the time for the first bus 18 05 or the last bus 19 12.

(iii) The correct answer of 4 minutes was often seen. However this sometimes came from wrong working. Many candidates found finding the length of each journey difficult and often 72 and 76 minutes were given as the journey times instead of 32 and 36 minutes. Many candidates are subtracting times as a column sum and not taking into account that there are 60 minutes in an hour and not 100.

(iv) Calculating the speed of the bus was the most challenging part of this question. Good solutions showed all working out, including the formula for speed, correct conversion of times from minutes to hours, division and correct rounding to 1 decimal place. A large number of candidates missed out on the chance of a mark by not showing their answer to more than 1 decimal place before rounding. This did not affect candidates who had the correct answer but candidates who had the wrong journey time or those that divided incorrectly could have gained a mark if they had shown the answer on their calculator and then rounded their answer to 1 decimal place. Candidates should be reminded to show all their working out, including any formulas used.

Answers: **(a)** 17 35 **(b)(i)** 17 51 **(ii)** 18 40 **(iii)** 4 **(iv)** 14.2

Question 2

(a) (i) Candidates were generally successful at answering this 'show that' question if they recognised that they had to use the \$78 given in the question to show that the total cost was \$364. Good solutions showed all working out, generally calculating the kit and travel costs separately and then adding to the membership cost to reach the total of \$364. However a very large proportion of candidates started with the \$364. The most common incorrect method was $3 + 5 + 6 = 14$, $364 \div 14 = 26$, kit = $26 \times 5 = 130$ and travel = $6 \times 26 = 156$. Total cost = $78 + 130 + 156 = 364$. This method demonstrates the importance of not using the value you are being asked to show in the calculation.

(ii) Candidates were more successful at finding the cost of the kit and travel because most had already worked out these values in part **(i)**. Candidates who found the correct cost for kit and travel using the \$364 in part **(i)** were not penalised again and most candidates simply copied their values from part **(i)** in the answer space. The most common incorrect answers were 15.6 and 13 from dividing 78 by 5 and 6 respectively.

(b) Candidates attempted this fraction question in a variety of ways. Successful solutions found $\frac{10}{13}$ of 364 by dividing and multiplying and then subtracting their value from 364. Many more able candidates showed good understanding of fractions and found $\frac{3}{13}$ of 364. A large number of candidates attempted to use percentages to solve this question. This was successful if candidates did not round their percentage value but often candidates rounded it to 76.9% or 77% and when calculating these percentages of 364 and then subtracting, their answers were not exact and therefore lost the accuracy mark. Candidates should be reminded not to round values prematurely within their working and to use the value from the calculator exactly.

(c) Candidates were similarly successful in calculating the total cost of Camilla's brother joining the soccer team. Again a variety of methods were seen with the most common calculating the 12% first and then subtracting this from 364. More able candidates often showed their understanding of percentages and calculated 88% of 364. A large proportion of candidates rounded their final answer to \$320 or \$320.30 which did not gain full marks as the answer was an exact value and only \$320.32 gained full marks. Many less able candidates subtracted 12 or 0.12 from 364.

(d) (i) This part was well answered with a variety of acceptable equations seen. The most common correct answer was $W + 6 + L = 24$. However many rearrangements were seen including $W + L = 18$ and $W = 18 - L$ which both gained full marks. Less able candidates often did not form an equation with answers such as $24W + 6L$ often seen.

(ii) Candidates found this the most challenging part of the question. Many incorrect equations were seen through confusion that W represented the number of points gained from the winning games rather than the number of games won. Therefore $W + 6 = 54$ was a common wrong answer, along with $18W = 54$ and $3W = 54$.

(iii) Candidates were more successful in calculating the value of W and L, even if they had formed the wrong equation in part **(ii)**. Many candidates calculated the correct values for W and L without using an equation. Many candidates gained a follow through mark if they incorrectly found a value for W but then used this to find L by subtracting their value for W from 18.

Answers: **(a)(ii)** 130, 156 **(b)** 84 **(c)** 320.32 **(d)(i)** $W + 6 + L = 24$ **(ii)** $3W + 6 = 54$ **(iii)** 16, 2

Question 3

(a) Few candidates correctly identified the shape as a quadrilateral with many candidates incorrectly trying to name it as a type of quadrilateral, trapezium, trapezoid and tetragon being the most common wrong answers.

(b) Good answers contained all three parts to describe an enlargement, including scale factor and centre of enlargement. The most common error was to omit the centre of enlargement. Less able candidates could correctly identify the transformation as enlargement but did not include the centre or gave the wrong scale factor. Very few double transformations were seen.

(c) Good solutions in this part contained the correct transformation, translation, and a correct vector to describe the translation. Few candidates described the translation in words but those that did often got it correct. The most common error was omitting the minus sign from the vector or writing the vector as a co-ordinate.

(d) Most candidates reflected the shape however not all in the correct line. The most common error was reflecting the shape in the y-axis rather than in the line $x = 2$. Diagrams were generally well drawn, although most were without a ruler. Candidates however should be reminded to always draw diagrams with a pencil as errors made in pen were difficult to correct and often led to answers which were particularly difficult to assess as corners of the shape were difficult to see.

(e) Most candidates were able to rotate the shape through 90° counterclockwise however not using the origin as the centre of rotation. Candidates who used a different centre of rotation were able to gain one mark. Similarly to part **(d)** most diagrams were drawn freehand without a ruler.

Answers: **(a)** Quadrilateral **(b)** Enlargement, (scale factor) 3, (centre) (–3,–1) **(c)** Translation, $\begin{pmatrix} 10 \\ -7 \end{pmatrix}$

Question 4

(a) (i) Candidates were able to identify 4 as the mode from the list of data. The common error was choosing 5 as this was the largest number in the list of data.

(ii) Candidates found the median with little difficulty. The most common error was finding the mode or mean instead of the median in this part.

(iii) Finding the mean from the data proved the most challenging part of this question. A large proportion of candidates found the mean correctly. The most common errors were inaccuracies in addition of all values or finding the median instead of the mean in this part.

(iv) Completing the bar chart was well answered by most candidates. Bars were generally drawn with a ruler accurately. The most common error was not reading the question fully and not writing any values on the vertical scale. Candidates should be reminded to reread the question after completing it to check they have done everything asked for.

(b) Nearly all candidates successfully completed the table. Very few wrong answers were seen and these candidates generally gained one mark for 3, 4 or 5 correct values.

(c) (i) Calculating the sector angle proved challenging for less able candidates with a large proportion choosing not to answer this part. Successful solutions used $\frac{18}{45} \times 360$ from the table rather than using the 120° given in the question for ages 4 and younger.

(ii) Candidates were more successful at gaining this mark as most were able to as a follow through mark from their incorrect answer to part **(i)**. Candidates understood that their answers to **(i)** and **(ii)** had to add to 240° and used this successfully to gain the follow through mark.

(d) Candidates showed good use of a protractor with most candidates correctly drawing an angle of 144° or 96°. Very few candidates did not use a ruler or pencil. Candidates should be encouraged to draw all diagrams in pencil so that any mistakes can be rubbed out and corrected rather than scribbled out if a pen is used.

Answers: **(a)(i)** 4 **(ii)** 3 **(iii)** 2.81 **(b)** 7, 12, 22, 6, 9, 15 **(c)(i)** 144 **(ii)** 96

Question 5

(a) (i) Candidates found identifying the radius from the diagram challenging. Common wrong answers were ratio, radio, diameter and chord.

(ii) Giving a reason why angle *ABO* is 90° proved to be one of the most challenging questions on the whole paper. Many less able candidates drew attention to the square drawn at *B*, or that the triangle was a right-angled triangle, and that this showed the angle was a right angle rather than giving a reason why it was 90°. Very few candidates were able to give a complete correct answer that included the two critical words of tangent and radius.

(iii) Finding the angle *AOB* was the most successfully answered part of this question. The vast majority of candidates correctly showed their understanding that the angles in a triangle add up to 180 to find the missing angle. The most common wrong answer was 49, incorrectly identifying triangle *ABO* as isosceles.

(iv) Identifying the angles *ADC* and *AOB* as corresponding angles was challenging for most candidates. More able candidates tried to give a reason using enlargement and similar triangles but few were able to use the correct terms as required. Candidates should be reminded of the key words to use when describing angles on parallel lines, as F-angles is not accepted as a correct answer.

(v) Many candidates believed that the two triangles were equal or congruent rather than similar. Often candidates wrote the same answer to both parts **(iv)** and **(v)**. A large number of candidates wrote that the triangles were enlargements or in proportion without using the correct term, similar.

(vi)(a) Many candidates did not gain full marks on this question due to rounding their answers to less than 3 significant figures. Good solutions with clear and correct use of trigonometry did not gain full marks because the answer was given as 6.2 instead of 6.21. Candidates should be reminded of the clear instructions given on the front page of the paper which directs candidates to give answers to 3 significant figures. Other common wrong answers were 5.4 cm, from treating the triangle as isosceles, or 3.5 cm from using cos instead of tan.

(vi)(b) Candidates were slightly more successful in finding the length of side *OA*. The majority of more able candidates identified that they needed to use Pythagoras' theorem to find the hypotenuse of the triangle and many were able to gain full marks on a follow through even if part **(a)** was answered incorrectly. Again a very common error was to round answers to 2 significant figures instead of 3; 8.2 was seen often. Many candidates missed out on possible follow through marks by not showing any working out and rounding their solution to 2 significant figures. Without working no marks were awarded for a follow through unless it is correct to 3 significant figures.

(vi)(c) Candidates demonstrated that they knew the formula for the area of a circle and generally were able to earn full marks as a follow through from an incorrect answer in part **(a)**.

(b) A large proportion of candidates chose not to attempt this part of the question. This was another 'show that' question and a significant number of candidates used the 900° given in the question to show that the sum of the interior angles of the polygon is 900° ($\frac{900}{7}$ = 128.571… × 7 = 900).

Candidates should be reminded that if asked to show a value, not to use it in their answer. Despite the diagram, many wrong answers attempted to find the interior angles of a regular heptagon rather than the diagram shown.

Answers: **(a)(i)** Radius **(ii)** (Angle between) tangent (and) radius **(iii)** 41 **(iv)** Corresponding (angles) **(v)** Similar **(vi)(a)** 6.21 **(vi)(b)** 8.23 **(vi)(c)** 121 **(b)** 5×180

Question 6

(a) Identifying the missing values in the table was well answered by all candidates.

(b) There was good plotting of points seen. The follow through from part **(a)(i)** was seen often. Very few straight lines joining points was seen and even fewer thick or feathered curves drawn.

(c)(i) Candidates found drawing the line of symmetry more challenging. Successful candidates used a ruler and drew the line the full length of the grid. However a number of candidates lost the mark because they drew the line freehand.

(ii) Candidates who had drawn the correct line in part **(i)** generally gave the correct equation for the line.

(d)(i) All candidates were able to gain full marks by correctly plotting the points and joining with a straight line.

(ii) Candidates were less successful at identifying the *x*-coordinate of each point of intersection of the curve and their straight line. This was mainly due to reading the negative part of the *x*-axis incorrectly. Many candidates gave the correct figures but did not include the minus sign or read their values from left to right across the *x*-axis instead of from right to left, e.g. –1.5 given instead of –0.5 or –4.5 given instead of –3.5.

(iii) Finding the slope of their straight line was one of the most challenging questions on the whole paper with a large proportion of candidates choosing not to attempt it. A number of more able candidates correctly identified the slope as –2 but then wrote their answer as the equation of the straight line. Candidates should be reminded to check they have answered the question in the form asked for. A common error was to not take into account the fact that the scales on both axes were not equal. A common wrong answer of –1 was seen from $\frac{-10}{10}$ rather than $\frac{-10}{5}$.

Answers: **(a)** 7, –2, 7, 14 **(c)(ii)** $x = -1$ **(d)(ii)** –3.3 to –3.5, –0.5 to –0.7 **(iii)** –2

Question 7

(a) (i) Working with money proved to be one of the most successfully answered question of the whole paper. The vast majority of candidates were able to multiply 400 by 12 correctly and reach the answer of 4800.

(ii) Similar to part **(i)** candidates successfully found the amount spent on furniture with very few errors seen.

(iii) Candidates who had correctly answered parts **(i)** and **(ii)** were able to calculate the amount of money remaining. The only common error was not including the $800 for office equipment in their subtraction, leading to the incorrect answer of $1008.

(iv) Candidates showed good understanding of working with money by correctly dividing their answer to part **(iii)** by the cost of one box of paper. The vast majority of candidates were then able to correctly interpret their decimal answer and give the correct number of boxes. Very few candidates left their answer as a decimal although these candidates gained one mark for the correct method.

(b) Compound interest continues to be a challenging topic for many candidates. Good solutions generally came from using the formula $(2000 \times (1 + 0.05)^3)$. However a number of fully correct solutions were seen where candidates had calculated the amount at the end of each of the three years. Many candidates were able to quote the formula and substitute correctly but made errors in using their calculator. Less able candidates often calculated simple interest instead of compound interest which gained no marks.

Answers: **(a)(i)** 4800 **(ii)** 192 **(iii)** 208 **(iv)** 42 **(b)** 2315.25

Question 8

(a) Giving the order of rotational symmetry of diagram 1 was challenging to most candidates with the correct answer of 2 only seen from more able candidates. Common wrong answers were 4 or 180° and some did not attempt this question.

(b) The vast majority of candidates gained full marks on this question by correctly completing diagram 4.

(c) Candidates were equally as successful at completing the table. The number of crosses and dots for diagram 4 was correctly identified by nearly all candidates. The most common wrong answer was 26 dots for diagram 5, adding 8 to 18 instead of 10.

(d) (i) Writing a worded description of the rule for continuing the sequence was challenging for most candidates. A common wrong answer was to write the *n*th term given in part **(ii)** in words. Many candidates showed they understood how the sequence continued but found describing it in words difficult, the key part that the amount added on each time went up by 2 was not described with enough detail.

(ii) Candidates successfully substituted 12 into the formula for Diagram *n*. Common errors following correct substitution was to subtract 12 instead of adding and writing $12^2 = 24$ instead of 144.

(e) (i) A large proportion of less able candidates did not attempt both parts of part **(e)**. However those that attempted part **(i)** usually gained marks for a correct answer or a part mark for $2n$ or $+2$. Some answers of $n + 2$ were seen.

(ii) Candidates who correctly answered part **(i)** generally gained full marks for finding n. The most common error was substituting 100 into their expression in part **(i)** instead of making their expression equal to 100 and then solving.

Answers: **(a)** 2 **(c)** 18, 28, 10, 12 **(d)(i)** Add two more each time **(ii)** 154 **(e)(i)** $2n + 2$ **(ii)** 49

Question 9

(a) (i) Most candidates were able to measure the line BQ to the nearest mm.

(ii) Candidates who measured the line BQ accurately in part **(i)** gave the actual distance by multiplying their measurement by 150.

(iii) Candidates found measuring the bearing very challenging. The majority of candidates showed little understanding of bearings with the most common answers being a measurement of length rather than an angle or 40° which was the angle from south measured in a clockwise direction or 140°, which was the angle from North measured in a counterclockwise direction. Some evidence of correct measuring was seen. However few candidates showed the ability to use a protractor accurately when measuring a bearing.

(b) Candidates showed a better understanding of bearings and scale drawing in part **(b)** than in part **(a)**. The majority of candidates scored at least 1 mark, with the majority scoring 2 marks for a line 14 cm long. The length was more successful than the angle. Some candidates did not mark the point with a cross or dot. These candidates often just wrote the letter M. This is unacceptable as an answer as it is not clear where to measure to. Candidates must make their position clear by using a dot, cross or a line joining their position of M to Q.

(c) (i) The majority of candidates gained 1 mark for this question by correctly dividing distance by speed to calculate time. However rounding again caused most candidates difficulty with the correct value 3.818181… often rounded to 3.81 or 3.8. Understanding of time and converting time from decimal time to hours and minutes caused most difficulty as many candidates attempted to change 3.81 or 3.82 to 4.21 or 4.22 in this part.

(ii) Candidates who had already attempted to change their time from 3.81 to 4.21 often then wrote their times as 4 h 21 minutes in part **(ii)** and similarly for other times. Very few correct conversions from decimal time to hours and minutes were seen.

Answers: **(a)(i)** 4.4 **(ii)** 660 **(iii)** 220 **(c)(i)** 3.82 **(ii)** 3 (h) 49 (min)

MATHEMATICS (US)

Paper 0444/41
Paper 4

Key Messages

To score well in this paper, candidates needed to have a good understanding and knowledge of all of the topics on the extended syllabus.

Candidates need to ensure that they read the questions carefully and answer the questions to the required level of accuracy. This is to at least 3 significant figures unless directed otherwise. In addition π should be used from the calculator or as 3.142. Using 3.14 or $\frac{22}{7}$ will not in general give the required accuracy.

All diagrams should be completed in pencil and a ruler should be used when appropriate.

In questions that require showing working or have the word 'show' in them, candidates should show all steps in their working. In addition, in 'show' questions, candidates should work towards the result rather than using the given result.

General Comments

Some candidates demonstrated knowledge across the syllabus but some had little or no understanding about many of the topics examined. The majority of candidates attempted every question on the paper but a number of candidates seemed to write down random answers which came from no working and bore little resemblance to the question. When candidates recognised parts that they could answer they were able to successfully complete these questions.

The most able frequently showed that they had understood the concepts and were able to apply their knowledge to problem solving. These candidates generally presented their solutions clearly. The less able candidates often presented their work poorly and it was at times very difficult to follow their thinking and award any marks.

Whilst most candidates followed the instructions in the rubric there were some marks lost due to inaccuracy of answers. These were generally from rounding within the middle of a calculation, using an inaccurate value of π, giving answers to the nearest dollar instead of the nearest cent, or not giving answers to at least 3 significant figures.

Candidates should be particularly careful regarding units whether it be changing litres to cm^3 in **Question 6** or working in cents or dollars in **Question 2**.

The topics which were answered most successfully included money, percentages, transformations, basic functions and basic algebra. The weaker topics included volume, graphs, statistics and bearings.

Comments on Specific Questions

Question 1

(a) (i) Throughout part **(a)**, there were many diagrams drawn freehand and some very poorly. Work was often done in ink and then crossed out and attempted again; these answers were very difficult to mark. Those correctly using the mirror line $y = 4$ usually gave a clear and accurate triangle. The most common error was a reflection in the x-axis ($y = 0$). There were only a few who chose to reflect in $x = 4$ or in any other $y = k$.

(ii) Most correctly rotated by 90° counterclockwise but some candidates used the incorrect centre, usually a vertex of the triangle. There were also some that used a clockwise rotation and others did not maintain the shape/size of the triangle. The majority of those who chose to use construction lines for their rotation often 'missed' the correct vertices by up to a quarter square or lost the triangle size and shape in the process, scoring no marks.

(iii) The translation seemed to be the most challenging for the candidates. A correct translation or a wrong translation of $\begin{pmatrix} -5 \\ +1 \end{pmatrix}$ were seen in equal quantity. The one mark for a correct x or a correct y translation was rarely given.

(b) (i) Enlargement or dilation were usually seen, but "grows" "minimises" "shrinks" and occasionally "negative enlargement" were not accepted. A centre of enlargement was attempted, but only a few obtained the (5, 5). The most common error in the scale factor was $\frac{1}{2}$ or 2 instead of the negative $\frac{1}{2}$. Completely incorrect answers included multiple transformations and properties and not single transformations, as required by the question. Many were describing an enlargement with a rotation and a translation, indicating that the candidate did not understand the concept of the centre of enlargement being the key to the movement of the shape, and the negative scale factor producing the rotation.

(ii) Most candidates recognised that this was a stretch and many also gave the factor of 3. However, the 'y-axis is invariant' was often missing or inadequately indicated as "the y's don't change".

Answers: **(b)(i)** Enlargement, (5, 5), sf –0.5 **(ii)** Stretch, factor 3, y-axis invariant

Question 2

(a) (i) Many candidates were unable to deal with the fact that some values were in cents whilst others were in dollars. The majority of candidates correctly worked out the total cost in cents but many did not convert their answer to dollars, and some divided by 10 instead of 100. A small number only included one day's fixed charge instead of 90 days.

(ii) Only a minority gave the correct answer with many writing \$32.02 as their answer. This common error came from calculating 176.11 ÷ 5.5. There were a few who calculated 90 × 24.5 in cents correctly and then attempted to subtract the result from 198.16. Again there were some who did not appreciate the need to find 90 × 24.5 so only subtracted one lot of 24.5 and others simply calculated 198.16 ÷ 5.5 or 198.16 ÷ 90.

(b) A large number wrote a concise method leading to a correct answer. Many others gave the correct answer but it was evident that they calculated the interest one year at a time. Often in these cases inaccuracies arose from rounding the intermediate totals which lead to wrong final answers. There were also many who calculated the simple interest instead of the compound interest.

(c) (i) There were many correct answers but answers of 1.4 and 140 were frequently seen. A significant number of candidates had the calculation the wrong way round, finding 2.2 as a percentage of 7.7. There were also quite a number who assumed an exponential increase, which was the requirement for the next part.

(ii) More able candidates had no problem in reaching the correct answer, and many others earned one method mark. Errors occurred when candidates needed to convert the answer they got from finding $\sqrt[3]{1.4}$ to a correct percentage. A common incorrect answer was 12% which in many cases came from trials which were seen, but it may also have come from candidates rounding their cube root to 1.12 without showing a more accurate answer. Less able candidates just divided their answer to part **(c)(i)** by 3.

(d) Few candidates appeared to have any idea of what was needed and $\frac{390}{5} = 78$ was a common incorrect answer.

(e) Many candidates correctly divided by 1.033, but the common error of finding 3.3% of $258.25 and either adding or subtracting it from $258.25 was seen very frequently.

Answers: **(a)(i)** 275.31 **(ii)** 3202 **(b)** 17.0 **(c)(i)** 40 **(ii)** 11.9 **(d)** 150 **(e)** 250

Question 3

(a) Most candidates correctly identified the modal group although a number gave $72 < t \leqslant 73$ or $70 < t \leqslant 75$.

(b) Few candidates were able to start any meaningful work with many simply writing an answer down, most commonly 72.5.

(c) (i) Few candidates correctly wrote the cumulative frequencies, most simply restating the frequencies.

(ii) The great majority correctly plotted their points at the correct heights but then wrongly drew bar charts.

(iii) Most candidates answered this question, even if they had not drawn a cumulative frequency graph. Those who had a correct increasing graph usually gave an answer in range. Those whose graphs were not correct were unlikely to gain a mark, although occasionally a candidate used linear interpolation successfully. Many simply wrote 72.5 as their answer

(iv) This was less well answered. Using the values on the axes, particularly the vertical axis, proved a problem for some. This meant that some of the values read from the graph were slightly out of range. Many quoted only one of the quartiles but did not identify which one. Again, less able candidates simply wrote down 72.5 again.

(d) Very few candidates were able to make any progress in this question. Many calculated that the speed for the first 2000m was 180 km/h so found the mean of 180 and 190 and gave the answer 185. Of the few marks that were awarded, most were one mark for $\frac{1.72}{190}$.

Answers: **(a)** $71 < t \leqslant 72$ **(b)** 72.3 **(c)(i)** 41, 62, 80, 90 **(iii)** 72.1 to 72.4 **(iv)** 1.9 to 2.2 **(d)** 184

Question 4

(a) Some of the more able candidates got this correct. The most common error was 0.4 from $y = 1$ rather than $x = 1$. Poor reading of the scale led to answers of −0.8 (8 squares below) or −1.8. A response of 1 was seen a few times and some gave a range. Together with a lot of candidates who missed this question out, this clearly showed that many did not understand the notation used in the question.

(b) This part was answered correctly by a few more candidates than in part **(a)**. A common incorrect answer was $x = 0.5$ and again quite a lot did not understand the notation and gave a range.

(c) Most candidates struggled with this and there was a great variety of incorrect responses. Of those who had more understanding, −3.8 or −3.9 were often seen instead of −4. The more able candidates gave a value −4 and a range to 10 with only the best candidates using correct inequality signs in their answers.

(d) The solution to the equation was poorly done, apart from by the most able candidates. Many did not draw a line and of those who did, many drew $y = 5$ or read the scale wrongly, often resulting in a line through (−1, −7) and (1, 3).

(e) It was evident that few candidates knew what the word tangent meant as most candidates did not attempt to draw a tangent. Of those that did, most were drawn in the wrong place, often at (0.5, 1).Tangents were required to be ruled and touch the curve. Tangents that were chords or that did not touch the curve were not accepted. Poor reading of the scale, omission of the negative sign and run/rise prevented many who gained the mark for drawing the tangent achieving all of the other marks.

Answers: **(a)** –1.6 to –1.4 **(b)** –0.5 **(c)** $k > -4$ **(d)** –2.3 to –2.1, –1.2 to –1.1, 1.3 to 1.4 **(e)** –6 to –4

Question 5

(a) Candidates were often able to find h(2) successfully.

(b) Few candidates scored full marks and there were a significant number of blank responses. Some candidates were able to set up the expression $(2x – 1)^2 + 1$ and earned the first mark. Answers of 4, −4, 1 were seen from those who expanded the brackets correctly but forgot to add the extra 1. Expanding the brackets caused problems for many. However, there were some good attempts at comparing coefficients clearly related to their answers.

(c) Finding the inverse function proved challenging for most candidates. Many interpreted 'inverse' as swapping positive and negative signs or writing reciprocals. Common errors included $–2x + 1$ and $\frac{x}{2} + 1$.

(d) The correct answer was rarely seen. The common incorrect answers were 3, 5 and 0.5.

Answers: **(a)** 9 **(b)** 4, –4, 2 **(c)** $\frac{x+1}{2}$ **(d)** $\sqrt{3}$

Question 6

Despite the formulae being at the front of the paper candidates frequently struggled to select the correct formula and/or copy it correctly into their work space.

(a) (i) This question was done poorly with many candidates not using the correct formula for the volume of a cylinder. The formula is not on the formula sheet so many candidates wrongly used the formula for the "Lateral surface area" of a cylinder. Of the correct solutions either 50 893.8 or 50 900.4 (from 3.142) needed to be seen. Candidates giving 50 868 (from 3.14) or 50914 (from $\frac{22}{7}$) were only awarded one mark as these answers didn't use values of π as given in the rubric. Some candidates did not quote an unrounded answer before giving 50 900.

(ii) Most candidates had no idea how to approach this question and many made a guess of 25 because it looked like half the height on the diagram. Of those who made a reasonable attempt common errors included forgetting to do the subtraction to get the height of space left rather than the height of the coffee or from being unable to convert 30 litres into cm^3 or using an inaccurate value for π.

(iii) The 30 litres was a problem here again. More common however was not recognising that the cup was a hemisphere, or using the volume of a cone. There were misunderstandings of process such as litres $\times$ volume rather than divided. Some candidates introduced rounding errors (particularly with the $\frac{1}{3}$ and the π) that resulted in an incorrect answer.

(b) (i) Some candidates showed understanding that they needed to solve an equation with *r* and the 95. However for many the algebraic manipulation proved to be too challenging. In addition, the use of π did cause some errors, but those who continued to use their calculator display could sometimes obtain the answer of 3.28(6…). Many candidates started with the 3.3 and these candidates were not given credit.

(ii) This part proved to be too challenging for most candidates and the majority did not recognise that Pythagoras' theorem needed to be used to get the slant height.

Answers: **(a)(i)** 50890 **(ii)** 20.5 **(iii)** 334 **(b)(i)** 3.28(6..) **(ii)** 93.1 to 93.6

Question 7

(a) (i) A number of candidates answered this correctly. Those who did not score 2 marks nearly always scored 1 mark for $8x + 20$ or better. The most common wrong answer was $–7x – 15$. This was usually from the expansion of the second bracket as $–15x – 35$.

(ii) Again a number of correct answers were seen but a number of arithmetic errors were also seen. The common wrong answer was $x^2 – 49$. Some spoiled the correct expansion by going further to factorise again as $(x – 7)(x – 7)$. A few candidates found the constant term to be $+14$ rather than $+49$.

(b) The working for part **(b)** was very poor, making the working very difficult to follow and mark. Many candidates were showing the next stage of working and/or crossing out letters and numbers on the same line so that there was never a correct line seen.

(i) There were some correct answers seen but many candidates only scored 1 mark for this question. The first step caused the problem. Many tried to multiply throughout by 3 first but did not multiply the 5 as part of this step, resulting in $2x + 5 = −21$. Most did earn a follow through mark for solving $2x = −26$. Another (less common) error was to add 5 to $−7$ rather than subtract 5 from $−7$. Again, a follow through mark was usually earned for solving $2x = −6$.

(ii) Nearly all candidates expanded the brackets correctly. Those who did not score full marks nearly always made errors with the signs when rearranging terms resulting in $–2x = 30$ or $\pm 2x = 12$.

(iii) A number of candidates correctly rearranged the equation to $3x^2 = 75$. Some continued correctly scoring full marks or 2 marks for $+5$ with no negative solution or $+5$ and $\sqrt{25}$. A common error occurred when candidates followed the wrong order of operations resulting in $3x = \sqrt{75}$. Many candidates tried to solve the equation using the quadratic formula. Whilst some were successful most rearranged the equation to $3x^2 – 1 – 74 = 0$ and used $−1$ as the coefficient of x and $−74$ as the constant. A few candidates used the difference of two squares as their approach and some were successful.

Answers: **(a)(i)** $–7x + 55$ **(ii)** $x^2 –14x + 49$ **(b)(i)** $–18$ **(ii)** 15 **(iii)** 5, $−5$

Question 8

(a) Few correct answers were seen. There was some confusion seen with candidates subtracting the *x* and *y* co-ordinates as though they were finding the slope.

(b) Candidates struggled with this part. Common errors included inverting the fraction resulting in the slope being $-\frac{1}{2}$ rather than –2 or in adding the co-ordinates in both the numerator and denominator giving $\frac{6}{-1}$ or errors arising from slips with signs. However, from all these errors, 1 follow through mark was often awarded for the correct substitution of the co-ordinates of *A* or *B* into their $y = mx + c$. Many candidates missed out this part and the subsequent parts.

(c) Candidates also struggled with this part. A few candidates scored 2 marks for the correct equation or correct follow through equation. A few others scored 1 mark usually for a follow through for their slope with *k* incorrect or sometimes for $y = kx + 7$. The SC mark for the omission of *y* was occasionally awarded.

(d) This part of the question caused most problems with very few scoring full marks and the rest either omitting the question or having no idea what was required. Most candidates who attempted the question did not know how to find a perpendicular slope from their part **(c)**. The format of the answer $ax + by = d$ also proved to be an obstacle for any of those who managed to reach $y = \frac{1}{2}x + 4\frac{1}{2}$.

Answers: **(a)** $(-0.5, 3)$ **(b)** $-2x + 2$ **(c)** $y = -2x + 7$ **(d)** $x - 2y = -9$

Question 9

(a)(i) This was very poorly answered with many angles clearly not representing a possible bearing. Those who did gain the marks usually found the 70° and subtracted from 360°. A common incorrect answer was 70°.

(ii) Continuing down the north line and supposing a 90° angle with *BC* was very common. The diagram was not to scale and candidates should not assume that *CB* was a West to East line. This often spoilt the question and many gained just one mark for angle *ABC* equal to 10° (or occasionally their angle if allowable). Many, although mostly more able candidates, did avoid that trap and realised the sine rule was needed. This was generally successful.

(iii) Again this part was not answered well, partly due to the incorrect earlier parts but mainly because candidates did not realise that the shortest distance had to be a perpendicular. Those who did realise a perpendicular was needed, and did not use the error of extending the north line, did succeed here. Some just found *BC* using the cosine rule and a few gained the SC mark, after losing marks earlier.

(b)(i) While this mark was gained by many candidates, there was a tendency to start with the expansion or not make it clear that $x(x - 25)$ was an expression for the area before putting the expansion equal to 2200. Many just wrote the expansion and assumed that transferring the 2200 to the right hand side would be enough. Some thought that a calculation was needed and wasted much time on what was a 1 mark part.

(ii) To obtain full marks, clear and accurate working demonstrating a correct method was required. However, considering the formula for solving quadratics was given on the formula sheet, many either ignored it or had little idea how to apply it. Many did not attempt the question at all, although some of the more able candidates did earn all 4 marks.

Answers: **(a)(i)** 290 **(ii)** 156.8 **(iii)** 8.68 **(b)(i)** $x(x - 25) = 2200$ **(ii)** $-36.04, 61.04$

Question 10

(a) (i) This straightforward part was answered correctly by most candidates. However, a few candidates either gave –3 and 5 or 13 and 21 as their answers. Others did not know it was as simple as the substitution of 1 and 2 and thought it had to be more complicated.

(ii) Most candidates managed to gain the marks from either writing down the equation $8n - 3 = 203$ and working out $n = 25.75$ or from showing evidence of substituting and evaluating $8n - 3$ for $n = 25$ and 26. Although many candidates started off correctly, errors were unfortunately shown in arithmetic.

(b) (i) While the expression for the *n*th term was done well, there were a considerable number of candidates who did not read the question and who gave the next term, 37, rather than the *n*th term. Some gave $n + 6$ or $7n + 6$ and a few gave an incorrect constant term.

(ii) This was not as well done as part **(b)(i)** but many gained at least 1 mark from either a quadratic expression or finding a second difference of 2. Many others gave a linear expression or did not attempt the question. This was a question that in general only the more able candidates succeeded in gaining the 2 marks.

(c) Many candidates gave the correct answers, often with no working. Many showed a lot of disconnected workings much of which did not seem to be leading anywhere. However, quite a lot of those cases ended up with at least one of the answers correct.

Answers: **(a)(i)** 5, 13 **(b)(i)** $6n + 7$ **(ii)** $n^2 + n + 2$ **(c)** 10, 14