MATHEMATICS (US)

Paper 0444/13
Paper 1 Core

General comments

The standard of performance was well spread across the candidates. The majority of candidates could tackle all questions with some degree of confidence, there were only a small number of questions which had not been attempted. Generally presentation was good. Many candidates showed method and were able to earn partial credit if they did not obtain the final answer, although as always, a lack of working, even when specifically requested, was noticeable on some scripts. Many cases of faint pencil work on drawings made marking a little difficult at times but in general work could be clearly seen. Careful checking of the wording of the questions would help to reduce errors in, for example, not giving an amount when interest is requested, and giving an answer to the required degree of accuracy.

Candidates did not appear to have a problem completing the paper in the allotted time.

Comments on specific questions

Question 1

This question on angles was generally correct, suggesting that 360° in a circle was very well known.

Answer: 74

Question 2

(a) The majority of candidates gave the correct answer in this question on rotational symmetry; the most common error was 180° or 1.

(b) The majority of candidates were able to draw the correct line of symmetry.

Answer: **(a)** 2 **(b)** correct line

Question 3

The majority of candidates gave the correct answer to this question on indices, of the ones who did not several scored 1 mark for either 64 or 7.

Answer: 57

Question 4

(a) Most candidates were able to simplify the expression, although 7 and 7^t was also seen.

(b) Most candidates were aware of what to do with the indices; 13 was the most common error.

Answer: **(a)** $7t$ **(b)** r^{13}

Question 5

Some candidates scored both marks, although the amount rather than the interest was given at times assumed it was compound interest and it is essential that candidates realise the difference be compound and simple interest.

Answer: 96

Question 6

Few candidates failed to gain 1 mark on this proof but many failed to show the full working required for 2 marks. Some just gave the stated sum with the answer of $\frac{17}{100}$.

A common response for 1 mark was from $\left(\frac{1}{10}\right)^2 + \left(\frac{2}{5}\right)^2 = 0.01 + 0.16 = 0.17$.

Answer: Full working leading to 0.17

Question 7

Many correct solutions were seen, but marks were lost by *c* = included or by continuing to 16*pr*. A few wrote $5^p + 11^r$.

Answer: 5*p* + 11*r*

Question 8

The majority of candidates understood what was required for this question on applied ratio. Weaker candidates multiplied 30 by 20.

Answer: 180

Question 9

This question on expanding brackets was answered well and it was rare to give no marks. The $y \times y^3$ seemed to cause the most errors. Some misunderstood ‘expand’ and attempted a form of factorising. Several scored 1 mark, usually for 3*y* seen. Common incorrect answers were $3y - y^3$ and $3y - y \times y^3$.

Answer: $3y - y^4$

Question 10

This question on percentages was generally well answered. 84 – 4.2 was seen as well as just 4.2 with no attempt made to add it to 84. It is essential that candidates read the question carefully. Errors usually occurred from using 1.5 instead of 1.05 or from subtracting from 84 rather than adding.

Answer: 88.2(0)

Question 11

(a) Candidates were not able to give an accurate description of continuous data.

(b) Most were able to give the correct median or to earn 1 mark for an attempt to order the values.

Answer: **(b)** 9.5

Question 12

(a) This question was poorly answered. Very few seemed to grasp the idea that that they we to write a calculation in **(a)** that they could easily evaluate without a calculator. Some cand were able to demonstrate some understanding of rounding but not of significant figures.

(b) The majority of candidates who gave the correct answer to part **(a)** gave the correct answer to part **(b)**. For those with an incorrect answer in **(a)** it was difficult to evaluate without a calculator and a lot of complex calculations were attempted with varying degrees of success. However only the correct answer was awarded credit in this part.

Answer: 4.5

Question 13

This factorisation question was often poorly done. Some gained just the 1 mark from partial factorisation, usually taking out $2y$. Some candidates did not use brackets.

Answer: $4y(x + 3z)$

Question 14

This question on subtracting fractions was done reasonably well. The majority knew how to tackle the question and did it in very straightforward steps, showing clear understanding. The most common approach was to change to improper fractions and this usually led to the answer being left as 127/40 but other correct methods were also seen. Changing to a common denominator caused problems for the less able candidates.

Answer: $3\frac{7}{40}$

Question 15

In this question on angles and polygons the majority of candidates just divided 360 by 5 and gave the answer as 72, which earned 1 mark. A few candidates did not know that a pentagon is a 5 sided shape.

Answer: 108

Question 16

(a) The correct answer was usually seen in this question on reading from graphs.

(b) Most candidates were able to draw a suitable line of best fit, however, some lines were poorly done with some just joining all the points. A small number failed to rule the line.

(c) The correct answer was usually seen.

Answer: **(a)** 9 **(c)** Positive

Question 17

The correct answer was rarely seen in this number skills question. Most candidates had correctly evaluated the denominator as 1.8 and earned 1 mark, but then did not do any more working.

Answer: 4

Question 18

(a) Several candidates gave a correct description in this question on similar triangles, but oth not detailed enough.

(b) (i) Most candidates were able to give the scale factor.

(ii) Candidates who gave the correct answer in part **(ii)** usually managed to give the correct value for the corresponding length.

Answer: **(b)(i)** 3 or $\frac{1}{3}$ **(ii)** 4.5

Question 19

(a) Responses to this probability question were mostly correct.

(b) (i)(ii) Responses to these probability questions were generally correct. It was pleasing to see candidates using the correct form throughout the question.

(iii) Generally correct, some candidates gave unacceptable words e.g. impossible.

Answer: **(a)** 0.71 **(b) (i)** 0.15 oe **(ii)** 0.75 oe **(iii)** 0

Question 20

(a) The majority of candidates were able to correctly measure the length of the line in centimetres.

(b) Most candidates knew the name tangent, with vertical line being the common incorrect answer.

(c) Surprisingly, several candidates thought that the centre was the circumference. Others drew a diameter. Most understood what the circumference was, however, some did not put a clear point on the circumference, leaving a '*D*' floating.

Answer: **(a)** 7.3 – 7.7 **(b)** Tangent **(c)** D marked on the circumference

Question 21

(a) (i) Most candidates did not construct the triangle using arcs and as a result only scored 1 mark.

(ii) Most candidates were correctly able to mark the midpoint of the required side.

(b) (i) Sketches were not done well with rectangles and parallelograms being the most common wrong responses. Diamond is not a mathematical name.

(ii) Candidates were not always able to name their sketch.

Answer: **(b)** **(ii)** Rhombus or Square

Question 22

(a) This part of this question on coordinates was nearly always correct.

(b) Most candidates were able to give the correct coordinates for the point, the most common error was (0, −1).

(c) Slope was not understood by many candidates, but those who did understand generally got the correct answer. Some gave the equation which was not asked for. 0.5 was the most common error, suggesting that the base had been divided by the height.

Answer: **(a)** (5,1) plotted **(b)** **(**− 1, 0) **(c)** 2

MATHEMATICS (US)

Paper 0444/23

Paper 2 Extended

Key Message

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

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates are showing evidence of good work in ratio, percentages, expanding brackets and calculator use. Candidates particularly struggled this year with working with negative fractional indices; sector area and arc length using an algebraic approach.

Comments on specific questions

Question 1

The majority of candidates answered this question on simple interest well. Of those not obtaining two marks in most cases this was because the candidate calculated the amount of interest then included the capital, consequently 696 was a common incorrect answer.

Answer: 96

Question 2

Candidates generally performed well on this question on squaring fractions. The most successful candidates followed carefully the instruction to write down all the steps in the working. The most common error was to omit one of the stages, for example $\frac{1}{100}+\frac{4}{25}=\frac{17}{100}$ alone is insufficient as the step to convert $\frac{4}{25}$ to $\frac{16}{100}$ has not been demonstrated.

Question 3

The majority of candidates correctly used the approach $\frac{x}{12}=\frac{300}{20}$ in this applied ratio question, and then used a method of cancelling and rearranging to find the value of x, with the resulting long multiplication sum 12 x 15 evaluated clearly.

Answer: 180

Question 4

The majority of candidates were able to expand the brackets and answered this correctly. Where marks were lost this was generally the mark for $-y^4$ with y^3, y^5 or *yyyyy* occasionally seen. Some candidates were seen to write $3y$ as $y3$. Where no marks were awarded this was usually due to an apparent lack of understanding of how to expand the bracket or for showing incorrect subsequent work e.g. an attempt to further simplify.

Answer: $3y - y^4$

Question 5

Most candidates correctly multiplied 84 by 1.05 in this percentages questions, using a method of multiplication and gave the answer to 2 decimal places since it was a money answer. Candidates advised when completing their checking to re-read the question in conjunction with their final answer to make sure that it is of a sensible size. A new rent of hundreds of dollars or a rent lower than the original rent would require further investigation.

Answer: 88.20

Question 6

Most candidates correctly converted the distance to $\frac{1}{4}$ of a kilometre and the time to $\frac{1}{10}$ of an hour then used the calculation $\frac{1}{4} \div \frac{1}{10}$ to get $\frac{10}{4}$ cancelling this to $\frac{5}{2}$ thus giving the decimal speed in the correct units.

Answer: 2.5

Question 7

This question on the order of operations and decimal division was well answered by most candidates. Most candidates correctly subtracted the two values and were then able to divide 7.2 by 1.8. Some chose to use an equivalent fractions approach.

Answer: 4

Question 8

The majority of candidates were able to solve the inequality correctly.

Answer: $x \geq -2$

Question 9

This question on fractions and fractional indices was a good discriminator with 1 or 0 marks being more commonly scored than 2. The most successful candidates where those who worked in stages showing their knowledge of laws of indices clearly. The use of the negative power was not always understood with a minority attempting to make the fraction negative or taking the reciprocal of the power fraction instead of the base fraction. Where a correct approach was taken this generally involved reaching $(7/4)^{-3}$ or $(4/7)^3$ at some stage in the calculation.

Question 10

Many candidates were able to obtain at least one mark on this question on indices. A variety of solutions to this question were seen, the most common errors being $4w^4$, $256w^{64}$, $64w^{64}$, $64w^4$ or solution that had not been fully completed, for example leaving the power as 256×1/4.

Answer: $4w^{64}$

Question 11

Some candidates demonstrated a lack of understanding of the vector $\begin{pmatrix} 8 \\ 6 \end{pmatrix}$ and instead treated it as if the coordinate (8, 6) and found the midpoint of the line segment joining (2, -1) to (8, 6) giving the answer $\left(5, \frac{5}{2}\right)$.

Answer: (6, 2)

Question 12

A significant number of candidates gave no response to this question on histograms.

Answer: 40 6

Question 13

Some candidates used a method in this question which demonstrated a lack of understanding of probability, giving the answer $\frac{1}{20}$ = 5%. Presumably because there were 20 gray cars and one was being chosen, rather than considering there were 20 possible gray cars that could be chosen from the total of 100 cars.

Answers: **(a) (i)** $\frac{20}{100}$ **(ii)** $\frac{90}{100}$ **(b)** 80

Question 14

This question on inverse proportionality was well answered by more than half of the candidates. With the most success arising from the starting point $y = \frac{k}{\sqrt{x}}$, then going on to find the value of k. The most common errors were to use direct variation or just x or x^2 instead of $\sqrt{x}$. Sometimes where candidates had correctly started with $y = \frac{k}{\sqrt{x}}$ there were a few instances of incorrect substitution (e.g. x and y transposed) or incorrect rearranging, for example k=2 was seen quite frequently.

Answer: 3 or -3

Question 15

This question on scale factors proved a good discriminator, with about a third of candidates scoring marks. Quite a few candidates understood that they needed to use the area scale factor of 200^2, however completing the calculation was done with varying degrees of success. The most successful realised that they needed to then divide by 100^2 to convert the answer from cm^2 to m^2 although this was often seen as dividing by 100 instead. Another common error was to multiply by 200 rather than the area scale factor. Few candidates changed the scale into metres from the beginning, so 900×2^2 was rarely seen. An even smaller number of candidates used the approach of square rooting the 900, multiplying by 200, dividing by 100 and then squaring again to obtain the correct answer.

Answer: 3600

Question 16

Approximately two thirds of candidates answered this question well. The most successful began by dividing through by π first or making the term in y^2 the subject with a positive sign. The most common were incorrect attempts at square rooting, sign errors or incorrectly cancelling π in the division. For examp $y^2 = \dfrac{\pi x^2 - A}{\pi}$ was often followed by $y^2 = \dfrac{\cancel{\pi} x^2 - A}{\cancel{\pi}} = x^2 - A$. It was common for candidates to believe that terms could be square rooted individually, for example $\dfrac{A}{\pi} = x^2 - y^2$ was often followed by $\sqrt{\dfrac{A}{\pi}} = x - y$. If candidates had the starting point $-\pi y^2 = A - \pi x^2$ it was extremely common for them to then divide by π rather than $-\pi$ and then to think that $\sqrt{-y^2} = -y$ or y..

Answer: $\sqrt{\dfrac{\pi x^2 - A}{\pi}}$

Question 17

Most candidates demonstrated a clear understanding of functions in this question.

Answers: **(a)** 150n **(b)** 3, 4, 6, 7

Question 18

This question was a good discriminator. Many students were able correctly working with the arc length to find the appropriate angle of the circle $\dfrac{\theta}{360} = \dfrac{4r}{2 \times \pi \times 5r}$. The most successful then left this in the form $\dfrac{4r}{2 \times \pi \times 5r}$ substituting into the area formula to get $\dfrac{4r}{2 \times \pi \times 5r} \times (5r)^2 \pi$. Some candidates made this step harder for themselves by making the angle the subject then working became $\dfrac{\dfrac{4r}{2 \times \pi \times 5r} \times 360}{360} \times (5r)^2 \pi$ which was harder to simplify. The most common error was to use $5r^2 \pi$ rather than $(5r)^2 \pi$ in the area formula.

Answer: $10r^2$

Question 19

About half the candidates performed well on this question on vectors. The most successful candidates began with a vector path first. The most common errors were directional or in the ratio aspect of CE and ED therefore halves and quarters were sometimes seen instead of thirds. Candidates are advised that to be more successful they should be very careful with noting the effect of + and – signs on directions and that a position vector should not be written as a column vector.

Answers: **(a)** $\dfrac{1}{3}$(c – d) **(b)** $\dfrac{1}{3}$c + $\dfrac{2}{3}$d

Question 20

Many candidates understood the need for a common denominator when adding fractions. Sign erro **(b)** were very common and 4(x + 2) – 3(2x – 1) was often expanded incorrectly to 4x + 8 – 6x – 3 leadi common incorrect answer of $\frac{17-2x}{12}$. Dealing with the addition of the whole number was tackled wi varying degrees of success. Many realised the 1 needed to become 12/12 but in a lot of cases a 1 was added to the numerator rather than 12 or the 1 was simply written at the front as if it were a mixed number. Common incorrect answers arising from these errors were $\frac{12-2x}{12}$ and $1+\frac{11-2x}{12}$ respectively. Incorrect cancelling between numerator and denominator was also apparent. Some candidates appear unaware that cancelling can only take place between common factors on numerators and denominators.

Answers: **(a)** $\frac{x}{x-1}$ **(b)** $\frac{23-2x}{12}$

Question 21

Quite a few candidates were able to gain full marks on this question. Many appeared unaware that factorising the numerator and denominator was the appropriate starting point and a large number of students simply crossed out matching terms in the numerator and denominator rather than cancelling common factors. A very common incorrect starting point was $\frac{h^2-h-20}{h^2-25} = \frac{-h-20}{-25}$. Some would then go on to divide the -20 and -25 by 5 or –5. The other most common errors were generally sign errors in the factorising of the numerator or denominator or following a correct answer of $\frac{h+4}{h+5}$ wrongly cancelling this to $\frac{4}{5}$.

Answer: $\frac{h+4}{h+5}$

Question 22

A large number of candidates correctly identified that they should be using the sine rule with the most successful using the version with the angles on the top, alleviating many of the rearranging issues having the angles on the bottom caused. A small number of candidates attempted to treat the triangle as a right angled triangle.

Answers: **(a)** 0.5 **(b)** 150

Question 23

Many candidates answered all three parts of this question on functions clearly and correctly. In part **(a)** the most common incorrect answer was 121 arising from g(3) × g(3) rather than gg(3). Occasionally candidates lost one of the two '-1' parts of the calculation; consequently 4[4(3)] – 1 or 4[4(3)-1] were calculated in error. In part **(b)** a common error was to find f(x) × g(x) so (3x+5)(4x -1) was sometimes seen. Other errors seen were to calculate gf(x) i.e. 4(3x +5)-1 or 3x(4x -1)+5. For those with the correct starting point of 3(4x - 1) + 5 the most common errors were in expanding the brackets or in simplifying the expression. It was common to see brackets expanded to 12x – 1 + 5 or the correct 12x – 3 + 5 was often followed by 12x – 2. In part **(c)**, rather than use the easier method of evaluating f(11) the majority of candidates took the longer approach of finding the inverse function $f^{-1}(x)$ and then equating this to 11, then solving to find 38. The most common incorrect answer was 2 arising from candidates solving f(x) = 11 rather than $f^{-1}(x) = 11$.

Answers: **(a)** 43 **(b)** 12x + 2 **(c)** 38

Question 24

Candidates generally answered both parts to this question well with the most successful ca attempting three dimensional Pythagoras' theorem in one stage using $\sqrt{6^2+2^2+3^2}$ in part **(a)**.

Answers: **(a)** 7 **(b)** $36 + 6\sqrt{13}$

MATHEMATICS (US)

0444/33

Paper 3 Core

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

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of the candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates answered all of the questions with some omitting parts of a question on a particular topic. The standard of presentation and amount of working shown was generally good. In the drawing of curves there were few instances of joining points with straight lines or attempting to join the two branches evident. There were still a few instances of candidates rubbing out construction lines and/or working in questions, losing marks for themselves. Centres should continue to encourage candidates to show clear working in the answer space provided; the formulae used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on specific questions

Question 1

All candidates attempted this question with many scoring well.

(a) This part on time was generally well answered. Some candidates appeared to assume that there were 100 minutes in an hour.

(b) Again this part on rounding was well answered and many candidates were able to give the correct answer. However, answers of 30000 and 25900 were seen.

(c) Many candidates understood the need to divide 5 litres by 250 millilitres in this question on measures. Candidates either scored full marks or no marks.

(d) (i) Some candidates understood the concept of common factor. The common error was to give the numbers that were factors of 30

(ii) This question on common multiples was generally well answered.

(iii) Most candidates gave the correct answer in this question on the least common multiple.

(e) (i) Many candidates drew good bar charts. Occasionally the scale was not linear or did not start at zero.

(ii) Although some candidates gave the correct answer for the mode, many gave an answer of 11 or 2.

Answers: **(a)(i)** -2 hr 45 mins, **(b)** 26000, **(c)** 20, **(d)(i)** 30 and 60, **(d)(ii)** 72 **(e)(ii)** 1

Question 2

(a) (i) Candidates found this part on time difficult. Many candidates used times beyond 24 00 su 55.

(ii) The majority of candidates correctly understood how to find the difference between two temperatures when one is positive and the other negative.

(b) Although the overwhelming majority of candidates understood how to convert one currency to another many lost marks because of accuracy and failing to read the question correctly which requires a 2 decimal place answer.

Answers: **(a)(i)** 0355 **(a)(ii)** 26 or -26 **(b)** 135.43

Question 3

Candidates did not show a good understanding of functions. In particular they would benefit from further work on the definition of terms such as range.

(a) (i) Candidates answered this well showing a good understanding of how to complete a mapping diagram.

(ii) The majority of candidates gave the correct answer.

(b) (i) Candidates made an attempt at writing down an expression but many thought that it should be x+5 rather than 5x+ ...

(ii) This was poorly answered. The majority of candidates did not seem to understand the concept of range, instead stating the domain.

Answers: **(a)(i)** 8, 12, 20 **(a)(ii)** 1, 2, 4, 8 **(b)(i)** 5x+25 **(b)(ii)** 30, 35, 40, 45, 50

Question 4

(a) Most candidates gave a correct answer, and were able to calculate a fraction of the money.

(b) Most candidates gave good answers, clearly showing how to divide an amount in a ratio.

(c) Many excellent answers for compound interest. Some candidates used simple interest or subtracted the interest.

(d) (i) Many candidates gained full marks in this part question on pie charts. Some only calculated the angle as they realised there are 360° in a circle whilst others realised that the two amounts had to add to 3150.

(ii) The pie chart was generally very accurate. The majority of candidates used a ruler but some attempted to draw the segments freehand.

Answers: **(a)** 240000 **(b)** 1200, 450, 750 **(c)** 224973 **(d)(i)** 2250, 900, 36°

Question 5

Many candidates demonstrated a good understanding of solving equations in one variable. However, a small of majority of candidates could completely solve a pair of simultaneous equations, although in many cases it was poor arithmetic which lost the marks.

(a) (i) Generally well done. The main error was a failure to change the sign associated with a term when moved to the other side of the equation. This was seen most in the x term rather than the constant term.

(ii) This part was completed correctly by even more candidates. The main error usually followed a correct expansion of brackets to subtract 12 rather than add 12. Few candidates used the alternative method of dividing by 4 rather expanding the bracket.

(b) This part was least well done. There is still a need to explain to candidates the process simultaneous equations. There was evidence of many methods which were mathe incorrect. This included removing one unknown from an equation and solving the re equation and using this result in the other equation for the second unknown.

Answers: **(a)(i)** 2.5 **(a)(ii)** 4.5 **(b)** x= 3, y=-4

Question 6

Candidates in general showed a good understanding of transformations but were less able to correctly state the name of a shape or describe a single transformation. However, it was evident that the vast majority of candidates do not know that a single transformation cannot have two describing words.

(a) Only a minority of candidates correctly answered this part. The common incorrect answers were rectangle and trapezium

(b) Similarly few candidates scored full marks. However, many did correctly state rotation but did not qualify 90° as being in the clockwise direction.

(c) (i) This part of the drawing was answered best.

(ii) Many candidates understood how to translate with but failed to do so accurately, with errors in either the x or y direction.

(iii) A large minority of candidates drew the correct enlargement. Many other candidates drew a correct enlargement but in the wrong place. This was closely followed by a group of candidates who drew shapes with correct bases but sides which had the wrong slope.

Answers: **(a)** parallelogram **(b)** Rotation, 90° clockwise, origin

Question 7

Many candidates found parts of this question on number sequences difficult. Although the vast majority of candidates could evaluate specific terms many could not translate this into general equations for the n^{th} term etc.

(a) (i) Very well answered. A common error was 23, 27 – that is going "up" from the first term.

(ii) Although the majority of candidates understood how to find the next term they could not express this well, writing an equation instead of an expression.

(iii) As already mentioned many candidates found this part difficult. The common error was to write n-4.

(b) A large majority of candidates gave the correct answer. Some candidates gave an answer of 6, 8, 10 stating the first term as n=0.

(c) Many candidates could find the answer for the 8^{th} diagram but not the n^{th}. However, some candidates did understand that the n^{th} diagram would be a term of the form $3n+k$.

Answers: **(a)(i)** 3, -1, **(a)(ii)** subtract 4 **(a)(iii)** $4n + 23$ **(b)** 8, 10, 12 **(c)** 27, $3n$+3

Question 8

Candidates did not fully understand this question on angles. Many understood how to calculate the angles but could not give fully reasoned arguments, simply stating the numerical work they had completed or given long written reasons which did not use any of the mathematically required words. Part **(a)** was answered the best with many candidates recognising the angles on a straight line adding to 180°.

Answers: **(a)** 63° **(b)** 90° **(c)(i)** 54.8 **(c)** 173° **(d)** 90°

Question 9

Candidates found this to be the most difficult question. Many candidates answered the trigonome but had problems with perimeter, volume and conversion of units.

(a) The main error for most candidates was the use of sin or cos instead of tan. Some candidates thought the angle at D was a right angle.

(b) Candidates generally gained these marks.

(c) The majority of candidates realised the need to use Pythagoras's Theorem but some did not recognise which side of the triangle was the hypotenuse. Some candidates failed to give the required accuracy.

(d) Candidates understood the need to add lengths to obtain the perimeter but some did not include the side by the house and others made mistakes in obtaining the lengths of the two unknown sides. Some candidates failed to show any working so marks were lost.

(e) Very few candidates gave the correct answer. However, some candidates did obtain figures 333 but then could not convert the units correctly. Other candidates used the perimeter obtained in the previous part instead of calculating the area.

Answers: **(a)** 5.40 **(b)** 32.4 **(c)** 5.66 **(d)** 64 **(e)** 33.3

Question 10

Candidates performed well in the graph question. There is still a need for a few candidates to use a curve instead of straight lines to join points. Drawing the line of symmetry was the least well answered question on the paper, partly because candidates did not draw a line.

(a) Generally candidates could complete the table apart from the odd slip.

(b) Candidates continue to produce good graphs. The main errors are the use of ruled lines instead of a curve and some double lines between points. In a few instances the graph was drawn with a point at the bottom.

(c) (i) A large minority of candidates did not draw a line of symmetry. Those candidates that did draw a line normally drew the correct one.

(ii) Where a line of symmetry had been drawn many correct equations were given. The main error was to use *y* instead of *x* in the equation.

(d) Some candidates did not answer this part. Those that did understood they were looking for points and many gave correct answers. However, there were some candidates who misread the question and found the values from the quadratic =0 instead of =3 whilst others read the axis the "wrong" way as for example -4.2 instead of -3.8. There was evidence of some careless omission of negative signs.

Answers: **(a)** -1, -5, -1,4 **(c)(ii)** x=-1 **(d)** 1.85, -3.85

Question 11

Candidates showed some understanding of bearings but did not show a clear understanding of bearings greater than 180°. A small majority of candidates showed a good understanding of numbers in standard form whilst others preferred to change to normal numbers.

(a) (i) Many correct answers seen.

(ii) Many candidates gave the correct answer. The common error was to have the correct length but an incorrect angle.

(iii) Candidates found this part difficult. The most common error was to find the bearing of C from A. Alternatively some candidates stated the distance of C from A.

(b) (i) Although some candidates gave the correct answer, the majority of candidates gave digits and correct power of 10 but not in standard form. For example, 324 x 10^3 w frequently.

(ii) The correct answer was seen in the work of about half the candidates, they understood the concep of subtracting one population from another but in order to do that they reverted to ordinary numbers

Answers: **(a)(i)** 15 **(a)(ii)** 262° **(b)(i)** 3.24 x 10^5 **(b)(ii)** C 2.48 x 10^5

MATHEMATICS (US)

Paper 0444/43
Paper 4 Extended

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.

The accurate statement and application of formulae in varying situations is always required.

Work should be clearly and concisely expressed with an appropriate level of accuracy.

All working should be in ink and in the working space provided.

Centres who issue extra paper can disadvantage their candidates as it is often difficult to award method marks when this working is not numbered and an incorrect answer is seen in the booklet.

General Comments

This paper proved to be accessible with almost all candidates able to attempt all questions. Most candidates set out their work clearly and showed sufficient working in the space provided on the question paper. Some candidates started a solution, realised that a mistake had been made, and then decided to use an alternative method or correct some of the calculation by overwriting the figures already written. Candidates that alter figures instead of replacing them risk losing the marks because their working becomes unclear. Those making several attempts at a question are advised to delete the work that is being replaced so that Examiners can clearly see the intended method and award marks accordingly.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time.

Good calculator skills were demonstrated and appropriate levels of accuracy were usually seen. When answering a multi-step question several calculations may be needed and candidates are advised to write down the answer to each step using more than 3 significant figures and then correct to the required accuracy at the end of the calculation.

Questions on arithmetic (percentages, ratio etc.), interpreting cumulative frequency graphs, calculating an estimate of the mean, drawing graphs, basic mensuration and simple sequences were particularly well answered. The more challenging questions and the aspects that candidates need to develop further include reverse percentages, similarity, describing transformations, more difficult sequences, general trigonometry in context and solving equations from graphs.

Comments on Specific Questions

Question 1

Most parts of this question were well answered with many of the more able candidates gaining full marks.

(a) (i) This question on time was answered well. A few candidates added 25 minutes instead of 1 hour 25 minutes and gave an answer of 08 15.

(ii) The majority knew how to calculate the average speed. Those that used the fractio exact decimal were usually successful. A significant number of candidates wrote 1 h minutes as 1.25 hours and calculated 92 ÷ 1.25. Using a rounded version of $\frac{85}{60}$ as 1.4 or 1.4 1.42 led some candidates to find a value outside the acceptable range.

(iii) There were many correct answers with $\frac{10}{85} \times 100$ or $\frac{10}{85} = 0.1176$ followed by a correct answer seen in the working for this percentages question. Some did not use consistent units and attempted $\frac{10}{1.25}$. Others reached 0.1176 and then gave the answer as 12% without showing a more accurate percentage value.

(iv) This part on reverse percentages was less well answered. Better candidates associated 92 with 115% and realised the need to divide by 1.15, correctly obtaining the answer 80. The most common mistake was to calculate 0.85 × 92 or to subtract 15% of 92 from 92. Some found the value 80 but spoiled their work by then subtracting 80 from 92.

(b) (i) This ration question was very well done with most achieving full marks.

(ii) There were many fully correct answers. Candidates need to ensure that they give the ratio in the **simplest form**. Unsimplified answers such as 8.25 : 6.75 and 33 : 27 were common. A few gave their answer in the form *n* : 1.

Answers: **(a)(i)** [0]9 15, **(ii)** 64.9 or 65.[0], **(iii)** 11.76, **(iv)** 80; **(b)(ii)** 11 : 9.

Question 2

This transformation question produced a wide range of responses with some candidates not attempting several parts. It was pleasing to note that in **part (b)** most candidates gave a **single** transformation and only a few lost all the available marks by giving two transformations. The use of the appropriate terminology in this part of the question was varied; candidates could improve their responses by using precise explanations and not adding additional information that may spoil their work. The mark allocation is an indication of the amount of detail required e.g. a description question with 3 marks requires 3 pieces of information. Plotting of points was generally accurate and most candidates had ruled lines.

(a) (i) Well done overall. The most common error was to translate 1 left and 11 down. A few miscounted, usually by 1 square.

(ii) Again, well done by the majority of candidates. When incorrect, the shape was usually correctly sized and orientated but with an incorrect centre. Several used (– 4, – 6) as a centre and a few attempted a scale factor of – ½.

(b) (i) There were many fully correct answers. Some just wrote 'reflection' and did not give a mirror line.

(ii) Well done with most using a rotation to describe the transformation. Those that used enlargement were usually successful in gaining all 3 marks.

(iii) This proved difficult for many candidates and was often left blank. A common error was to describe the transformation as a shear. If attempted, the invariant line was usually written incorrectly with 'in *y*-axis' and 'along *y* = 8' being the most frequently seen wrong answers.

Answers: **(a)(i)** image at (– 3, 1), (– 7, 7), (–3, 7), **(ii)** image at (– 4, – 1), (– 4, – 4), (– 2, – 4);
(b)(i) reflection, *y* = 1, **(ii)** rotation, (3, 2), 180, or enlargement, (3, 2), (factor) – 1,
(iii) stretch, (factor) 0.5, invariant line *y*-axis or *x* = 0.

Question 3

Candidates displayed a good understanding and were able to use the formulas for volume and surfa Overall they performed well on this question with many achieving full marks. It is encouraging to no most candidates used an appropriate value for π in their calculations.

(a) Most candidates calculated 8000 ÷ 1080 and correctly gave the answer as 7.41. Some showed the calculation and then lost the accuracy mark by writing their answer directly as 7.4 or 7.40 without writing a more accurate value e.g. 7.407. Good advice to candidates would be to always write a full answer before rounding to the appropriate degree of accuracy. Surprisingly, a significant number of candidates calculated 1080 ÷ 8000 and 0.135 was a very common incorrect answer.

(b) This was very well done. Only the weaker candidates made errors, some giving an answer of 900 from calculating 1080 ÷ 12 × 10 instead of 1080 ÷ (12 × 10).

(c) (i) There were many correct answers with working clearly showing the necessary steps. Some found the square root rather than the cube root. Writing $r = \sqrt[3]{}$ would help candidates avoid errors and they are advised to show this step rather than proceed directly from r^3 = to r =. A common mistake was to find $\sqrt[3]{1080}$ as the first step.

(ii) This was very well done. Most were able to take their answer to **part (c)(i)**, substitute correctly into the given formula for surface area and gain the method mark.

(d) A few used the efficient scale factor method and were able to find $\sqrt{2}$. The vast majority of candidates found R by using $4\pi R^2 = 2 \times$ their **(c)(ii)** and then compared this with their r from **part (c)(i)**. This method often led to premature rounding within the calculations and to a final answer out of the acceptable range.

Answers: **(a)** 7.407; **(b)** 9; **(c)(i)** 6.36 to 6.37, **(ii)** 508 to 510; **(d)** 1.41

Question 4

There was a varied response to this question on probability. Many showed a good understanding of probability although some ignored the information about **without** replacement that was emphasised in the question.

(a) Many correct solutions were seen. Some candidates were unsure about how to combine the probabilities. Common errors were writing the probability of picking only one disc $\frac{2}{5}$, adding $\frac{2}{5}$ and $\frac{1}{4}$ and finding $\frac{1}{5} \times \frac{1}{4}$.

(b) This proved more of a challenge with many varied attempts. Most were able to identify the pairs that totalled 5 or at least one correct product. The more able candidates generally used efficient methods and took account of the without replacement. Some listed the numbers that added to 5, not realising that some could be obtained in more than one way, and gave an answer of $\frac{3}{20}$. Others incorrectly listed 25 possible outcomes in a two-way table and this usually led to the answer $\frac{6}{25}$.

(c) Nearly all candidates that completed **part (b)** gained the mark here by giving a correct answer or by following through their answer.

Answers: **(a)** $\frac{2}{20}$; **(b)** $\frac{6}{20}$; **(c)** $\frac{14}{20}$.

Question 5

Parts of this question tested the more demanding concepts of algebraic equations and function nota only the best candidates were able to score marks in **parts (c)** and **(d)**. The instruction at the start of **p** to **use your graph to solve the equations** was largely ignored. Candidates would perform better if t followed the hints given in the question.

(a) Most completed the table successfully. The most common error was an answer of 1 when $x = -1$.

(b) Some excellent curves were seen. The plotting of points was generally good with most using neat and accurate points or crosses. Candidates using pen rather than pencil often find it difficult to correct errors and can end up with several attempts at joining the points. Any wrong working should be clearly deleted so that Examiners have a clear indication of the final answer, using pencil and rubber would improve the quality. Some candidates continue to connect the two separate branches with the consequent loss of 1 mark.

(c) (i) Better candidates realised the need to use their graph to find the value of x when $y = 4$. The drawing of the curve between $x = ½$ and $x = 1$ required a good degree of accuracy and some candidates lost the mark here because of a poorly drawn curve. Others seemed confused by $f(x) = 4$ and calculated f(4) instead with –11.875 being seen on numerous occasions.

(ii) Very few candidates realised that they needed to draw the line $y = 3x$ on the graph and use it to find the x value of the point of intersection. Some obtained a value in the range despite not drawing the line.

(d) A challenge that proved to be beyond the majority of candidates with many not attempting this part. Those that started with $\frac{2}{x^2} - 3x = 3x$ usually obtained the correct answer. A common incorrect response was to find 0.7^3 and give the answer 0.343.

(e) (i) An easy 1 mark and most drew the line correctly. It was not always clear that the line passed through the point (3, - 9) and some candidates seem confused by the proximity of the plotted point (3, - 8)

(ii) The more able candidates realised the need to find the gradient using the given points, correctly obtained –3.5 and then used this with $y = mx + c$ to find the exact value of the intercept as 1.5. Many candidates attempted to use their graph to find the gradient and intercept rather than use the algebraic method. Gradient values of $+\frac{7}{2}$, $-\frac{2}{7}$ and $-\frac{7}{4}$ were common errors and the intercept value 1.4 or 1.6 was seen on numerous occasions. Candidates can improve their work by making clear what they are finding e.g. write the word gradient by the appropriate calculation, and by giving a full answer with the correct notation.

(iii) This was usually correct.

Answers: **(a)** 5 and –1; **(c)(i)** 0.55 to 0.65, **(ii)** 0.65 to 0.75; **(d)** $\frac{1}{3}$;
(e)(i) ruled line through (– 1, 5) and (3, –9), **(ii)** y = –3.5x + 1.5, **(iii)** tangent.

Question 6

Many candidates found parts of this question to be very demanding, particularly **parts (b)(i)** and **(c)(i)** that required candidates to show clearly how to form the given equation. It was common to see candidates attempt to solve these equations, with the quadratic formula being used repeatedly throughout the question.

(a) Well answered by the majority of candidates with many gaining full marks, often by using a numerical approach rather than an algebraic method. Those that used algebra gave well-worked solutions, clearly writing a single equation or a correct pair of simultaneous equations. Incorrect answers usually came from confusing the connection between w and l and writing $w = l + 0.25$. Some candidates introduced other variables instead of using w and l and this often led to confusion.

(b) (i) This was the most demanding question on the paper with many weaker candidates le... t blank. It proved a challenge for the more able candidates with many making little progre... $xy = 5$ and $(x + 2)Y = 6$ stage. Some confused y and Y, others did not make use of y... Although a variety of starting points were seen, most successful candidates usually... expressions for y and Y, then equated to 1 and proceeded to give a clear and logical proof of... required equation. A significant number attempted to solve the equation.

(ii) This was generally well done. Many were able to factorise correctly and gain the 2 marks. There were some cases of reversed signs but overall this part was well answered.

(iii) Many candidates found the correct perimeter or gained the follow through marks by using their values from **part (b)(ii)**. Some obtained the perimeter 21 despite not being able to factorise. The most common errors were: simply quoting the positive x value, finding the sum of two adjacent sides and incorrect addition of 10 + 10 + 0.5 + 0.5.

(c) (i) Although this was another 'show that' question candidates were generally more successful than in **part (b)(i)**. Many were able to use Pythagoras' Theorem correctly and expand the brackets then collect terms to obtain the required equation. Incorrect expansions $4x^2 + 9$ and $x^2 + 9$ were seen occasionally and it was noticeable that candidates made more mistakes if they started $(2x + 3)^2 – (x + 3)^2$. Some errors or omissions were made in the final line of working. Candidates should check carefully that they have written the equation precisely to avoid losing the accuracy mark. A common error was to start with $(2x + 3)(x + 3)$. Several candidates attempted to solve the equation using the quadratic formula.

(ii) The majority of candidates knew the formula and applied it well clearly showing all their working. Most observed the 2 decimal places but truncating to 2.05 and –4.05 was a common error. A minority used completing the square and they were usually successful. Those using the formula need to take greater care with their presentation to avoid losing marks unnecessarily. They need to ensure that the division line is completely drawn and the square root sign encloses all of $b^2 – 4ac$.

(iii) Generally well done. Most found the area correctly or chose a correct positive value and were able to gain the follow through marks for correct use of the basic area of triangle formula. A few only multiplied their value of $(x + 3)$ by 5 and some used 2.5 multiplied by their x.

Answers: **(a)** 0.57; **(b)(ii)** $(x – 10)(x + 1)$, **(iii)** 21; **(c)(ii)** –4.06 and 2.06,
(iii) 12.63 to 12.65 or 12.6 or 12.7.

Question 7

This question using trigonometry was well done by some candidates but many found **part (a)** challenging and were unsure about how to show that angle $ABC = 40.5°$, correct to one decimal place.

(a) Those that realised that they needed to use the area of a triangle formula ½ $ab\sin C$ were able to write ½ .16.25 sin$B$ = 130 and rearrange to sin$B$ = 0.65. Some found the height of the triangle first and then used sin$B$ = 10.4/16. As this was a 'show that' question, candidates needed to give an angle value to at least 4 figs. and state that it was 40.5 to one decimal place. Numerous candidates lost a mark by writing only one value instead of both 40.54…. **and** 40.5. Some used the 40.5 answer and calculated ½ .16.25 sin40.5 as 129.889… stating that this was approximately 130. This method is not an acceptable proof and candidates can improve their work on this type of question by making sure that they do not use the given answer in any calculation.

(b) Many candidates correctly used cosine rule and gave a clear, concise and accurate calculation. The most common error was seen in attempts to evaluate $16^2 + 25^2 – 2 × 16 × 25 × \cos 40.5$ as 81cos40.5. Some found the perpendicular height from A to BC as 10.4 and used Pythagoras's Theorem to find part of the base BC as 12.16. Then used Pythagoras's Theorem again with 10.4 and 12.84 to find AC correctly but this more complicated method often led to premature rounding and answers out of the acceptable range.

(c) Good candidates found the shortest distance by either using the area o $\frac{1}{2} \times 25 \times h = 130$ or using $\sin 40.5 = \frac{h}{16}$. A large number of candidates incorrectly ass triangle *ABC* was isosceles and calculated $16^2 - 12.5^2$.

Answers: **(b)** 16.5; **(c)** 10.39 to 10.4[0].

Question 8

There were varied responses to this question on interpreting trigonometric functions and transformations of functions.

(a) (i) Many were successful in obtaining the a value for the function $a\cos(bx°)$ by associating this value with the amplitude of the cosine curve. Fewer obtained the *b* value correctly.

(ii) Candidates found this very challenging and correct responses were seldom seen. The problem was associating the horizontal translation of the cosine curve with the value – 60 in the required function. Using – 30 was a common error.

(b) This was very well answered. Most candidates were able to sketch $y = 2\mathrm{g}(x)$ as a stretch of 2 with *x*-axis invariant of the original function.

Answers: **(a)(i)** $a = 4$, $b = 2$, **(ii)** $4\cos(2x - 60)$;

Question 9

Some very good solutions were seen from candidates that clearly knew their circle theorems. Others found this question difficult with **part (c)** proving to be beyond many of the weaker candidates.

(a) There were many correct answers and many more gained at least one mark by correctly finding some of the angles *ABX*, *XDC* or the obtuse angles at *X*. Some used alternate angles and gave the answer as 28º. Others assumed that *X* was the centre of the circle and having found that angle *DXC* = 128º then took the triangle *DXC* to be isosceles leading to an answer of 26º.

(b) Many correct solutions were seen but slightly fewer candidates were successful in this part of the question compared with **part (a)**. Those that worked with angles at the centre usually gave angle *SPQ* as $11x$ and then formed an equation based on opposite angles of a cyclic quadrilateral. Far fewer gave the reflex angle *SOQ* as $50x$ and used angles at a point. Some thought that the quadrilateral *SOQR* was cyclic and $25x + 22x = 180$ (or even 360) was a common mistake.

(c) This type of question requires candidates to show a clear progression through the various stages of calculation. To ensure the accuracy of the final answer is within the acceptable range candidates should keep at least 4 significant figures in the working for their answers to each stage. The method to find the area of a sector was well known and many were able to find a correct value. Using 44 ÷ 360 as 12% or 0.12 is not advised as this level of premature approximation leads to an out of range final answer. Those that realised angle *OLM* was a right angle usually made some progress on finding the area of the triangle. Most successful candidates found *LM* using 8tan44 and then used ½ × 8 × *LM* to find the area of the triangle. Some incorrectly assumed *OM* was 8 and attempted ½ × 8 × 8 sin44. It was common to see candidates dropping a perpendicular *LP* from *L* to *OM* and then using a combination of trigonometry and Pythagoras' to find *LP* and *OP*. A few then calculated *OM* which led to *PM* or *LM* and then the area of the triangle. Some were successful but this inefficient method was often left unfinished or led to mistakes and inaccurate values being obtained.

Answers: **(a)** 24; **(b)** 5; **(c)** 6.32 to 6.34

Question 10

Candidates performed well on this data handling question with many achieving full marks. Most ca[ndidates] showed a good understanding of cumulative frequency and completed **part (a)** successfully. The meth[od for] calculating the estimated mean was well known by many candidates and most clearly showed the wor[king] required to gain full marks.

(a) (i) This was very well answered. Nearly all were able to read the median value as 72.

(ii) Again, this was very well answered with most finding the lower quartile as 68.

(iii) Some candidates still wrote the inter-quartile range as 68 to 76, rather than giving a single value.

(iv) This part was answered well with many correctly reading 36 from the graph and subtracting from 200. Only a few gave the answer as 36. Some interpreted more than 1 hour by reading above the curve at 38 and finding 200 – 38 = 162.

(b) (i) Most realised the need to subtract 9 from 20 and gave the correct value 11. A few did not subtract and gave the answer 20. Some thought the answer was 10, maybe from interpreting ≤ 50 by reading at 49 and finding 19 – 9.

(ii) This part was answered very well with most candidates working accurately using the correct mid-values and the correct method for the estimate of the mean. Some used the upper or lower bounds, others used interval widths instead of mid-values and a few used mid-values 35.5, 45.5 etc. Occasional slips within the calculation were seen but candidates clearly showing all their working still gained the method marks. Candidates are advised to show clearly the addition of the *fx* values.

Answers: **(a)(i)** 72, **(ii)** 68, **(iii)** 8, **(iv)** 164; **(b)(i)** 11, **(ii)** 69.95

Question 11

All candidates were able to score some marks on this question on sequences but few answered it fully correctly.

(a) Most candidates were able to give the 6th term for sequences *A*, *B*, *C* and *D*, with only the occasional slip. Many did not realise that sequence *E* was the difference between *D* and *C*, those that did nearly always scored full marks for the whole question. Writing the n^{th} term proved more difficult with candidates often recognising *B* as n^2 and *C* as $n^2 + n$, but not attempting *D* and *E*. The linear sequence *A* was not always simplified although answers such as $11 – 2(n - 1)$ were given full marks. The most common error was to write $11 - 2n$ and this scored a method mark for writing a linear expression of the form $k – 2n$. Some expressed sequence *D* as n^3 rather than 3^n. Sequence *E* was rarely correct with some of those realising the need to subtract making a slip by writing $3^n – n^2 + n$.

(b) (i) This was often correct with some finding the correct value despite an incorrect expression in the table. Others correctly followed through their expression and gained the follow through mark. Some omitted the negative sign and gave the answer as 187.

(ii) Many correct answers were seen.

(c) Many realised the sequence involved repeated multiplication by 3 and as in **part (b)(i)** despite not writing an expression in the table were able to use their calculator to find the correct value.

(d) This was rarely correct. Only the candidates with the correct expression for the *n*th term were successful.

Answers: **(a)** A : 1, $13-2n$; B: 36, n^2 ; C: 42, $n(n+1)$; D: 729, 3^n ; E: 687, $3^n - n(n+1)$.
(b)(i) –187, **(ii)** 10 100; **(c)** 8; **(d)** 58 939.