MATHEMATICS (US)

Paper 0444/13
Paper 1 (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

Several of the candidates could tackle all questions, although a significant number did not attempt to do so. Candidates should be encouraged to attempt all questions. It is important that candidates read the questions carefully in order to understand what is required, especially when the question asks for the answer in a specific form, for example, a fraction. Careful checking would help to reduce errors. Candidates should ensure they do not round or truncate answers in the middle of calculations as this can lead to a loss of accuracy in the final answer.

Generally presentation was good. Some candidates showed method and were able to earn partial credit if they did not obtain the final answer, although a lack of working did cost some candidates marks.

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

Comments on specific questions

Question 1

This question was generally well answered.

Answer: 5034

Question 2

This was well answered with the majority of candidates giving the correct answer, apart from an occasional slip and partial solution i.e. −10 + 7.

Answer: −3

Question 3

This was well answered with the majority of candidates giving the correct answer. 144 from 12^2 was seen at times.

Answer: 36

Question 4

Many candidates were able to give the correct answer. The obvious error of n^{10} was not seen often.

Answer: n^7

Question 5

(a) Most answers were correct but some candidates did not know that scientific notation required the first part to be between 1 and 10 so that 24.7 and 247 were often seen. Several candidates missed out the question.

(b) Again answers were mostly correct but an index of 3 was seen at times. Otherwise the errors were similar to those in part **(a)**.

Answer: **(a)** 2.47×10^6 **(b)** 7.9×10^{-3}

Question 6

This was not very well answered. A lack of working prevented candidates from scoring 1 mark for the conversion to decimals.

Answer: 0.4^2, 0.22, $\left(\frac{1}{2}\right)^2$ $\sqrt{0.09}$

Question 7

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

(b) The majority scored the mark, either for a correct answer or as a follow through from an incorrect answer in part **(a)**.

Answer: **(a)** Station wagon **(b)** 35

Question 8

This was generally well answered with the majority of candidates scoring both marks. A few attempted to use decimals. Other errors were rare.

Answer: $\frac{23}{30}$

Question 9

(a) Several correct answers were seen, with the few errors tending to be dividing by 100 or 1000 rather than multiplying by an incorrect power of 10.

(b) Few candidates were able to give the correct answer. A variety of incorrect answers were seen with 1280 and 12.8 being common.

Answer: **(a)** 18.3 **(b)** 128

Question 10

Several correct answers were seen. The main error was not realising a scale factor was needed and just adding 20 to 16.

Answer: 48

Question 11

(a) This part was well answered but a few answers of the highest value, 175, were seen.

(b) This part was less well answered. Many candidates confused the median and mean. Some showed working, which usually resulted in success; others correctly identified 164 and 168 as the middle pair but then did not know how to find the answer.

Answer: **(a)** 172 **(b)** 166

Question 12

(a) This was very well answered with almost all candidates giving the correct answer.

(b) The majority of candidates scored both marks with just a small number gaining 1 mark for a correct fraction, but not in its simplest form. A small number of candidates had not read the question carefully and gave answers as a decimal, 0.48.

Answer: **(a)** 0.6 **(b)** $\frac{12}{25}$

Question 13

(a) Many correct answers were seen as nearly all candidates realised multiplication was needed.

(b) This part was less well answered. Some did not realise the need to divide, while others could not correctly carry out the division.

Answer: **(a)** 960 **(b)** 200

Question 14

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

(ii) Again the majority gave the correct answer. Candidates should be encouraged to give a numerical answer rather than words, e.g. impossible.

(b) In general this part was less well answered than part **(a)**. Some candidates didn't know the method and a variety of incorrect responses were seen. However, several were able to give the correct answer.

Answer: **(a)(i)** $\frac{5}{12}$ **(ii)** 0 **(b)** 0.65

Question 15

This was correctly answered by the majority of candidates. Errors in writing times, for example, writing 7 and a half hours as 7.3, led to errors in the addition of times, giving an answer of 35.60. Although several did score 1 mark for (usually) 5 and 4, some candidates were not able to work out the time intervals correctly.

Answer: 36

Question 16

(a) Some candidates did not understand vector operations at all, giving answers as co-ordinates or writing fraction lines in vectors.

(b) This part was less well answered with several adding or even multiplying the co-ordinates in various combinations. Several candidates did not attempt this part of the question.

Answer: **(a)** $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ **(b)** (8, 7)

Question 17

(a) Correct answers were rarely seen. The majority appeared not to understand how to calculate the circumference of a circle.

(b) Few were able to give a correct reason, mainly due to a lack of the correct answer in part **(a)**.

Answer: **(a)** 60

Question 18

(a) Correct answers were rarely seen. The majority appeared to understand the concept of perimeter, but almost all thought 4.5 was involved in the perimeter and others were confused by the number of sides the shape had.

(b) Some correct responses were seen but there were many confused attempts. Several scored 1 mark for 4.5 × 5.

Answer: **(a)** 30 **(b)** 47.5

Question 19

(a) Few correct answers were seen to this part.

(b) Many candidates could not answer this part correctly. Little working was seen and quite a lot of candidates did not attempt to answer this part. Most did not use 360° in any way.

Answer: **(a)** 142 **(b)** 9

Question 20

(a) Most candidates gained the 2 marks for drawing the lines of symmetry. The main error was to just draw the one line, the vertical from the top vertex.

(b)(i) There were quite a lot of drawings of a rectangle and a rhombus but squares were also common. Some hadn't appreciated that the shape had to be a quadrilateral and triangles and cuboids were often seen.

(ii) The majority of candidates with acceptable drawings were usually able to correctly name their shape.

Question 21

(a) (i) The majority of candidates were able to give the correct answer for the next term. Some didn't score the mark for the reason as they stated 7 but didn't state subtract.

(ii) This was less well answered than part **(a)** and several omitted to give any reason.

(b) Many appeared not to be familiar with the "*n*th term". The majority had shown the sequence to increase by 5 and had then given the answer 28 which was the next term.

Answer: **(a)(i)** 21, subtract 7 **(ii)** 162, multiply by 3 **(b)** $5n - 2$

Question 22

Few candidates appeared to understand the concept of solving the system of linear equations. Again a lack of working prevented candidates from scoring method marks.

Answer: $x = 5$, $y = -2$

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 efficient methods of calculation.

General Comments

The level and variety of the paper was such that all candidates were able to demonstrate their knowledge and ability. The final question had parts where there were high nil response rates but this seemed to be due to the nature of the question rather than lack of time.
Candidates showed that they were competent with substitution in Questions **1** and **18(a),** understood the rules of indices in Question **2**, dealt well with fractions in Question **5** and could solve a distance-speed problem in Question **9**.
Candidates particularly struggled with inverse proportion in Question **16**, drawing a tangent in Question **19**, solving equations involving indices in Question **20**, calculations for a histogram in Question **22** and geometry problems in Questions **21** and **25(b)**.

Comments on Specific Questions

Question 1

Almost all candidates gave the correct value of 36. A small number of candidates gave an answer of 144 from $(4 \times 3)^2$.

Answer: 36

Question 2

Almost all candidates simplified the indices correctly. A few gave answers of n^{10} or $2n^7$.

Answer: n^7

Question 3

The majority of candidates chose the correct quadrilateral. The most popular incorrect choice was *D*, perhaps because the lengths of the sides looked similar.

Answer: *B*

Question 4

The vast majority of candidates were able to write both large and small numbers in standard form correctly. There were some responses of 247×10^4 and 24.7×10^5 in part **(a)**. In part **(b)** the negative was occasionally missing or $7.9 \div 10^3$ was given.

Answer: **(a)** 2.47×10^6 **(b)** 7.9×10^{-3}

Question 5

Candidates demonstrated a proficient understanding of dealing with fractions.

Answer: $\frac{23}{30}$

Question 6

This question proved challenging for a reasonable number of candidates. Whilst there were a good number of correct answers, it was also common to see the incorrect answer of Friday, as the candidate had identified that the total mass of cats on Friday was 4 kg. There were a small number of candidates who showed correct total masses for each of the days, but made an incorrect conclusion. Many gave their conclusion (whether correct or not) without showing any working which meant that they scored 0 marks for an incorrect answer.

Answer: Thursday

Question 7

The majority of candidates could not gain the marks here because they were unable to convert $\sqrt{0.09}$ to a decimal. A conversion either wasn't seen and it was assumed as the smallest value, or 0.03 was seen. 1.6 was also commonly seen as the value for 0.4^2.

Answer: 0.4^2, 0.22, $\left(\frac{1}{2}\right)^2$, $\sqrt{0.09}$

Question 8

Part **(a)** was slightly better attempted than part **(b)** but both of these equations involving indices caused problems. In part **(a)**, common values given were $\frac{1}{3}$, 2, –2, 1 and 0. In part **(b)**, common answers were $\frac{1}{2}$ and 2.

Answer: **(a)** $\frac{1}{2}$ **(b)** $\frac{3}{2}$

Question 9

Candidates demonstrated their understanding of the relationship between speed, distance and time and the majority gained both marks. Some did not take account of the units but could still gain a method mark by showing 20×15.

Answer: 5

Question 10

There was a reasonable attempt at this question with many scoring 1 mark for showing one of the simplified values, usually $3\sqrt{3}$. There was a tendency for 75 to be split into 15×5 and then $5\sqrt{15}$. Similarly, the correct selection of 3×9 was also often then seen as $3\sqrt{9}$. Another common incorrect answer was $\sqrt{102}$. There were a number of candidates who successfully reached $3\sqrt{3} + 5\sqrt{3}$ but then did not make the final step to combine the values. A number of candidates tried to estimate the decimal value of the calculation.

Answer: $8\sqrt{3}$

Question 11

The majority of candidates interpreted the question correctly and arrived at the correct answer. For those who were not successful, multiplication by 0.4 and/or 0.2 often explained an incorrect answer. Some stopped at the 1st year value of 12 000. Candidates should be steered towards the most efficient methods of calculation, in this case, finding 60% and then 80% rather than carrying out each subtraction. Candidates should also be looking for mental strategies to help them, in this case finding 10% and multiplying whole numbers rather than trying to multiply by a decimal which led to many arithmetic errors.

Answer: 9600

Question 12

There were a limited number of fully correct responses to this question. Where full marks were not awarded, some gained 1 mark for correct use of the formula for volume of the sphere. Incorrect answers that could not gain credit were predominantly those where the diameter was used in place of the radius in calculating either the volume of the whole sphere or of the hemisphere and the use of r^2 in the formula. Arithmetic errors were common. 6 and 3 were often seen given as answers.

Answer: 18

Question 13

Very few candidates were able to gain both marks in this question. If a mark was gained, it was usually for the amplitude of 4. Common answers were 4 and 3*x*, or 4 and 3 either way round. A very high proportion of candidates left both answer spaces blank.

Answer: 120 and 4

Question 14

In part **(a)** of this question, candidates were required to find the perimeter of a compound shape made up of a square and a rhombus. The majority of candidates were unable to correctly identify that all of the sides of the shape would be equal. This commonly resulted in an answer of 29 cm where it was incorrectly assumed that two of the sides had length 4.5 cm (the perpendicular distance across the rhombus). In part **(b)**, candidates were required to find the area of the compound shape. This was better attempted than part **(a)** with a good number of fully correct answers. Common incorrect answers came from incorrectly finding the area of the rhombus (4.5×4.5 rather than 4.5×5) or from finding the correct area for the square and doubling. Some gained a mark for finding 22.5 but then gave that as their final answer, perhaps having been distracted by the arithmetic and forgetting to add on the square.

Answer: **(a)** 30 **(b)** 47.5

Question 15

Part **(a)** caused very few problems to candidates. There were a few answers of 44 and some arithmetic errors. Part **(b)** caused more problems with only the most successful candidates employing the most efficient method of 360 ÷ 40. The incorrect method of 180 ÷ 40 was often seen with answers of 4 or 5. Many were working with the interior angle of 140 and using trial and error.

Answer: **(a)** 68 **(b)** 9

Question 16

There were very few marks awarded in this question. Where candidates didn't score any marks, it was generally because they were using direct proportion and not squaring or direct proportion with squaring. Many candidates had no strategy for attempting this problem and the answer of 100 was fairly common from simply $(9+1)^2$.

Answer: 0.5

Question 17

This was a reasonably well attempted question and it was quite common to award at least one mark. Many candidates were able to gain a mark by finding the gradient of $-\frac{1}{2}$ from the given points although this posed many problems, with gradients seen inverted, or incorrect pairs of values used. Some drew a grid which is always a good starting point to understand a question like this, but candidates must remember that only calculations will give accurate values. The majority of candidates did not know how to continue from this point and many gave an answer of $y = -\frac{1}{2}x$ or worked out the equation of line *AB*, $y = -\frac{1}{2}x + 7$. Many candidates attempted to deal with the perpendicular gradient but more often than not this resulted in final answers involving $y = \frac{1}{2}x$ or $y = -2x$. Many candidates gave an answer of $y = kx$ to gain a mark for understanding that the line would have no intercept on the *y*-axis. The word perpendicular led many down the path of finding the midpoint of line *AB*, some progressing no further than this.

Answer: $y = 2x$

Question 18

Candidates demonstrated a good understanding of functions in this question. The vast majority of candidates were able to correctly substitute – 5 into f(*x*) in part (**a**). Dealing with the negative caused a few errors including answers of 14 (from 15 – 1) and –14. The majority of candidates knew that a power of zero resulted in a value of 1 in part **(b)**, although 0 and 2 were also commonly seen. Part **(c)** was well understood with many making the correct first step even if it was then simplified incorrectly. Lack of brackets in the first step resulted in some not scoring. Other answers seen were $1(3x-1)-x$, $3(1-x)-x$ and $3(1-x)-1$ (fg(x)). Part **(d)** was the most challenging part of the question. Although there were some candidates who gave a correct answer, it was more common to award no marks. Incorrect expressions given included $-1+x$, $x+1$, $1-y$ and $\frac{1}{1-x}$.

Answer: **(a)** –16 **(b)** 1 **(c)** $2-3x$ **(d)** $1-x$

Question 19

It was clear that the vast majority of candidates did not understand the meaning of drawing a tangent. There was either no line drawn at all or lines drawn at $x = 1$ or $y = 1$. More candidates interpreted part **(b)** correctly and gave the correct point. There was a high rate of nil responses to this question and a variety of incorrect points given.

Answer: **(a)** $2.1 \leqslant \text{grad} \leqslant 3.9$ **(b)** (–2, 8)

Question 20

This proved to be a very challenging question with very few scoring more than 1 mark throughout. Part **(a)** was easier to interpret and a number scored a mark for correctly dividing by 3. Many struggled to evaluate $\frac{4}{3} \div 3$ and left answers such as $\sqrt{\frac{4/3}{3}}$, $\sqrt{\frac{1.3}{3}}$ and $\frac{\sqrt{4/3}}{3}$. Some incorrect first steps were $w^2 = \frac{12}{3}$ (leading to an answer of 2) and $3w = \frac{2}{\sqrt{3}}$. Part **(b)** proved even more challenging and errors seen included $4 \times \frac{2}{5} = \frac{8}{5}$; $4 \times 5 = 20$ then $20 \div 2 = 10$; $y^2 = 20$ then $y = \sqrt{20}$. Many candidates left this part blank.

Answer: **(a)** $\pm \frac{2}{3}$ **(b)** 32

Question 21

There were a few candidates who correctly selected the $\frac{1}{2}bc\sin A$ formula and substituted correctly to get as far as $\sin x = \frac{1}{2}$ but the majority of candidates did not have a strategy (just writing 60 in the triangle and nothing else) or assumed a right-angled triangle. The use of Pythagoras' theorem was seen, along with $\cos \frac{12}{20}$, $\frac{1}{2} 20 \times 12$ and simply 45° assuming an isosceles right-angled triangle.

Answer: 30

Question 22

This was one of the least understood questions on the paper and only the most able candidates tended to gain any marks. The most common response by far was to give 4, 7 and 3 as answers, following the 60 and 6 given in the table, taking no account of the class widths. Some candidates calculated frequency densities but took no account of the proportionality involved.

Answer: 1, 3.5, 1

Question 23

This simplification was dealt with proficiently by the majority of candidates and was well set out so that method marks could be awarded. The factorisation of both, or one of $7n(6p - 1)$ and $2t(6p - 1) + 3m(6p - 1)$ was achieved by the majority of candidates, although not all were able to make any further progress from this point and so 2 marks was common. The major challenge stemmed from the cancellation of $6p - 1$. Quite often the $6p - 1$ in the numerator was cancelled with only one bracket in the denominator, leaving a final answer $\frac{7n}{2t(6p-1)+3m}$ or $\frac{7n}{2t+3m(6p-1)}$. Those who were able to fully factorise the denominator into $(2t + 3m)(6p - 1)$ usually went on to achieve full marks.

Answer: $\frac{7n}{2t+3m}$

Question 24

Many candidates struggled with all or parts of this question and a full range of marks was awarded. Where fully correct answers were not given then there were a reasonable number of candidates who could correctly identify the lines on the diagram, but struggled with identifying the appropriate inequalities signs. Less able candidates could not identify $y = -\frac{3}{5}x + 6$ (the gradient was often $\frac{3}{5}$ or $\frac{5}{3}$), but were able to recognise $y = x$ and/or $x = 2$ and so gained some credit. There was some incorrect use of 10 and 6 such as $6y > 10x$, $y > 6$ and $x < 10$. There were a minority of candidates who used completely incorrect notation, for example $R > y > x$ or $x > x = 2$ and did not gain credit. Some candidates did not appreciate the form that their answers should give and gave co-ordinates or vague descriptions.

Answer: $y \leqslant -\frac{3}{5}x + 6$, $x \geqslant 2$, $y > x$

Question 25

Part **(a)** of this question involved circle theorems and candidates demonstrated a good degree of understanding. Many candidates found the correct angle in part **(i)** and many others gained 1 mark for showing a right angle at *XAC* or *ABC*. A common answer was 30, perhaps after finding 150 and 30 at *O*, looking at the isosceles triangle so that *BC* and *AO* were equal. Part **(ii)** was the least well attempted part in **(a)**. Some assumed that the angle at *B* was split into equal 30° sections which led to an answer of 120. Other more popular answers were 130 and 135 where a 45° angle was seen somewhere within *B*. Some were confusing theorems and halving 75 to give an answer of 37 or 37.5. There was also a high nil response rate in this part. Part **(iii)** had the highest nil response rate within the question but was also the best answered, indicating that those who answered it were generally doing so correctly. Well over half of candidates gave a correct answer or followed through correctly from their previous answers. Only the more able candidates scored any marks in part **(b)**. Candidates needed to work out the fraction of the arc (2π) to the whole circle (18π) i.e. $\frac{1}{9}$ and so carry out the straightforward arithmetic which is always prevalent in these types of questions. Numerous candidates were unnecessarily multiplying $2 \times \pi \times 9$ using a decimal form of π and then struggled to progress any further. Other answers included 68 from measuring, 60 (from possibly guessing the fraction was $\frac{1}{6}$) and 2π. Some wrote 2π on the diagram and then had no strategy to progress any further and others made no response at all.

Answer: **(a)(i)** 75 **(a)(ii)** 150 **(a)(iii)** 75 **(b)** 40

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. The majority of candidates attempted all of the questions with some part questions being omitted by individuals. The standard of presentation was generally good. Many 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. Centres should continue to encourage candidates to show all working clearly in the working space provided. The formulae being used, substitutions and calculations performed, are essential if partial credit is to be awarded.

Candidates should take the time to read the questions carefully and understand what can and cannot be assumed in each part of a question. In particular, they need to be aware of what is required in questions requiring reasons in the answer. For example, in geometry questions if asked for a reason, it would be necessary to state, for example, that the interior angles of a triangle add to 180° rather than just give the numerical calculation.

Comments on specific questions

Question 1

(a) (i) Many candidates gave the correct answers. A few candidates misread the question and wrote 8^2 and 9^2 rather than 64 and 81. A few candidates just wrote 8 and 9.

(ii) Candidates tended to misunderstand this question. Although a large minority of candidates gave a correct answer of 90 and a few candidates gave an alternative correct answer of 1350, many candidates found a common factor, either 3 or 5. A substantial number of candidates did not give an answer to this part.

(iii) Many candidates showed an understanding of factors. Some candidates gave the correct answer. The most common errors were to either misread the question and include the even factors as well or only give three of the factors, with normally 1 or 27 being missed.

(iv) The majority of candidates gave the correct answer. The most common error was to give the common factors rather than the highest common factor.

(b)(i) Some candidates gave the correct answer. The most common error was to find the square root instead of the cube root.

(ii) Many candidates gave the correct answer. The most common error was to give an answer of 19.4.

(iii) Many candidates gave the correct answer. The common error was to multiply 0.2 by –4.

(iv) Many candidates found this part challenging. The common errors were to either mishandle changing the mixed number or not giving an answer to four significant digits.

Answers: **(a)(i)** 64, 81 **(ii)** 90*k* **(iii)** 1, 3, 9, 27 **(iv)** 16 **(b)(i)** $\frac{9}{4}$ or 2.25 **(ii)** $\frac{1}{2}$ **(iii)** 625 **(iv)** 1.318

Question 2

(a) Most candidates gave the correct answers. A few lost a mark for rounding \$25.56 to \$26.00.

(b)(i) Many candidates gave the correct answer. The most common error was to calculate the percentage that needed to be borrowed, 15%.

(ii) Fewer candidates gave the correct answer. Many candidates only found the amount borrowed, \$660, and then worked out the interest rather than the total amount owed. A few candidates used \$4400 or \$3740 instead of \$660.

(c) Many candidates gave the correct answer. The most common error was to misread the question and multiply \$321 by 12 instead of dividing by 12.

(d) Many candidates found this part challenging. Although many candidates correctly identified that the van would travel further they omitted to give a valid reason for their decision. In particular, some candidates made a calculation which, although correct, was evaluated to an insufficient degree of accuracy to be useful in making the final decision.

(e) Although most candidates showed an understanding of ratios, many only found one part, 1400, instead of two parts, 2800. Some candidates found the amount for repairs instead of fuel.

Answers: **(a)** 258(.00), 25.56, 758.56 **(b)(i)** 85 **(ii)** 739.2(0) **(c)** 26.75 **(d)** Van and 12.6 > 12.4 **(e)** 2800

Question 3

(a)(i) The majority of candidates gave the correct answer. The most common error was to give an answer of 24.30 – 23.85 rather than evaluating it. A few candidates gave a range for the distance rather than the time.

(ii) Candidates generally gave the correct answer. Again, some candidates used the wrong data, time instead of distance.

(b)(i) Most candidates showed an understanding of how to plot points with many correctly plotting the required points with good accuracy. The most common error was to misread the scale on the *x*-axis and plot all the points between 24.0 and 24.1.

(ii) The majority of candidates gave the correct answer. Some candidates embellished their answers with words such as weak or strong. A small number of candidates omitted to give an answer.

(iii) A large number of candidates thought that the given statement was correct. Many candidates who did say that the statement was not correct gave a good explanation.

(iv) Although many candidates drew a reasonable line of best fit a similar number of candidates did not. The most common errors were to join up every point or simply join the first point to the last point. A few candidates attempted to fit a positive line to the data.

(v) Most candidates showed that they understood how to read from a line of best fit. Occasionally the scale on the *y*-axis was misread.

Answers: **(a)(i)** [0].45 **(ii)** 6.115 or 6.12 **(b)(ii)** Negative

Question 4

(a) (i) Many correct answers were given by the candidates.

(ii) Many correct answers were given by the candidates. The most common error was to give an answer of 71.

(b) Few candidates scored 3 marks; many candidates scored 2 marks for 43. Many candidates did not give suitable reasons for their answer with most simply showing the calculation they performed rather than stating the geometrical properties behind the calculation. Where candidates did state the properties, some candidates lost the last mark as they only mentioned angles in a triangle and omitted angles on a straight line.

(c) About half the candidates calculated the correct answer. Some candidates tried using the cosine rule or Pythagoras' theorem but invariably didn't give a complete method.

(d) (i) This part was well answered by many candidates. The main error was to find 375^2 and assume that this had proved the result.

(ii) Candidates found this part challenging. Most candidates divided 375 by 450 but many inverted these numbers. Some candidates added their answer directly to 14 45 not recognising that their number was in hours rather than minutes. Quite a few candidates used 100 minutes in an hour especially when their first part answer was 1.2. A few candidates did not use the 24-hour clock.

Answers: **(a)(i)** 35 **(ii)** 74 **(b)** 43 **(c)** 32.2 **(d)(ii)** 15 35

Question 5

(a) Many candidates made good attempts at the construction. The most common errors were for either the line *AB* to not be vertical or to not show the construction arcs.

(b) Some candidates gave the correct distance, or the correct distance from their diagram.

(c) Quite a few candidates did not answer this part. Many gave an answer of 360−23 rather than 180+23.

Answers: **(b)** 14.9 to 15.3 **(c)** 203

Question 6

(a) Generally, candidates gave the correct answer. Some candidates did not recognise that they needed to obtain the factor $\frac{45}{18}$ in order to complete this part.

(b) (i) Candidates generally found this part challenging. Some candidates did not give an answer whilst others found $\frac{5}{8}$ rather than $\frac{8}{5}$ of 395.

(ii) Many candidates gave the correct follow through from their previous answer. However, common errors were to either multiply by 1000, or multiply or divide by 100.

(c)(i) All candidates found this challenging. A few candidates did give an answer such as 9*C*+160/5. Many candidates attempted to find a value rather than an expression.

(ii) The majority of candidates gave the correct answer even if they had not given a correct expression in the previous part.

Answers: **(a)** 325, 150, 450, 75 **(b)(i)** 632 **(ii)** 0.632 **(c)(i)** $\frac{9C+160}{5}$ **(ii)** 356

Question 7

(a) Many candidates gave the correct answer. The most common error was to assume that a hexagon had a different number of sides with 8*h* being seen frequently. Another fairly common error was to multiply the sides together instead of adding them so h^6 was sometimes seen.

(b) (i) Slightly more candidates gave the correct answer. The most common error was to multiply the sides together instead of adding them, usually when the same error had been made in the previous part.

(ii) Many candidates gave the correct answer. However, a substantial number of candidates did not recognise that this part was related to the previous part with sides equal to *x* and just wrote down length x breadth.

(c) Some candidates found this part challenging with a substantial number not giving an answer. Of those candidates that attempted this part, many did not write down the correct expression for the perimeter but subsequently did equate this to 53 and solved their expression correctly and scored some part marks. Those candidates who only wrote down a final incorrect answer could not score any part marks.

(d) (i) Although some candidates gave the correct answer the majority of candidates either added up all of the coefficients to give an answer of 10 or retained the letter *b* in their answer.

(ii) The clear majority of candidates gave the correct answer. The most frequent error was to mishandle the negative signs with answers such as $6a - b$ being seen frequently.

(e) (i) Nearly all candidates gave the correct answer. The few who gave an incorrect answer tended to omit multiplying the second term inside the bracket by 5 so $5x - 4$ was commonly seen here.

(ii) Slightly fewer candidates gave the correct answer. Those candidates who incorrectly multiplied out the expression in the previous part tended to make the same error here. A few candidates tried to simplify the expression further by giving the final answer as either 4x or $4x^3$.

(f) Only a minority of candidates gave the fully factorised answer. The majority of candidates gave partially factorised answers such as $2x(4x - 2)$ or $x(8x - 4)$. A few candidates mishandled the factorisation, giving answers such as $4x^2$ arising from incorrectly taking x^2 out of the expression to give $x^2(8 - 4)$.

Answers: **(a)** $6h$ **(b)(i)** $4x$ **(ii)** x^2 **(c)** 7.5 **(d)(i)** −3 **(ii)** $6a + b$ **(e)(i)** $5x - 20$ **(ii)** $x^3 + 3x$ **(f)** $4x(2x - 1)$

Question 8

(a) Many candidates drew the correct reflection. The common error was to reflect in the *y*-axis rather than the *x*-axis.

(b) Slightly more candidates gave the correct answer for the translation. The common errors were to incorrectly translate in either the *x* or *y* direction or to translate by $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$ instead of $\begin{pmatrix} 1 \\ -3 \end{pmatrix}$.

(c) Many candidates recognised this as a rotation but omitted to state the other necessary requirements, usually missing out the centre of rotation. Some candidates stated 180° instead of 90°.

(d) Many candidates recognised this as an enlargement and slightly more gave the other two requirements to describe the transformation correctly. The common error was to miss out the scale factor.

Answers: **(c)** Rotation, (about) (0,0), 90° (anti-clockwise) **(d)** Enlargement, [centre] (0, 0), [sf] 2

Question 9

(a) The majority of candidates gave the correct answers. The main error was when evaluating the values for $x = -3$ and $x = -2$ where the negative sign was often not used correctly.

(b) Most candidates plotted their points correctly. There was little evidence of joining points with straight lines.

(c) Many candidates knew where to draw the line $y = 6$.

(d) Many candidates gave correct answers for their curve. The common error was to not recognise that each small square on the two axes had different values, 0.2 on the x-axis and 0.4 on the y-axis.

Answers: **(a)** 15, 8, 0, 0, 8 **(d)** −1.8 or –1.7 or –1.6, 3.6 or 3.7 or 3.8

Question 10

(a) Many candidates did not give an answer.

(b) Many candidates did not give an answer. Some candidates gained a mark for obtaining one of the values correctly.

(c) Most candidates did not give an answer.

(d) A few candidates recognised that they had to equate 3x – 5 to 7.

(e) Some candidates gave the correct answer. The common error was to indicate an answer of $g(x) = f(x) - 4$.

Answers: **(a)** $0 < x < 10$ **(b)** -5 [< $f(x)$ <] 25 **(c)** x – 5 **(d)** 4 **(e)** $g(x) = f(x + 4)$

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

The paper covered a wide range of topics from the syllabus and most candidates were able to make a positive attempt at some or all of the questions. More able candidates provided solutions that usually displayed clear methods. However some candidates provided solutions with little or no working and some didn't carry out calculations to sufficient accuracy and consequently lost marks. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time. For questions requiring several calculations, candidates are advised to write down the answer to each step using more than 3 significant figures and only correct to the required accuracy at the end of the calculation.

The topics that proved to be more accessible were ratio and percentages, drawing curves, manipulating simple algebraic expressions and equations and sequences. The more challenging topics were interpretation of graphs, determining the combination of outcomes to give a result in probability, interpreting statistical data, using algebraic methods to show a result and some aspects of the question on vectors.

Comments on Specific Questions

Question 1

(a) Many correct answers were seen. Errors usually involved a refection in an incorrect vertical line or reflection in the line $y = 1$.

(b) Most candidates were able to draw the correct image with some earning one mark for a translation with either the correct horizontal displacement or the correct vertical displacement. A small number misinterpreted $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and translated the triangle using $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$.

(c) Candidates were less successful in this part of the question. Most understood how to enlarge the triangle with scale factor 2 but were less clear on how to use the centre of enlargement and so the image triangle was often in the incorrect position. The given centre of enlargement (4, 5) often became one of the vertices of the image triangle or was placed in the 'centre' of the image triangle. A small number enlarged the triangle with scale factor 3.

(d) Most candidates were able to correctly identify the rotation and also the angle of 90° although a significant number omitted the direction of rotation. Identifying the centre of rotation proved more challenging with many incorrectly giving (6, 4) and to a lesser degree (6, 3).

Answers: **(d)** Rotation, 90° clockwise, centre (7, 4)

Question 2

(a) (i) This question was almost always correct. Errors usually involved division by 25 and occasionally finding the number of edge pieces rather than the total number of pieces.

(ii) This was another part that was frequently correct. Errors usually involved the percentage of the number of edge pieces as a percentage of the number of inside pieces.

(iii) Again, this was a part that was mostly correct. Most answers were given as decimals and any errors seen were usually due to finding Betty's time or incorrectly converting to hours and minutes.

(b) Many appeared to understand that the sale price was 65% and a majority of these went on to obtain the correct answer. However, some then went on to calculate 35% of $15.99 and add it on.

(c) Only a minority of candidates realised the correct relationship between the ratio of the areas and the ratio of the lengths. Those who did usually gained full marks. A few used the length, 35, and width, 25, of the photograph and trialled scaled up values until they reached $63 \times 45 = 2835$. However, many used the area scale factor of 3.24 as a length scale factor leading to the common incorrect response of 113.4. Others squared the ratio of areas rather than taking the square root.

(d) (i) A small majority of candidates were able to convert the area units correctly. Many however simply divided by 100 to obtain 66.1.

(ii) The majority of candidates appreciated that the percentage profit was based on the cost price and not the selling price and usually earned all three marks. A few reached 148% but then forgot to subtract 100. Almost all other errors involved those basing the profit on the selling price.

Answers: **(a)(i)** 1050 **(ii)** 12 **(iii)** 5.25 **(b)** 24.60 **(c)** 63 **(d)(i)** 0.661 **(ii)** 48

Question 3

(a) Most candidates were able to complete the table correctly. Errors in completing the table were few and far between and usually involved evaluating $\frac{2}{-2^2}$ instead of $\frac{2}{(-2)^2}$.

(b) The points were usually plotted correctly with occasional errors involving the misinterpretation of the scale on the *y*-axis. Curves were usually smooth but a number of candidates joined their points with line segments. A few joined the two branches of the curve. Some candidates used a pen to plot their points and draw their curve, making it difficult to make changes when slips were made. Some curves were drawn with thick lines which led to the loss of marks for the quality of the curve.

(c) This was frequently interpreted as 'the largest value of *y*' and 24.1 was a very common error. Those with some idea of what was required gave the incorrect answer of 6. Very few candidates were able to give the correct answer.

(d) (i) More able candidates could draw the correct line and use the points of intersection with the curve to find three solutions. Inaccuracies in drawing the curve, or line, usually meant that one or more of the solutions were outside the required tolerance. A significant number were unable to draw the correct line.

(ii) Yet again more able candidates performed well. Others struggled to make a correct start. Some opted to eliminate the fraction as their first step and often forgot to multiply the $3x + 1$ by x^2. Those that opted for collecting terms often made errors with the signs when rearranging.

Answers: **(a)** –4.5 and 10.5 **(c)** 5 **(d)(i)** –0.4 to –0.31, 0.35 to 0.45, 2.2 to 2.3

(ii) 6, –14, 0

Question 4

(a) Many answered this part well with a few candidates adding the probabilities rather than multiplying.

(b) Candidates were far less successful in this part. The most common incorrect answer came from $\frac{7}{8} \times \frac{7}{8}$.

(c) Candidates were generally more successful in this part than part **(b)** with a small majority reaching the correct probability. Less able candidates tended to work out the probability that the first spin is odd and the second spin is even, not appreciating that the result could be achieved in the reverse order also.

(d) This proved to be the most challenging part of the question. It was common to see candidates considering some of the possible combinations, but not all. Many considered (5, 8) and (6, 8) but forgot the possibility of (8, 8). When calculating probabilities, the fact that there were two 5's was often overlooked. The small number that drew up a complete possibility diagram usually obtained the correct answer. A significant number attempted a tree diagram, but with so many outcomes to consider these were often incorrect.

(e) This proved less of a challenge than the previous part. Successful candidates tended to list the possible combinations and a few drew a possibility diagram. Others attempted to list the individual outcomes such as (3, 4), (3, 4), (3, 4), (3, 5) etc., but all too often some outcomes were omitted or repeated numbers were not taken into account. Only the more able candidates used a more efficient approach such as (3, more than 3), (4, more than 4), etc. A significant number calculated the probability of (3, 4) + (4, 5) + (5, 6) + (6, 8).

Answers: **(a)** $\frac{1}{64}$ **(b)** $\frac{63}{64}$ **(c)** $\frac{30}{64}$ **(d)** $\frac{7}{64}$ **(e)** $\frac{24}{64}$

Question 5

(a) Many candidates were familiar with the cosine rule and made good attempts to find the required angle. Most started with the explicit version of the cosine rule but those starting with the implicit version were more prone to errors when rearranging. A very frequent error was omitting to show the required angle to more than one decimal place after otherwise correct working. Premature approximation with values in the working often led to inaccurate answers.

(b) More able candidates were successful in this part but less able candidates found this more challenging. The cosine rule and the sine rule were widely used to find angle *BLA* or angle *BAL*. Several of those who obtained a correct value for their angle were unable to continue and find the correct bearing angle. Premature approximation with values in the working often led to inaccurate answers.

(c) This proved more challenging for all candidates. Many candidates struggled to identify the required distance *BC* where the light was visible and many opted for *AB*, *AL*, *BL* or *AC*. Those that opted for *BC* used a wide variety of methods, some long-winded, that often resulted in a loss of accuracy along the way. Most candidates who had found a distance were able to then calculate a time correctly.

Answers: **(a)** 130.11 **(b)** 59.5 **(c)** 1h 50 min

Question 6

(a) (i) Most candidates were able to read off the value of the lower quartile without a problem but many appeared to struggle reading off the scale for the upper quartile. Almost all candidates that had values for the two quartiles were able to calculate the inter-quartile range from their values.

(ii)(a) Many responses were seen with candidates identifying that the median for Website *A* was lower than the median for Website *B* but then spoiling it by the inclusion of other statistics in their reasoning.

(ii)(b) Candidates were more successful in their comparison of the upper quartiles, rarely including other statistics in their reasoning.

(b) The correct method was frequently seen with few arithmetic errors. Common errors included the use of the upper bounds of the interval rather than the mid-values and in some cases using the interval widths instead of the mid-values. A small number simply added the mid-values and divided by 6.

(c) Many candidates were successful in calculating the cost of a monthly payment. For others, the calculation of the deposit was often correct but this was then subtracted from the cash price rather than the total cost leading to the common incorrect answer of $273.75.

Answers: **(a)(i)** 6000, 10200, 4200 **(ii)(a)** True, median price lower **(ii)(b)** False, A's UQ < 13600 **(b)** 11025 **(c)** 323.25

Question 7

(a) This proved to be the most challenging question on the paper. Although an algebraic method was asked for, many candidates attempted methods involving trigonometry. Others used the given value of r to find the distance from O to the chord AB and then Pythagoras' theorem to show that half the length of AB was 12. These methods earned no credit. Those that identified the perpendicular from O to AB as $18 - r$ usually went on to make a correct statement for Pythagoras' theorem. Not all went on to show that $r = 13$ as some struggled to expand $(18 - r)^2$ correctly.

(b) Most candidates were able to use simple trigonometry or the cosine rule to find angle AOB. Many, however, gave their answer as 134.8 and so omitted to show that the answer rounded to 134.8. In all such questions it is important that candidates obtain their answer to a greater degree of accuracy than given in the question. Some candidates assumed the value of 134.8 to find the angle OAB and then used their answer to find angle AOB. This circular argument earns no credit.

(c) (i) There was a lot of confusion over terminology such as sector and segment and this was reflected in some of the responses that were seen. More able candidates generally performed well, some finding the area of the minor sector and subtracting that from the area of the circle. Others opted to find the angle in the major sector and obtain their area directly. A significant number of candidates opted to calculate the area of half of the major sector but often omitted to multiply their answer by 2. As a result of the confusion, a significant number gave the area of the major segment as their answer. Loss of accuracy in the final answer resulted from premature approximation of some of the intermediate values.

(ii) Those that were successful in the previous part usually went on to find the area of triangle OAB and correctly find the area of the major segment. Some candidates restarted rather than use their previous answer, although not all were successful. A significant number with an incorrect answer in part **(i)** were able to earn marks for a correct method based on their previous answer.

(iii) Candidates of all abilities were more successful in this part, appreciating that the volume could be found by multiplying their previous answer by 40.

(d) A significant number of candidates were able to equate an expression for the volume to their previous answer. Most went on to obtain a correct answer based on their previous answer. Some, usually the less able candidates, used an incorrect formula for the volume of a cylinder.

Answers: **(b)** 134.76 **(c)(i)** 332 **(ii)** 392 **(iii)** 15700 **(d)** 29.5

Question 8

(a)(i) Many correct answers were seen. The most common error involved $2 \times 3 - 3 \times (-2)$, often evaluated as 0.

(ii) This question proved challenging, with only a minority obtaining the correct answer. Partial credit could be earned for a correct method but frequently the modulus was calculated as $\sqrt{12^2 - 5^2}$. Others simply interpreted the question by taking the absolute values of the two components and $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$ was a common incorrect answer.

(b)(i)(a) Many correct answers were seen along with incorrect answers such as **a** + **b**.

(i)(b) Few of the less able candidates could obtain the correct answer with a common incorrect answer being $\frac{3}{5}$ **b** – **a**. Others misinterpreted the ratio and fractions, so that $\frac{2}{3}$ often appeared in incorrect answers. More able candidates were frequently successful.

(i)(c) Many candidates found this part challenging. Some opted for the route $\overrightarrow{OB} + \overrightarrow{BM}$ but often used $\overrightarrow{MB}$ rather than $\overrightarrow{BM}$. Those that opted for the route $\overrightarrow{OA} + \overrightarrow{AM}$ were slightly more successful as they could use their answer to the previous part. Some more able candidates did not earn full credit as their answers were not always simplified.

(ii) Very few correct answers were seen in this part. There was little evidence that candidates connected this with the previous part and many answers were given without any working.

Answers: **(a)(i)** $\begin{pmatrix} 12 \\ -5 \end{pmatrix}$ **(ii)** 13 **(b)(i)(a)** **b** – **a** **(i)(b)** $\frac{3}{5}$(**b** – **a**) **(i)(c)** $\frac{1}{5}$(2**a** + 3**b**) **(ii)** 1.5

Question 9

(a) Almost all candidates were able to solve the equation correctly. The few errors seen usually involved one or more sign errors when rearranging the equation or leaving the answer as an unsimplified improper fraction.

(b) Candidates were only slightly less successful in this part of the question. In addition to the type of error seen in part **(a)**, some candidates made errors with the inequality.

(c) Almost all candidates factorised the quadratic expression correctly. Errors usually involved the signs reversed or going further than needed and treating the question as a quadratic equation.

(d) Candidates were slightly less successful in this part. Errors usually involved the omission of one or both of the squares, most often with 6*y*, or incorrect signs when collecting the *xy* terms.

Answers: **(a)** 2.25 **(ii)** $x \geqslant 3.5$ **(iii)** $(x - 7)(x + 3)$ **(iv)** $12x^2 + xy - 6y^2$

Question 10

(a) Almost all candidates were able to complete the first column correctly. Less able candidates struggled to find the general terms but many of the others were successful. For the linear sequences, if the candidate obtained the $3n$ or the $-6n$ they were usually successful in finding the appropriate number term. Many spotted the general term for the third sequence but far less were successful with the final sequence, not recognising that the sequence was obtained by subtracting n.

(b) (i) Many candidates successfully equated the given expression to 155 and were able to show the required result. Most incorrect answers resulted from substituting $n = 155$ into the given expression.

(ii) Many correct solutions of the quadratic equation were seen; the majority of these were worked out using the quadratic formula. Errors with the signs and incorrect substitutions were seen. Only a very few candidates used the method of completing the square.

(iii) Not all candidates related this to the previous part and n was a common incorrect answer. A few gave their answer as a fraction and occasionally as a negative number. However, many correct answers were seen.

Answers: **(a)** 14, $3n - 1$
-4, $26 - 6n$
25, n^2
20, $n^2 - n$
(b)(ii) 10 and $-\frac{31}{3}$ **(iii)** 10

Question 11

Credit was earned in three stages, eliminating the fractions from the equation, simplifying the result to the correct quadratic equation and solving the quadratic equation. Fully correct answers were in the minority but many earned partial credit for work at the various stages. The majority of candidates were able to earn some credit for elimination of the fractions, usually for collecting two of the given fractions as a single fraction. Errors at the first stage clearly led to an incorrect quadratic equation and many candidates earned credit for simplifying their equation to a quadratic. In most cases, solving the quadratic usually involved the use of the formula, either because of previous errors or difficulty with the correct coefficients. Making a correct attempt at solving their quadratic also earned the candidates some credit.

Answers: 5 and $-\frac{27}{2}$