MATHEMATICS (US)

Paper 0444/11

Paper 11 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to apply formulae correctly and to give answers in the form required.

General comments

Candidates must check their work for sense and accuracy as it was very noticeable that there were many answers in context that made no sense and numerical errors that lost candidates' marks. Candidates must show all working to enable method marks to be awarded. This is vital in two-step problems, in particular with algebra where each step should be shown separately to maximise the chance of gaining marks, for example in **Questions 4**, **15**, **17**, **18** and **19(b)**. This will also help candidates check their own work.

The questions that presented least difficulty were **Questions 4**, **7**, **10(a)**, **11**, **12(a)** and **13**, Those that proved to be the most challenging were **Questions 3(a), 12(b)**, **14(b)**, **15**, **16(b)**, **19(b)**, **21** and **22**. The questions that showed the highest number of blank responses by far, were **Questions 14(b)**, (write a formula), **19(b)** (solve an equation for *x*) and **20** (solve a system of equations). It is more likely that the blank responses were down to the syllabus area of these questions rather than lack of time

Comments on specific questions

Question 1

Less than half the number of candidates gave the correct answer to this question which was expected to be a straightforward start to the paper. Many candidates had difficulty with this question and common errors included confusing the x and y directions and incorrect use of negative signs. Few candidates treated the vector as a fraction, including a horizontal line between components.

Answer: $\begin{pmatrix} 7 \\ -4 \end{pmatrix}$

Question 2

Many candidates gave truncated values as their answer to part **(a)** such as 15.0 or 15.07 or rounded to an incorrect number of decimal places. Also, some changed the position of the decimal point giving answers of 151 or 1.51. In part **(b)**, integers such as 10, 15 or 16 were seen instead of the correct answer.

Answers: **(a)** 15.1 **(b)** 20

Question 3

Most candidates were able to identify some letters with reflection symmetry, but many made errors or omissions. Identifying Z as the only letter with rotation symmetry proved difficult for many, with extra letters being listed by many candidates, in particular B or E.

Answers: **(a)** E B A **(b)** Z

Question 4

Common incorrect answers assumed the diagram contained parallel lines so answers such as 105, 75 or 98 were seen. Some candidates did score the method mark for 67 but as this was a two-step problem, the 67 needed to be subtracted from 180. Some who used the sum of angles in a quadrilateral forgot to include the right angle in their subtraction.

Answer: 113

Question 5

The majority of candidates placed the numbers in order with some omitting the multiple copies of 132. After a correct ordering, some candidates went on to pick out the 6th number rather than realising that the middle of 12 values is half way between the 6th and 7th values. After the correct first step of ordering the data, some still went on to find the mean so candidates must remember the differences in the three averages and how to find them. Some however, found the value half way between 145 and 163, the centre of the given unordered list.

Answer: 137

Question 6

Candidates did well with this question with sufficient workings to show correct conversion of fractions to decimals.

Answer: 0.096 $\frac{2}{3}$ 75% 0.78 $\frac{3}{2}$

Question 7

This question was answered well by the majority of candidates, most of whom showed complete and convincing working. Some candidates made arithmetical errors which should have been picked up when checked. Some ignored the need for a common denominator and simply added the numerators and the denominators to give $\frac{2}{10}$ cancelled down to $\frac{1}{5}$.

Answer: $\frac{5}{12}$

Question 8

Most candidates made a sensible attempt at factorisation, with many being able to factorise correctly. However many did not factorise the given expression completely. A large number of candidates made algebraic errors. A single mark was available to those candidates who gave a correct partial factorisation.

Answer: $4w(2wx - 3y)$

Question 9

Some candidates did not realise that they needed to half their answer of 960 cm^2 to reach the area of the sign made up of two triangles. Other candidates used methods that did not show understanding of area formulae.

Answer: 480

Question 10

There were many correct answers to part **(a**), the most common error being to identify one of the extreme values, with −11 being chosen much more frequently than −1. There were only a few candidates who gave an answer which was not one of the given values. Part **(b)** proved to be more challenging. Many candidates seemed to be under the impression that −11 was greater than all of the other numbers and that −1 was the smallest of the given values, so that a correct answer of −3 in part **(a)** was often followed by an incorrect answer of 1 in part **(b)**.

Answers: **(a)** −3 **(b)** 4

Question 11

The weaknesses in algebra skills of many were exposed in this question as less able candidates were unable to collect the terms correctly. Answers involving 15 + 8 or $10x + 6x$ were very common. Almost all of the candidates who were able to collect the terms went on to produce the correct expression but a number of candidates seemed very confused about what was required and added an equals symbol, for example arriving at $4x = 23$, before going on to attempt to solve their resulting equation.

Answer: $4x - 7$

Question 12

It appeared that many candidates had not read either part very carefully. Consequently, in part **(a)** many candidates spoiled correct answers by including extra numbers that did not meet the criteria. Others gave even numbers or numbers with only one digit that were factors of 182. It was acceptable to give both correct factors, 13 and 91, as long as this answer was not spoilt with any other value. Often those that identified 91 as their answer to part **(a)**, went on to include it in the list of prime factors in part **(b)**. A significant number of candidates thought that 1 was a prime number. Some gave lists of all factors rather than just the prime factors.

Answers: **(a)** 13 or 91 **(b)** 2, 7, 13

Question 13

Generally, candidates did well with both parts with the occasional incorrect answer to part **(a)** being 2 800 or 2.8 × 100. In part **(b)**, many got as far as 5 000 000 but were not always successful in putting this into correct scientific notation.

Answers: **(a)** 280 **(b)** 5×10^6

Question 14

This question caused significant difficulties with a high number of answer lines left blank. Many candidates started part **(a)** by working out how much it cost to hire the bicycle for a day and subtracted that from the total charge. Candidates divided this by the daily charge to get an answer of 3 days hire but then the first day was ignored. Others divided $39 by $6 to obtain 6.5 days or even 6 or 7 days which showed a misunderstanding of the context. The misunderstanding of the context also was noticeable in part **(b)** as many candidates were unable to construct the correct function.

Answers: **(a)** 4 **(b)** $15 + 6d$

Question 15

This question had no scaffolding so candidates were left to determine the approach, which raises the difficulty level of the question. A number of candidates evaluated the exterior angle, but were unable to make any further progress. Attempts that involved the sum of the interior angles being $180\times(n-2)$ were very common, but rarely resulted in a complete method. The majority of the less able candidates appeared to attempt various spurious calculations involving 360 or 180 and the given angle. A few candidates gave nonagon as their answer without showing any working. Only the most confident of candidates arrived at the correct answer after showing minimal or no working.

Answer: 9

Question 16

There were many correct answers to part **(a)**. The majority of candidates realised that an angle of 90° was involved in the question, however a significant number incorrectly identified x as being a right angle. There were fewer correct answers to part **(b)**, with candidates often making errors in identifying which angles were alternate, or believing that angle y was equal to angle *OAC*, or suggesting that *BAC* was a right angle. The vast majority of candidates who started by labelling some of the missing angles on the diagram gained at least one mark for part **(b)**. In this part, candidates gained marks for a follow through of their answer to the pervious part as long as that value was viable as an angle in the diagram.

Answers: **(a)** 66 **(b)** 42

Question 17

Questions on interest have two aspects for candidates to consider; compound or simple interest, total interest earned or the total interest and the principal? If candidates consider these two aspects they should be able to get at least some marks. This question wanted the total interest Dominic has after 2 years but many candidates added the principal to the interest giving $882 as their answer. A significant number of candidates attempted simple interest rather than compound and made numerical errors in their calculations.

Answer: 82

Question 18

This was another question without scaffolding leaving candidates to determine their method. This required two steps so working is vital to see where the candidates' answer comes from. The majority were able to perform a correct currency conversion, but only a minority went on to evaluate the correct final answer. Working that involved a mixture of currencies was not uncommon, for example converting $30 to euros, €24 to dollars and then using both the resulting values in a subtraction. Candidates should be aware that the instruction to give the answer in dollars does not mean the same as to the nearest dollar.

Answer: 1.20

Question 19

In part **(a)**, the two most common errors involved the negative sign, leading to an answer of −80 or squaring the 5 as well as the −4. Some wrote the correct $5(-4)^2$ but still gave their answer as −80. In part **(b)**, candidates struggled with correctly rearranging the formula.

Answers: **(a)** 80 **(b)** $zy - w$

Question 20

There were three main methods used by candidates. The majority of candidates attempted an elimination method, usually with some success. It is worth candidates looking at the equations to see what the simplest multiplication that needs to be done is to keep the numbers small and minimise sign errors. Here, the simplest method was to multiply the first equation by 2 to equate the coefficients of y and those who attempted this method were often successful. A number of able candidates made an error in the final stage of calculating y, when $26y = 13$ was followed by $y = 2$. A second method used was to rearrange one equation and substitute it in the other equation but this was not common. Candidates often make more errors with this method as there is probably a denominator to take into account. Also, candidates can get confused with this method and substitute back into the equation they have already used. A significant number rearranged both equations to make x the subject (or y), equated the two resulting equations and solved this. A few candidates used Cramer's Rule which is fine as long as candidates know exactly what they are doing but frequently they go wrong at one stage or another. There were many arithmetical errors in all methods and negative signs also caused difficulties for a large number of candidates.

Answer: (x =) 3, (y =) 0.5

Question 21

Candidates were not confident with what was expected for part **(a)**. Some candidates drew a triangle with the three points on the circumference but the triangles were not sufficiently accurately drawn so as to be able to be awarded a mark. Part **(b)** could be answered without attempting part **(a)** but as this answer was sometimes left blank it was not clear whether candidates thought their two answers must be connected or instead did not understand the mathematical terminology used.

Answer: **(b)** 60

Question 22

The syllabus area of this question is often challenging for candidates. There was a clue in part **(a)** as to what form the answer should take. In general, candidates gave the lower value but instead of the 36 expected, candidates gave infinity as the top value. There were some very accurate graphs drawn for part **(b)** as well as answers that showed little understanding of what was required.

Answer: **(a)** $1 \leq f \leq 36$

MATHEMATICS (US)

Paper 0444/13

Paper 13 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required.

General comments

The vast majority of candidates could make an attempt at most questions and candidates did not appear to have a problem completing the paper in the allotted time.
It is important that candidates understand the correct form for answers - probability should not be written as a ratio and vectors should not contain a fraction line. When solving a non-calculator question where the instruction to show each step of the working is clearly stated, candidates should realise that marks will be lost if working is not shown.

Answers to **Question 20** suggested a small number of candidates did not have access to, or were not able to use, a pair of compasses correctly. Candidates should be reminded to give answers to 3 significant figures. There were several questions where candidates lost marks for either truncating answers or premature rounding.

Comments on specific questions

Question 1

This question was generally well answered. A small number of candidates did not give the answer as a fraction.

Answer: $\frac{13}{100}$

Question 2

(a) This was not well answered considering it was a straightforward question. 300 4620 was a common incorrect response.

(b) Many candidates did not know how to round to 3 significant figures and 305 with zeros missing was often seen. Only a small number of candidates gained the mark following through from their answer in part **(a)**.

Answer: **(a)** 304 620 **(b)** 305 000

Question 3

(a) The term rotational symmetry was not well known. Several candidates did not answer the question and there were a variety of incorrect answers, 4 being the most common.

(b) There were many correct responses in this part. The most common errors were extra lines usually vertical and horizontal.

Answer: **(a)** 2

Question 4

(a) Many correct answers were seen, but several gave the answer as a probability.

(b) This part was not well answered. Several candidates did not relate the question to the diagram and 15 was a common incorrect answer.

Answer: **(a)** 5 **(b)** 0.75

Question 5

(a) This was generally well answered.

(b) Again most candidates were able to give the correct answer. However a small number omitted the negative sign.

Answer: **(a)** 23 **(b)** −15.5

Question 6

(a) This was generally well answered.

(b) Again the majority of candidates gave the correct answer.

Answer: **(a)** −2 **(b)** 1

Question 7

The majority of candidates were able to correctly answer this question. Some however did not understand the basic rules for subtracting fractions.

Answer: $\frac{2}{15}$

Question 8

Many candidates were able to correctly rearrange the formula. The main error was to subtract 1 from y, rather than adding, but several candidates were able to gain one mark for a correct first step.

Answer: $\frac{y+1}{6}$

Question 9

The majority of candidates gave the correct answer. The most common error was writing 0.1055 before $\frac{1}{10}$.

Answer: 0.0155 $\frac{1}{10}$ 0.1055 15% $\frac{1}{5}$

Question 10

Only the more able candidates were able to score both marks on this question. Many did not know the correct format for scientific notation with 240 000 000 and 24×10^7 being common incorrect answers.

Answer: 2.4×10^8

Question 11

More able candidates realised that an equation was needed, although some wrote $2x + 3x + 4x = 90$. Many candidates did not know how to attempt this question and several did not make any attempt.

Answer: 30

Question 12

Many correct answers were seen. Of those not scoring both marks several scored one mark for working.

Answer: 70

Question 13

(a) The majority of candidates were able to correctly calculate the volume. A small number added the dimensions rather than multiplying.

(b) Most candidates were able to give the correct answer. Incorrect answers seen were 170, 0.17, 17 000 and 17.

Answer: **(a)** 1440 **(b)** 1700

Question 14

(a) The majority of candidates were able to give the correct answer. However a small minority who reorganised the terms finished with incorrect signs. The j term was usually correct for candidates scoring one mark. Some candidates multiplied the terms.

(b) Many correct answers were seen to this basic factorising question. However some did not know how to factorise and gave numerical answers.

Answer: **(a)** $6j - k$ **(b)** $5(p + 2)$

Question 15

(a) This was generally correct. A small number of candidates had not read the question correctly and gave the answers 2 and 6.

(b) This was also generally correct. Some candidates did not choose a two digit number while others confused the term multiple with factor.

(c) This part was found more challenging and a correct answer was rarely seen. 1.5 was a common answer. The term irrational was not understood by many candidates.

Answer: **(a)** 12 **(b)** 60 **(c)** Irrational number between 1 and 2

Question 16

Many candidates were able to give the correct answer. Of those who did not give the correct answer several earned 1 or 2 marks for correct working.

Answer: 9.5

Question 17

(a) This was generally correctly answered, with candidates showing an understanding of scatter diagrams.

(b) This was also generally correct, but several candidates appeared not to be familiar with the term correlation and gave a description. The word increase was often seen.

(c) (i) Many correct answers were seen. There are still a significant number of candidates who do not interpret "a line" as a single straight line. A zigzag line joining the points is still quite common. Some candidates think the line of best fit must go to the point where the axes meet.

(ii) Where a ruled line had been drawn in the previous part most candidates were able to gain this mark.

Answer: **(a)** 16 **(b)** Positive

Question 18

(a) Only a small number of candidates were able to construct an angle bisector. Some just drew a diagonal line between the corners.

(b) Few candidates scored both marks. Many had drawn a line but hadn't used arcs.

Question 19

(a) The majority of candidates scored both marks. Of those who did not many gained one mark for showing that the angle at *D* was 90°.

(b) The majority of candidates knew to use Pythagoras' theorem and most scored both marks. Of the few candidates who did not gain the marks several would have earned one mark had they showed some working.

Answer: **(a)** 71.7 **(b)** 13

Question 20

(a) This was generally correct with the most common incorrect answers being rhombus and parallelogram.

(b) The majority of candidates were able to correctly identify and measure the angle.

(c) Most candidates were able to accurately measure the lengths and the formula was often applied correctly. A small number split the shape into a rectangle and a triangle but this method at times produced errors.

Answer: **(a)** Trapezoid **(b)** 64° **(c)** 24

Question 21

(a) (i) The majority of candidates answered this question correctly.

(ii) Many candidates scored the mark but some wrote the function $3x - 5$ rather than the domain.

(b) The majority of candidates were able to give an acceptable explanation.

Answer: **(a)(i)** −5, 1, 7 **(ii)** −2, 0, 2, 4

MATHEMATICS (US)

Paper 0444/23
Paper 23 (Extended)

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 a suitable level of accuracy.

General comment

There are some topics that candidates do not know well such as cumulative frequency, vectors and functions. Candidates need to be more proficient in calculations especially multiplication and division and where the multiplication involves both numbers greater than 10. Some topics have been learned well such as mensuration, money arithmetic, transformations and scientific notation. In algebra candidates can solve linear equations well but struggle to change the subject of the formula. Methods have been learned but they need to be applied to the problem given.

Comments on particular questions

Question 1

This question was answered well. The few exceptions showed working that divided rather than multiplied or made errors in the multiplication.

Answer: 28 500

Question 2

A common error was to write 0.6^2 as 3.6 and some could not correctly convert 3.6% to a decimal. A few candidates wrote the answer in the complete reverse order because they did not understand the inequality signs. However there was also a hint with the word *smallest* clearly indicating the required order.

Answer: 3.6% < 0.34 < $0.6^2 < \frac{3}{5}$

Question 3

Most responses gave the correct value but it was not always in standard form so 24×10^7 or 240 000 000 were often seen.

Answer: 2.4×10^8

Question 4

The common error was to make the correct expression equal to 180 leading to an answer of 10.

Answer: 30

Question 5

There were two main errors, the first being the use of time multiplied by distance and the second being incorrect division by 0.8, usually errors involving the position of the decimal point.

Answer: 70

Question 6

After obtaining 8, from 16 ÷ 2, some worked out the cube root of 8 to get 2 rather than the cube of 8.

Answer: 512

Question 7

Most candidates knew what was required for this question. Some gave the numbers repeated whilst others gave extra numbers such as 0.

Answers: 1, 2 and 5

Question 8

There was a tendency to leave the two parts as $4\sqrt{5} + 3\sqrt{5}$ without adding them together. Others left the roots in an unsimplified form such as $2\sqrt{20}$ for the first one.

Answer: $7\sqrt{5}$

Question 9

Many candidates found this question to be challenging. However some did get the 60° correct but could not then successfully find the other angle.

Answers: 60°, 120°

Question 10

This question was answered well. Some multiplied the $2x + 5$ by 3 as well as the 8. The other main error was to add 5 to the 24 rather than subtract it.

Answer: 9.5

Question 11

Most of the candidates knew the approximate method but not precisely. Many responses gave the sum of the angles, 2880, as their answer. Some used an incorrect version of the formula, either (18 – 1) × 180 ÷ 18 or (18 – 2) × 360 ÷ 18 were often used.

Answer: 160

Question 12

The most common error was to attempt to square both sides first. Some of those who did make the correct move first by subtracting 2 from both sides then squared both sides but instead of writing $(y - 2)^2$ on the left hand side, wrote $y^2 - 4$. This was also a common error when expanding the brackets. In this question it was unnecessary to expand the brackets at all. Another common error was to perform the three correct operations in the wrong order.

Answer: $8 + (y - 2)^2$

Question 13

The most common error was to answer the question as direct proportionality leading to the answer of 9. Some used the correct method and found the value for k as 48 but then didn't substitute the correct value for x.

Answer: 4

Question 14

Most candidates gave the value 3 but very few obtained 180. However some did give 0, usually from a correct sketch of the graph.

Answer: 3, 180, 0

Question 15

The most common error was to treat this as simple interest and thus the answer 13 200 was seen often. Some candidates did write down the correct formula but found it difficult to work out $12\,000 \times 1.05^2$, whereas those who worked the answer out year by year were usually more successful.

Answer: 13 230

Question 16

In part **(a)** many achieved the correct answer. Most candidates substituted the value 39 but some made errors with the calculation. In part **(b)** most just doubled the expression in part **(a)** so giving an answer of $\frac{1}{2}n^2(n + 1)^2$.

Answers: **(a)** 3025 **(b)** $2n^2(n + 1)^2$

Question 17

There were many different approaches seen to this question. A common approach was to add the first two fractions often with the correct denominator of $6x$ and the numerator of $9 + 4x^2$. Some candidates then added the next two terms of $3 + 2x$ to their numerator without considering the denominator. It was clear that having two terms with a denominator and two terms without one, did confuse many candidates. There were many correct methods with errors, the common one being $2x \times 2x$ given as $2x^2$ or $4x$.

Answer: $\frac{16x^2 + 18x + 9}{6x}$

Question 18

Many candidates found this question challenging. In part **(a)** the common error was to attempt $\overrightarrow{OP}$ rather than $\overrightarrow{AP}$ and in part **(b)** candidates attempted $\overrightarrow{AQ}$ rather than $\overrightarrow{OQ}$. A further error was to write **b** – **a** for $\overrightarrow{BA}$. Very few candidates wrote down the route they were taking in vector terms first; doing so would have assisted them in finding the required expression.

Answers: **(a)** $\frac{1}{2}\mathbf{b} - \frac{1}{2}\mathbf{a}$ **(b)** $\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$

Question 19

In part **(a)** most candidates gave the correct answer. A few gave a rotation or a reflection in the wrong mirror line. Part **(b)** was answered quite well. Some images were the correct size and shape but in the wrong position on the grid.

Answer: **(a)** Reflection in line $y = x$

Question 20

In part **(a)** many candidates treated the composite function hf as a product and so calculated $1^3 \times (-2)^2$. Others used an incorrect order of functions and so worked out 1^3 first and then substituted the result into the other function. In part **(b)** many identified the correct operations and reversed them correctly but put them in the wrong order so $4(x + 1)$ was a common answer. In part **(c)** many used the two functions the wrong way round so a common answer seen was $((x - 1) \div 4)^3$. In part **(d)** many correct answers were seen but answers of 9 and 0 were also seen.

Answers: **(a)** 64 **(b)** $4x + 1$ **(c)** $\frac{x^3 - 1}{4}$ **(d)** 3

Question 21

Some candidates found the two scales difficult to read and there were some misreads from correct positions. In part **(a)** some candidates found the median instead. In part **(b)** it was common for many to read at 500 and give either 15 or 18 as their reading. In part **(c)** most candidates gave the correct values for the first two classes but gave 1.5 in the third class (from 6 ÷ 4), as they had not realised that the class width was smaller than the others.

Answers: **(a)** 3.1 **(b)** $\frac{16}{200}$ **(c)** 18.5 26 3

Question 22

In part **(a)** many candidates achieved the volume of the glass as 48π but then had problems dividing 636 by 48, although some form of cancelling would have helped to make it easier. Some candidates left π in the answer. In part **(b)** a technique for multiplying 48 by 13 would have helped, possibly by separating 13 into 10 and 3 then multiplying or correctly using a method for long multiplication.

Answers: **(a)** 13 **(b)** 12π

MATHEMATICS (US)

Paper 0444/31

Paper 31 (Core)

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. The standard of presentation was generally good and there was evidence that most candidates were using the correct equipment to answer the construction question, e.g. compasses and ruler. Candidates continue to improve in showing their workings and gaining method marks. However many candidates were unable to gain marks in the show/explain questions 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. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

Comments on Specific Questions

Question 1

Many aspects of number work were examined in this question.

(a) Candidates of all abilities found this question challenging. Writing large values in figures proved difficult because of the number of zeros required in the answer and many candidates misread the number given in the question. Very common errors were 63076, 603076, 6300076.

(b) (i) Candidates were more successful in correctly calculating the answer to this sum. A number of candidates chose to round their answer from the calculator to –0.38 without showing the full answer of –0.375 in their working. Another error was to miss out the minus sign from their answer.

(ii) Candidates found this negative number sum easier with the majority of candidates giving the correct answer. Few errors were seen but the most common was a missing decimal point, misread from the candidate's calculator.

(iii) Candidates found choosing the correct inequalities sign more difficult when having to deal with negative numbers. Many candidates who had correctly answered parts **(i)** and **(ii)** chose the incorrect direction for the inequalities sign.

(c) Most candidates found this fractions question challenging. More able candidates found the correct fraction but most then made errors in rounding their answer to 4 significant figures. The most common incorrect answers were 1.67, 1.666 or 1.6667. Many less able candidates had difficulty with the fractions calculation.

(d) (i) This part was very well answered with the vast majority of candidates understanding that any number to the power zero will be 1. The most common error was 8.

(ii) More able candidates gave the correct fraction for this negative indices question. A number of candidates showed some understanding of indices but did not fully process their fraction and gave the answer of $\frac{1}{5^3}$. Some candidates used their calculator but did not convert the decimal answer back to a fraction, so leaving 0.008.

(iii) Candidates showed a good understanding of simplifying algebraic terms with the majority of candidates gaining full or part marks on this question. Common part marks were given for $24x$ or $11x^9$.

Answers: **(a)** 6 003 076 **(b)(i)** –0.375 **(b)(ii)** –2.2 **(b)(iii)** > **(c)** 1.667 **(d)(i)** 1 **(d)(ii)** $\frac{1}{125}$ **(d)(iii)** $24x^9$.

Question 2

This question was attempted by all candidates with the majority able to gain marks in all parts except for part **(a)(i)**. The remainder of the question was well answered giving candidates the opportunity to show their understanding of ratio, percentages, fractions and money.

(a) (i) This 'show that' question proved to be one of the most challenging questions on the paper. All questions of this type require candidates to explicitly show each part of their method. The majority of candidates started their answer with 1.5 litres or 1500 ml and gained no marks because they have started with the value they are being asked to show. Candidates who correctly started with the 540 ml had to clearly show their division by 9 and multiplication by 25 to gain the 1500 ml. Candidates had to show the division by 1000 to gain the final mark.

(ii) Candidates were more successful in this part as they were permitted to use either the 1500 ml or 540 ml. The most common error was candidates dividing 540 by 25 and gaining the incorrect answer of 108 ml.

(iii) Most candidates were able to gain full marks on this question. Some less able candidates calculated 70% of the total amount of fruit juice rather than 70% of their answer in part **(a)(ii)**. Those who had made errors in the previous part were still able to gain full marks in this part.

(b) (i) This question was one of the best answered in the whole paper. Candidates who did not gain the mark generally rounded to an incorrect value of 2.3 or 2.

(ii) The majority of candidates gained full marks with less able candidates still scoring one mark for correctly calculating seven eighths of 16. Candidates who tried to calculate the profit of an individual carton scored no marks.

(iii) Only a minority of candidates scored full marks. Most found the actual profit of 16.60 but compared this to the total amount (52.60) instead of the original cost (36).

Answers: **(a)(ii)** 300 **(a)(iii)** 210 **(b)(i)** 2.25 **(b)(ii)** 52.6[0] **(b)(iii)** 46.1

Question 3

Candidates generally found the transformation parts of this question the most challenging.

(a) (i) The majority of candidates correctly identified the shape, although many different spellings were seen. The most common errors were parallelogram or rhombus.

(ii) Candidates found the calculation of the area of a trapezium challenging. Those who correctly gave the area as 16 generally split it into a rectangle and triangles. Most candidates could identify the units to be cm². Some candidates did not include units despite space given in the answer row for this. Candidates who attempted the formula for the area of a trapezium often went wrong in substituting the wrong values or quoting the wrong formula, often multiplying 6 and 2 rather than adding.

(b) The description of the rotation was attempted by most candidates, with the majority gaining one mark for correctly identifying the transformation as a rotation. Few candidates gained all three marks as most left out one of the two required parts to describe a rotation. A large number of candidates gave the incorrect direction of rotation or the wrong centre, with (–2, 8) often given or the correct values with no brackets.

(c) (i) Candidates found the transformation of the trapezium challenging with many less able candidates choosing not to attempt any of part **(c)**. The trapezium was often reflected in the wrong mirror line. A number of candidates lost marks because one of the points was incorrectly plotted outside the tolerance of the question.

(ii) The translation was the most successful of the three transformations, with most candidates who attempted this question gaining full marks. Again a number of candidates correctly identified the movement but drew one of the corners outside of the tolerance of the question.

(iii) The enlargement was the most challenging of the three transformations, with very few completely correct answers seen. Many attempts were shown with lines drawn from *P* to the trapezium but few were able to draw the correct enlargement. A scale factor of 0.5 proved particularly challenging with many enlargements of scale factor 2 seen.

(d) Identifying an obtuse angle proved to be challenging for a large number of candidates. Often this was left unanswered or wrong angles identified. Some candidates were unsure how to mark an obtuse angle and often compasses were used to construct their own angle rather than drawing an arc at the correct corner.

Answers: **(a)(i)** Trapezium **(a)(ii)** 16 cm² **(b)(i)** Rotation, 90° [anti-clockwise], [centre] (–2, –8)

Question 4

Candidates were given the opportunity to show their understanding of scatter diagrams in this question. Part **(a)(v)** proved the most challenging as candidates were asked to give a worded description of the results shown in the scatter diagram.

(a) (i) Candidates scored well on this question as most were able to correctly plot 3 out of the 4 points. The point which caused most difficulty was K which was often plotted at (11.8, 6.8) instead of (11.8, 6.85).

(ii) Most candidates drew a ruled line of best fit in the correct position in relation to the points. The most common error was to not use a ruler or to join up all the points.

(iii) Candidates who were able to draw a correct line of best fit generally were able to read off a correct value from their graph.

(iv) The majority of candidates were able to identify the correlation, with few candidates giving further embellishments, like weak negative etc. A large proportion of candidates did not attempt this or the next part of the question.

(v) This part proved to be the most challenging as candidates were required to write a worded answer explaining the results in the scatter diagram. Good answers linked the speed and distance correctly, e.g. faster athlete can jump further, or time and distance, e.g. shorter time means longer jumps. Few candidates who attempted to link the correct measurements got it wrong but a large number of candidates simply gave a numerical comparison, e.g. distance jumped is less than time or time is half distance jumped. These do not describe the relationship between the two measurements.

(b) (i) Most candidates attempted this question with some success. Fewer candidates calculated median or mode than in previous years and good answers showed calculations in full. Most lost marks were due to incorrect rounding. Answers of 11.6 were very common which was an incorrect rounding of the correct answer. A number of candidates gave 11.6 as their answer with no working and therefore lost all marks.

(ii) This part proved more challenging for candidates as many felt they had to identify the 5 athletes whose times were less than 11.5 seconds and then to find an average of these values. A number of less able candidates found 3, 4 or 6 athletes or used a total of 11 instead of 12 athletes to calculate their percentage. As in part **(b)(i)** a number of candidates used the correct method but missed out on full marks due to poor rounding. 41.6 was a very common incorrect answer.

(iii) Most candidates showed a good understanding of range. However a number gave the range for the 100 m rather than the range for the long jump. Candidates should be reminded to reread the question once they have answered it to check they have answered it correctly. Some candidates gave the longest and shortest jumps but did not subtract them.

Answers: **(a)(iv)** Negative **(b)(i)** 11.7 **(b)(ii)** 41.7 **(b)(iii)** 2.45

Question 5

This question tested the candidate's understanding of perimeter, area and volume and required candidates to be able to convert between units of measurement.

(a) Very good answers for this question showed the candidate's ability to form and solve an equation. As it was a 'show that' question it also required candidates to show all lines of working out. To gain full marks candidates had to form an equation in x and then solve it showing all lines of working. Many candidates however approached this question using a purely numerical method and only gave x=150 at the end. This very common method gained one of the two marks. Again a large number of candidates used the 150 in their answer and therefore gained no marks.

(b) Most candidates showed an understanding of perimeter but the majority of candidates did not score on this question because they did not add all the sides of the shape together. It was very common for candidates to miss out the two sides without any markings on the diagram.

(c) (i) More able candidates gave very detailed answers to this question, clearly showing the three calculations of area and their addition. Less able candidates calculated it as one rectangle, often giving 24 000 from 50 × 480.

(**ii**) Many candidates correctly followed through their previous answer and gained full marks. A large proportion of candidates chose not to attempt this question or to restart without using their previous answer, usually ending in no marks scored.

(d) (i) Most candidates found this trigonometry question challenging. Good solutions included the correct trigonometric ratio but many candidates were unable to use it correctly to find the value of the angle.

(ii) Few candidates recognised this question as a Pythagoras' theorem question. Of those that did, some incorrectly chose to subtract the squares of both sides rather than add.

Answers: **(b)** 1060 **(c)(i)** 16 500 **(c)(ii)** 2 805 000 **(d)(i)** 78.7 **(d)(ii)** 151

Question 6

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and draw a quadratic curve.

(a) (i) Most candidates were able to attempt this question and many were successful. The most common incorrect answers were those for $x = -2$, given as 12 and $x = -1$, given as 9.

(ii) Points were generally plotted correctly and curves were drawn accurately with smoother shapes and less "sketching" than previously. The most common plotting errors were at $x = -3$ and $x = 3$ where $y = +1$ was plotted instead of $y = -1$.

(iii) This proved to be the most challenging question on the whole paper. Candidates seemed to think that the equation should involve x and y, or 8. $y = 8$ was common as candidates recognised that the answer involved $x = 0$ and substituted this into the original equation. Many candidates gave co-ordinates as their answer. $y = 0$ was also a common error. Many less able candidates chose not to attempt this question.

(iv) Of the candidates who attempted this question most attempted to read from the graph, but some solved the equation algebraically. A large number of candidates read the negative co-ordinate as –3.(...) and some gave 2 positive values e.g. 2.8 and 2.9. Those that attempted to solve it algebraically generally went wrong.

(b) (i) Candidates were successful in plotting the two points correctly and drawing a line which extended beyond their points in both directions. A large number of candidates plotted the second point incorrectly at (2.5, 1) or (–2, –1).

(ii) This question proved very challenging to all candidates. Common errors were to give the gradient as –0.5. Many candidates could give the y intercept as 4. A significant number of candidates gave purely numerical answers or ones involving m and/or b.

(iii) Most candidates attempted this but a large number did not recognise that the scales were different on each axis, giving the y co-ordinate as 6.2 instead of 6.4.

Answers: **(a)(i)** 4, 7, 4 **(a)(iii)** $x = 0$ **(a)(iv)** –2.7 to –2.9, 2.7 to 2.9 **(b)(ii)** [y=] $-2x + 4$
(b)(iii) (–1.1 to –1.4, 6.3 to 6.6)

Question 7

This construction and measuring question was well answered by those who attempted it. The vast majority of candidates used the correct equipment to construct a perpendicular bisector and angle bisector, and most candidates made their construction arcs clear.

(a) This part was the most attempted part in this question and those who gave an answer involving degrees were generally successful. 70–90 degrees was most common for those who gave an incorrect angle measurement. A large number gave an answer in centimetres or kilometres, measuring the distance *AB*.

(b) (i) Those who drew a correct bisector within the tolerances generally scored two marks as candidates left in clear construction arcs. A number of candidates drew the correct arcs, but then did not draw in the bisector. Some candidates used a broken line - the locus must be a continuous line. Where the bisector was missing there was often a line drawn from *A*.

(ii) Again those who drew an accurate bisector generally showed construction arcs and scored two marks. The arcs on the lines *AB* and *BC* are often not left clearly enough. A number drew a line from *A* to *C* and appeared to find a midpoint of that, then drew a line from that to *B*.

(iii) Candidates found this part the most challenging. Many had not drawn the bisectors long enough and therefore could not mark *T* at the intersection. A large number whose bisectors did not meet put *T* on one or other of them. Some marked *T* at the intersection of their arcs, or on the midpoint of *AB*.

(c) Candidates did very well at this part with most candidates successfully measuring the distance from *A* to their *T* and correctly using the scale factor to convert to kilometres.

(d) Candidates were required to explain why the transmitter's signal did or did not reach town *C*. To earn the mark candidates needed either to refer to the circle in part **(d)** or refer to their correct distance *TC*. Those who just stated that it was "too far" or "not strong enough" did not score. In referring to the circle, use of words such as "range", "area", "radius", "locus" etc. were acceptable. When the candidate referred to their distance *TC* this had to be correct within the tolerances either in centimetres or kilometres.

(e) This part proved to be the most difficult of the question as candidates had to calculate the volume of a cylinder. Good solutions included the correct formula for the volume of a cylinder and correct substitution. Less able candidates chose not to attempt this question.

Answers: **(a)** 106 to 110 **(c)** 24.0 to 25.6 **(e)** 1.88

Question 8

Candidates demonstrated a good understanding of probability in this question.

(a) (i) The bar chart was drawn well by the vast majority of candidates. Most candidates chose a scale of 1 square to 1 unit, and were able to accurately draw the heights. Most candidates chose bars 6 squares wide, but some left gaps between bars. The mark was awarded providing the bars and the gaps between the bars were equal, which they generally were. Candidates who did not draw a linear scale could only gain one mark for bars of equal widths.

(ii) This question was also completed well by most candidates. Most gave the answer as a fraction. However some converted to a percentage and lost the mark if they did not write the percentage sign with their answer.

(b) This part proved to be the most challenging of the question as candidates were asked to explain why the probability given in the question was wrong. Most understood that the numerator should not be higher that the denominator, but did not explain that probability must be between 0 and 1, or not exceed 1. Many put the answer in terms of not being able to take more yellow beads than the number of beads, or that you could not have 7 yellow beads in a bag of 5 beads implying they understood the physical position, but not demonstrating that the numbers in probability do not necessarily tie into the real numbers e.g. could be cancelled down etc.

(c) (i) Many **c**andidates were successful in giving the correct probability. Candidates who attempted to give their answer as a percentage rounded to 2 significant figures only and lost the mark due to inaccuracy.

(ii) The correct fraction was given by the more able candidates.

Answers: **(a)(ii)** $\frac{19}{120}$ **(b)** Probability must be between 0 and 1 **(c)(i)** $\frac{9}{22}$ **(c)(ii)** $\frac{20}{22}$

Question 9

Candidates of all abilities were able to gain marks on this question about sequences.

(a) (i) This question was the best answered of the whole paper with most candidates able to continue the sequence correctly.

(ii) This required a very basic answer of "add 5". However candidates had a tendency to over-complicate their answer, often trying to give it as an expression in n. Those who referred to "the difference" without saying what to do with the difference did not earn the mark. Many gave "n+5" as an incorrect response.

(iii) Successful candidates were able to give the correct expression. However many candidates did not attempt this part or repeated their incorrect answer from the previous part of 'n+5'.

(iv) Many candidates gained the mark in this question despite not scoring on the previous two parts. Most continued to add 5 to the sequence given in the table, with many showing evidence of this in their working. Candidates who had made errors in part **(iii)** generally still gained the mark in this part.

(b) (i) Candidates were successful in continuing the sequence having recognised it increasing by four. A common mistake however was to increase by three and give the values of 9 and 12.

(ii) Candidates who had shown understanding of the nth term earlier in the question were able to answer this successfully. Again many less able candidates did not attempt the question or gave the answer as 'n+4'

Answers: **(a)(i)** 18, 23, 28 **(a)(ii)** Add 5 **(a)(iii)** $5n - 2$ **(a)(iv)** 73 **(b)(i)** 10, 14 **(b)(ii)** $4n - 2$

MATHEMATICS (US)

Paper 0444/33

Paper 33 (Core)

Key Messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formula, show all working clearly and use a suitable level of accuracy.

General Comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates attempted all of the questions with the occasional part question being omitted by individuals. The standard of presentation was generally good. A substantial number of candidates did show all necessary working. However, some candidates just provided answers or did not carry out calculations to sufficient accuracy and consequently lost marks. Candidates should be encouraged to give all necessary detail in descriptions, especially in transformations.

Centres should continue to encourage candidates to show all working clearly in the answer space provided. The formulae being used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Candidates should take the time to read the questions carefully to understand what is actually required in each part.

Comments on Specific Questions

Question 1

Candidates showed a good understanding of transformations. They were generally able to draw accurately. Describing the transformations could be improved by further practice on what information is required for each type of transformation and ensuring that a single transformation is given.

(a) (i) Most candidates were able to draw the correct line.

(ii) Many candidates drew the correct reflection. The common error was to make a reflection in the y-axis instead of their drawn line.

(iii) Some candidates drew the correct rotation. More candidates gave a correctly orientated rotation about another point such as the base of the original flag or their drawn reflection. A few candidates gave an incorrectly orientated rotation about the correct point.

(b) (i) Generally candidates were able to give a good description of this transformation.

(ii) A common error was to not fully describe the enlargement by missing out either the scale factor or centre of enlargement.

Answers: **(b)(i)** Translation by $\begin{pmatrix} -3 \\ -4 \end{pmatrix}$ **(b)(ii)** Enlargement, [scale factor] 2, [centre] (6, 0)

Question 2

Candidates showed a good grasp of statistics, especially with regard to frequency and bar charts. They could improve further by identifying carefully the difference between mean, mode etc., showing all their working and where necessary using the correct number of significant figures.

(a) (i) Candidates were able to provide very accurate frequency tables with only a few slips. The tally column was rarely used but when it was, normally it was for the frequency with the relative frequency in the frequency column.

(ii) The bar chart was usually drawn accurately. The common errors were to not label the vertical axis and very occasionally to draw bars of different widths.

(b) More than half the candidates gave the correct fraction. If a decimal was given many candidates gave an answer to 3 significant figures but those who only used 2 significant figures lost the mark.

(c) Candidates were fairly equally divided between whether the statement was correct or not. Candidates who said the statement was false tended to give the correct reason that the group sizes were different. Candidates who said the statement was true suggested this was because the same number of girls and boys liked comedy.

(d) Many candidates gave the correct answer. A few candidates misread the question and found the expected number of horror movies.

Answers: **(a) (i)** 4, 5, 3, 6, 2 **(b)** $\frac{14}{24}$ **(d)** 13

Question 3

Many candidates showed a good understanding of money and interest calculations.

(a) All candidates understood what was required in this part. The common error of a few candidates was to round their answer as it was an exact answer.

(b) A large majority of candidates completed this “show that” part correctly. The common error was to either not show that 20% = 0.2 or 80% = 0.8 or to use the answer to show the original earnings.

(c) (i) Many candidates gave the correct answer. Occasionally candidates found one of the other amounts, such as savings.

(ii) Although some candidates recognised that $\frac{9}{15}$ can be found via the 9:4:2 ratio, many went back to the amounts of money. In such cases many candidates lost marks for premature approximation.

(d) (i) Very few candidates used a multiplier of 1.15 to obtain the answer. Many candidates found 15% and then added it on. Again marks were lost through premature approximation or not giving the full exact answer.

(ii) Candidates found this part challenging. A common error was premature approximation and/or not giving the full exact answer. Some candidates were also unable to distinguish between whether to multiply or divide by 0.52.

(e) (i) Candidates understood how to start to calculate percentages. However, common errors of leaving incomplete answers of $\frac{1}{8}$ or 0.125 were seen.

(ii) Very few candidates attempted to use the simple interest formula. Occasionally 1.45 was used instead of 1.045 as the multiplier. When candidates worked on a year by year basis they generally understood to use the correct degree of accuracy.

Answers: **(a)** 249.75 **(c)(i)** 230.4[0] **(c)(ii)** $\frac{3}{5}$ **(d)(i)** 488.75 **(d)(ii)** 19.15 **(e)(i)** 12.5 **(e)(ii)** 172.93

Question 4

Candidates were able to demonstrate that they understood travel graphs, timetables and distance = speed × time. They could improve their responses by careful reading of the question to ensure that the correct times and places are being used.

(a) The vast majority of candidates understood how waiting time is portrayed on a travel graph and could read off times.

(b) Although many candidates gave very good explanations, some candidates appeared to misunderstand the question and wrote yes or no instead of before or after.

(c) Almost all candidates gave the correct answer.

(d) (i) Most candidates demonstrated an understanding of distance = speed × time and gave the correct answer.

(ii) A majority of candidates could draw the remainder of the travel graph accurately. The common error was to miss out the part of the travel graph relating to staying at the lake.

(e) (i) Many candidates could read a timetable and provide the correct answer. The two most common errors due to misreading the question were 1027 (bus arrives at Country Park just before 11 30) or 1127 (bus leaves High Street just before 11 30).

(ii) A small majority of candidates demonstrated how to find the difference of two times. The common error was a misread of the start and destination points. A few candidates assumed there were 100 minutes in an hour.

(f) The majority of candidates who drew a line either gave the correct length or bearing but few gave a completely correct answer.

Answers: **(a)** 10 **(b)** Before, steeper gradient **(c)** 11 20 **(d)(i)** 13 50 **(e)(i)** 10 57 **(ii)** 24

Question 5

Candidates demonstrated some knowledge of trigonometry. However, there is a need for further practice on which formulae and theorems should be used in particular circumstances.

(a) (i) Candidates generally gave the correct answer.

(ii) Candidates generally understood that the sum of the angles of a triangle equals 180.

(iii) Very few candidates gave the correct answer. Many candidates appeared to misread the question and gave the value of angle *ABC,* not the reflex angle.

(iv) Most candidates understood that angles on a straight line add up to 180.

(v) Many candidates gave the correct answer or the correct follow through from previous answers.

(vi) Most candidates gave the correct answer or the correct follow through from previous answers.

(vii) Few candidates gave one of the correct answers. Some candidates used triangles involving the angle *A,* or gave one of the similar triangles in clockwise order and the other in anticlockwise order.

(b) (i) Although some candidates understood the need to use a formula, many did not use a correct one. A common error was to use a formula for the interior angle.

(ii) Some candidates were able to obtain the follow through from the previous part. A common error was to assume the interior and exterior angles added to 360 not 180.

(c) (i) Most candidates correctly drew an example of a radius. A few candidates drew a diameter rather than a radius.

(ii) Most candidates correctly drew an example of a chord.

(d) (i) Many candidates gave the correct answer.

(ii) A few candidates gave the correct answer. Many candidates gave an answer of 2.

Answers: **(a)(i)** 85 **(a)(ii)** 10 **(a)(iii)** 320 **(a)(iv)** 95 **(a)(v)** 95 **(a)(vi)** 55
(a)(vii) *BCE* and *GCF* or *BCD* and *GCH* or *CED* and *CFH* **(b)(i)** 30° **(b)(ii)** 150° **(d)(i)** 2 **(d)(ii)** 0

Question 6

Candidates continue to improve in their calculations of values, the plotting of the points and drawing of neat, continuous curves. They could improve by being careful when reading different scales on the x-axis and y-axis.

(a) (i) Only a very few candidates gave the correct answer. Where candidates did not show any working they generally lost all the marks. When working was shown some candidates achieved part marks, although in many cases the formula for the slope was inverted or the difference in the x co-ordinates was inverted to the difference in the y co-ordinates.

(ii) Some candidates used their gradient to form an equation but several did not recognise that the constant term came from reading off the intersect of the line with the y-axis.

(b) (i) Nearly all candidates obtained the correct points.

(ii) Many candidates demonstrated a good understanding of plotting points and drawing neat continuous curves. There were only a few cases of straight lines being used.

(iii) Most candidates demonstrated an ability to read values of intersections. The common error was to misread the negative solution, writing –3.6 as –4.4 for example.

(c) Most candidates demonstrated an ability to read values of intersections. The common error was in the y co-ordinates where the scale is different to the x co-ordinates.

Answers: **(a)(i)** –2 **(a)(ii)** $-2x + 3$ **(b)(i)** 6, 7, 6 **(a)(iii)** –3.8 to –3.5 and 1.5 to 1.8
(c) (1.7, –0.4) and (–1.7, 6.4)

Question 7

Candidates were able to demonstrate an understanding of expressions and simplifications. Their answers would be improved by careful reading of the question and attention to detail in simplification. This includes multiplying out of brackets correctly and ensuring negative signs are used correctly.

(a) The vast majority of candidates gave the correct answer.

(b) Nearly all candidates understood and wrote down a correct expression for the perimeter of a triangle. The main errors were slips in the subsequent simplifications especially with regard to the minus signs.

(c) (i) Many candidates understood and correctly wrote down an expression for the perimeter of the rectangle. Some did not multiply the sum of the two given sides by two. The main error was in the simplification with incorrect multiplication of brackets.

(ii) Candidates who did equate their two solutions usually did so correctly although some added the two solutions instead of equating them. Full marks were often awarded for correct follow through from the previous parts.

(d) Candidates found this part challenging with some omitting it completely. When answers were seen they followed an attempt to place their x-values into the expressions for the two sides. However, when this gave a negative answer the minus sign was often ignored.

(e) Where candidates had given answers to the previous part they generally multiplied them together correctly.

Answers: **(a)** $2x - 3$ **(b)** $5x - 4$ **(c)(i)** $4x + 4$ **(c)(ii)** 8 **(d)** 12, 6 **(e)** 72

Question 8

Candidates found this question challenging. They can improve their answers by more practice on converting between cm an mm.

(a) (i) Many candidates identified the shape correctly as a prism. Some added the word rectangular instead of triangular losing them the mark. A common error was to write pyramid.

(ii) Many candidates showed a good understanding of trigonometry and gave the correct answer. A few candidates did not half the base to give the base side of the right-angled triangle.

(iii) Most candidates understood that their answer would be the original multiplied or divided by ten or tens. Only a few candidates did this correctly. Some candidates then went on to round the answer.

(iv) Candidates generally rounded this correctly.

(b) (i) Many candidates identified the correct formula required. Some used the given diameter instead of the radius. Common wrong formulae used were $2\pi r^2$ and $2\pi r$.

(ii) Many candidates identified that the label was a rectangle. However, some did not recognise that one side was the circumference.

Answers: **(a)(i)** [Triangular] prism **(a)(ii)** 70.5 **(a)(iii)** 150.63 **(a)(iv)** 120 **(b)(i)** 70.7 **(b)(ii)** 37.7

Question 9

Candidates showed a good understanding of sequences in this question. Most used a counting on method rather than attempting a formula. Candidates should continue to be encouraged to show all their working and formulae that they use.

(a) Almost all candidates gave the correct answer. The only error was in the answers for the final column where some candidates just continued the sequences to the next term rather than the 8th term.

(b) (i) A small majority of candidates gave the correct answer. The common wrong answer was $n + 2$.

(ii) Quite a few candidates gave the correct answer. The common wrong answer was $n + 4$.

(c) Many candidates showed no working. Those that did showed that they were counting up and did so accurately. The most common error was to say that pattern B with 16 tables was the answer, mostly with no supporting working.

Answers: **(a)** 10 12 20 **(b)(i)** $2n + 4$ **(b)(ii)** $4n + 2$ **(c)** B [by] 15 [tables]
14 18 34

MATHEMATICS (US)

Paper 0444/43
Paper 43 (Extended)

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 a suitable level of accuracy.

General Comments

Candidates appeared to have sufficient time to complete the paper and omissions were usually due to lack of familiarity or difficulty with topics covered by the questions. Many candidates demonstrated their knowledge and application of Mathematics and produced work of a good standard. For these candidates presentation of written work was usually clearly set out. As always the standard of work was variable, with the marks covering a wide range. For less able candidates, working tended to be more haphazard and difficult to follow, making it difficult to award method marks when the answer was incorrect. All candidates need to be aware of the need to retain sufficient figures in their workings so that their final answer is accurate; a number of marks were lost due to premature approximation of values. Centres should continue to encourage candidates to show the formulas they use and the calculations performed.

Comments on Specific Questions

Question 1

(a) (i) Many correct answers were seen with most candidates using 920, dividing by 8 and multiplying by 7. A significant proportion opted to calculate the total number of seats before dividing by 26 and multiplying by 7. As it was a 'show that' question it is important that candidates show all steps in the calculation. A few lost the mark by simply showing 115×7.

(ii) Of the two methods available, finding 920 as a percentage of 2990 was preferred by many rather than 8 as a percentage of 26. A significant number of candidates lost a mark for giving their answer to 2 significant figures without showing a more accurate value.

(b) A majority of candidates set out their solutions clearly and many went on to earn all five marks. Some spoilt their solution by rounding the exact answer to 3 significant figures. Others attempted to express 1211 as a percentage of the total number of tickets. Other errors involved confusion between the ticket prices for the three areas.

(c) More able candidates earned all three marks, appreciating that the ticket sales was 95% of the previous concert. Almost as many calculated 105% of the ticket sales.

Answers: **(a)(i)** $\frac{920}{8} \times 7$ **(ii)** 30.8 **(b)** 1211 **(c)** 37720

Question 2

(a) (i) The correct angle of 104° was identified by most candidates but some lost the mark for the reason through use of descriptors such as edge, arc, perimeter, origin. A small number had the reason reversed.

(ii) Few candidates obtained the correct angle of 128° with fewer being able to give a reason. Some stated opposite angles without mentioning the cyclic quadrilateral.

(iii) Many candidates identified the correct angle but most of these could not give an adequate reason, not mentioning at least one of tangent, radius or 90º.

(b) (i) A majority of candidates set out their solutions clearly and earned all four marks. Some gave the final answer as 7.7 and lost the accuracy mark. A small number quoted the cosine rule incorrectly, e.g. $a^2 + b^2 + 2ab\cos 56$ or used sin56 instead of cos56. Less able candidates used right-angled trigonometry and/or Pythagoras' theorem. Others assumed that *BE* was a tangent and gave answers as if the triangle was isosceles.

(ii) Candidates were generally more successful in this part, even when the previous part was incorrect. Both the sine rule and the cosine rule were equally common and it was not rare to award a minimum of two marks for a correct method. Some dropped a perpendicular from *B* to *CE* but tended to lose out on the accuracy mark because of premature approximation at the first stage.

Answers: **(a)(i)** 104 **(ii)** 128 **(iii)** 34 **(b)(i)** 7.65 **(ii)** 49.3

Question 3

(a) (i) Most candidates applied Pythagoras' theorem correctly and obtained both marks. A few lost the accuracy mark by giving their answer to two significant figures only. Some less able candidates attempted to use trigonometry.

(ii) Many candidates were able to draw a perpendicular from *B* to *DC* and apply the tangent ratio correctly to find the required angle. A significant minority preferred to use the sine ratio by calculating the hypotenuse as their first step. Generally candidates were less successful in this part of the question, either by treating the base side as 6 (from 17 – 11) or creating alternative triangles on the diagram and making little progress as a result.

(iii) The majority of candidates used the formula for the area of a trapezoid while a small number opted to find the area using two triangles and a rectangle. Many were successful but some lost marks by setting out the calculations incorrectly, such as $(11 + 17 \times 4.7) \div 2$.

(b) Many candidates didn't appreciate the significance of 'similar' in relation to the two trapezoids. Most of these simply recalculated the area with 4.7 replaced by 9.4, leading to the common incorrect answer of 131.6. For the rest, most multiplied all dimensions by 2 and recalculated the area correctly. The use of area scale factor = (linear scale factor)^2 was rarely seen.

Answers: **(a)(i)** 5.37 **(ii)** 54.1 **(iii)** 65.8 **(b)** 263.2

Question 4

(a) (i) A large majority of candidates simplified correctly, although it was common to see a wide variety of errors in dealing with the two terms. Some simply cancelled the x^3 and x^5, others inverted correctly but then multiplied the x terms to give x^{15}.

(ii) Most candidates were successful with the multiplication of the two terms, with just a few candidates multiplying the indices.

(iii) Candidates were generally less successful in this part, with some not differentiating between a number to a power and a power raised to another power. It was common to award one mark, either for simplifying the coefficient or for simplifying the algebraic term. It was common to see 64 to the power $\frac{2}{3}$ evaluated as $64 \times \frac{2}{3}$.

(b) Many candidates earned all four marks but for some, poor presentation was an issue. Candidates need to ensure the division line is completely drawn under the numerator and that the root sign encloses all of '$b^2 - 4ac$'. Some were able to recover but many lost marks needlessly. Another common error occurred with negative signs when substituting the values, such as -7^2 instead of $(-7)^2$. Some of those obtaining the correct solutions then wrote their answers to the wrong degree of accuracy.

(c) Many candidates demonstrated their algebraic skills to good effect and earned all three marks. Some didn't recognise the difference of two squares and $(x - 5)^2$ was sometimes seen. Factorising the denominator proved more challenging; sometimes only x was used as a factor and sometimes $x^2(x + 5)$ was given. Less able candidates simply cancelled the x terms and/or the 5s individually without factorising.

Answers: **(a)(i)** $\frac{x^8}{3}$ **(ii)** $15x^7y^3$ **(iii)** $16x^8$ **(b)** 3.48 and –1.15 **(c)** $\frac{x+5}{x^2}$

Question 5

(a) (i) Many candidates earned the mark for a correct decision, justified by writing the probabilities as fractions with a common denominator or as decimals or percentages. A few lost the mark because of the lack of justification.

(ii) Many correct answers were seen, usually given as a fraction in its simplest form, but answers as decimals and percentages were also seen. The most common error was adding the two probabilities.

(iii) This part proved more of a challenge and a wide variety of incorrect methods were seen often involving the correct four fractions but incorrectly combined. Some drew a tree diagram to help and were usually successful.

(b) (i) Many candidates completed the tree diagram accurately and earned all three marks. Most errors were slips in writing one of the probabilities. Only a few seemed unfamiliar with the idea of a probability tree diagram.

(ii) Again, many correct solutions were seen, usually with a fully simplified fraction. A few gave equivalent fractions or sometimes 0.36 or 36%. As in part **(a)(ii)** a common error was adding the correct fractions instead of multiplying.

(iii) Fewer fully correct solutions were seen, with the probability of Yeung finishing exactly one race being a common error. Those who chose the method of 1 – (finishes no race) usually reached the correct answer. Many others attempted to use the longer method that required 7 routes but often without much success. Errors often resulted from slips in the arithmetic or omission of at least one route. As in earlier parts there was confusion regarding when to multiply or add probabilities. Some less able candidates gave the answer as $\frac{7}{8}$ by counting the ends of the branches.

Answers: **(a)(i)** Ariven, $\frac{10}{15} > \frac{9}{15}$ **(ii)** $\frac{2}{5}$ **(iii)** $\frac{7}{15}$ **(b)(ii)** $\frac{9}{25}$ **(iii)** $\frac{172}{175}$

Question 6

(a) Many candidates were familiar with a method for calculating the area of a triangle, but not always the most efficient. Many were able to write $0.5 \times 8 \times 8 \times \sin 56$ and go on to obtain an answer with at least two decimal places. Some lost the final mark by giving their answer as 26.5 instead of showing a more accurate answer that rounded to 26.5. A significant number used a variety of methods including trigonometry of a right-angled triangle, sine and cosine rules to calculate the base and height and then go on to find the area. These were more likely to lose the final mark as the longer methods tended to be approximated at intermediate stages.

(b) (i) A majority of candidates were able to equate the area of the triangle with an expression for the area of the sector. This was often rearranged correctly and a solution obtained. For a small number there was some confusion between area and circumference. A small number treated the sector as an isosceles triangle.

(ii) Many of those with a correct method in part **(i)** were able to calculate the arc length of the sector. The most common error was to stop with the arc length, not adding on the two radii. Again, there were instances where candidates mixed up the area and circumference formulae.

(c) (i) As with any question involving having to show an algebraic expression, a significant number of candidates attempt to work backwards. Marks were awarded for a correct method leading to the given expression. Those who started with the correct formulae for the area of a sector and a triangle usually gained full marks. Those that were influenced by the given answer often started with $\frac{1}{12}\pi r^2$ rather than $\frac{30}{360}\pi r^2$, or with $\frac{1}{4}r^2$ rather than $\frac{1}{2}r^2\sin 30$, and lost the appropriate marks. A significant number of candidates did not attempt this question.

(ii) Not all candidates linked this question with the formula from the previous part. A majority of those that did usually managed one correct rearrangement with many going on to obtain a value for *r*. Those that began by multiplying by 4 were generally more successful than those that started in other ways. Premature approximation of some values, particularly $(\frac{1}{3}\pi - 1)$ often led to a loss of accuracy with the final answer. Those that didn't use the formula from the previous part usually equated the area of the sector as 5.

Answers: **(a)** 26.52 to 26.53 **(b)(i)** 72.0 **(ii)** 21.1 **(c)(ii)** 20.6

Question 7

(a) (i) Most candidates obtained the correct midpoint with some adding the co-ordinates but not dividing by 2. A few reversed the co-ordinates.

(ii) Many correct equations were seen. Where the final answer was incorrect some earned a mark for a correct method for finding the gradient or for a correct method to find the y-intercept. Calculating the reciprocal of the correct gradient and subtracting the co-ordinates in an inconsistent order were the usual causes of error with the gradient. Only a small minority of candidates attempted to set up a pair of simultaneous equations.

(b) (i) Almost all candidates factorised the expression correctly.

(ii) Despite the accuracy of the previous part quite a number of candidates were unable to interpret the quadratic in a graphical context and just produced spurious values. Sometimes the whole answer set was accurate but not inserted correctly into the answer spaces. Other answers were only partly accurate with –10 being the least accurate of the three parts.

(iii) Linking the equation of the line of symmetry with the factors of the expression in part **(i)** or with the co-ordinates of the intercepts on the graph in the previous part was challenging for many candidates. Many incorrect answers were seen, including $y = -1.5$. Several candidates made no attempt at all.

(c) Again, many candidates didn't link the quadratic expression with a sketch of the graph and a large number of candidates constructed a table of values in order to sketch the graph, rather than factorising the quadratic expression. Many were able to draw a parabola but the intercepts were often not labelled or were incorrect.

(d) (i) This proved to be a challenging question for many candidates. The most common approach was to expand $(x + p)^2$ but many seemed unfamiliar with the process of equating coefficients. Very few attempted to factorise the quadratic expression in order to complete the square. It was more common to award marks for finding p than q.

(ii) Several candidates made no attempt at this part and when answers were seen many were incorrect. A common incorrect answer was –7.

Answers: **(a)(i)** (1, 2) **(ii)** $y = 3x - 1$ **(b)(i)** $(x + 5)(x - 2)$ **(ii)** –5, 2, –10 **(iii)** $x = -1.5$ **(d)(i)** $p = 6$, $q = 43$ **(ii)** –43

Question 8

(a) (i) A large minority of candidates formed the correct equation but only some of these were able to solve it using clear algebraic steps. It was common to see attempts at trial and improvement being used to solve the equation. Some of those that could not set up the equation earned a mark for an attempt at the total number of litres or for the correct number of motorists. For the rest, some added the numbers along each row, with 90 a common answer for the number of litres and sometimes $33 + p$ for the motorists. Some common errors included division by 5, 33 or $33p$.

(ii) The two most common answers were 17 and 18, often with little evidence of any working that could lead to the answer. As 18 was the middle number in the top row of the table it was a popular choice for the median.

(b) (i) Almost all candidates obtained the correct cost of the journey.

(ii) Again, many correct answers were seen. Candidates often worked out petrol consumption as either 8 km/litre or 0.125 litre/km. Some used proportion with the distances and the total amount of petrol used.

(iii) Many candidates were able to link the answers from the previous two parts and perform the appropriate division with only a small number dividing in the wrong order. A significant number attempted to make use of the $1.28 from part **(i)** but many struggled to make any worthwhile progress.

Answers: **(a)(i)** 7 **(ii)** 17 **(b)(i)** 64 **(ii)** 40 **(iii)** 1.6(0)

Question 9

(a) Few correct answers were seen. Errors with the signs of the numbers, reversal of the x and y components and treating the vector as a fraction and cancelling were common errors.

(b) Few correct answers were seen in this part. Some were able to apply Pythagoras' theorem correctly for the position vector but many simply wrote down the vector *OP* and several attempted the gradient of *OP*.

(c) (i) A majority of candidates were familiar with the idea of slope and obtained the correct answer. Some of the errors included attempting to find the equation of the line, calculating the length of the line and obtaining the reciprocal of the slope.

(ii) Many candidates earned at least one of the two marks. Most of those earning one mark earned it for a correct intercept. Several candidates made no attempt at all.

Answers: **(a)** $\begin{pmatrix} -4 \\ 2 \end{pmatrix}$ **(b)** 5.83 **(c)(i)** $\frac{3}{5}$ **(ii)** $y = -\frac{5}{3}x + 2$

Question 10

(a) (i) Many of the candidates were able to simplify an expression for the perimeter with a few spoiling their answer by further incorrect simplification or attempting to solve an equation. Some earned a mark for a partially correct expression.

(ii) Many of those candidates who were successful in part **(i)** were able to set up an equation, solve it correctly and go on to find the length of the longest side. Simple slips with the rearranging or with the number work were the most common causes of errors.

(b) More able candidates again demonstrated their algebraic expertise and earned all six marks with efficient solutions that were clearly set out and easy to follow. For others, errors usually involved numerical slips or incorrect signs. These errors occurred when setting up the equations, when eliminating a variable or when applying the substitution method (the least popular method for solving the equations). For less able candidates, working was often haphazard, covering most of the page with many restarts at solving the equations.

Answers: **(a)(i)** $5x + 14$ **(ii)** 14.2 **(b)** $a = 3.25$, $b = 2.5$

Question 11

(a) In general candidates struggled to cope with the various transformations. For f(x – 1), common errors included moving the graph either down one unit or to the left by one unit. Candidates found f(x)+1 a little easier and a majority drew the correct transformation. A few translated the graph downward or horizontally. Many candidates earned at least one of the two marks for the final transformation with candidates more likely to draw the correct maximum for the curve than deal with the horizontal sections correctly. A few stretched the graph horizontally and for all three it was common to see sloping straight lines drawn.

(b) Candidates were familiar with the basics of the four types of graph and most earned all four marks. When errors were made it was common to see C and D reversed.

Answers: **(b)** C A D B