MATHEMATICS (US)

Paper 0444/13
Paper 13 (Core)

There were too few candidates for a meaningful report to be produced.

MATHEMATICS (US)

Paper 0444/23
Paper 23 (Extended)

Key messages

It is very important for candidates to give the answers in the form requested by the question. If a form is not requested then algebraic answers should be given in their simplest form and numerical answers should be fully simplified if given as fractions, or written to three significant figures if given as decimals.

General comments

This is an examination paper without the use of a calculator. As such candidates need to ensure that they are able to accurately multiply and divide concisely. Many candidates used overly long calculation methods, often with small errors in them. In such papers it is common to use surds in certain questions but the candidates did not appear to be comfortable in manipulating them.

Comments on specific questions

Question 1

This was well answered but some gave the answer as 4^3 or 81.

Question 2

This was well answered. Only a few candidates showed working, with the common incorrect answer being 0.05.

Question 3

This construction was completed accurately in most papers. Some did not show their construction arcs, which were requested, whilst a few drew a reflection of the triangle with *BC* as 6.2 cm and *AC* as 7.6 cm.

Question 4

Candidates usually gave the correct answer or a^4.

Question 5

Most candidates answered this correctly, although there were some arithmetic errors. The main error in method was to attempt 20 ÷ 1.2 which gave 16.6….

Question 6

(a) Many candidates did not know the name of this shape. Common incorrect answers included parallelogram, isosceles, diamond, rhombus, trapezium and polygon.

(b) This was answered better than part (a). The most common error was to give an answer of 40, without the multiplication by 2. A small number of candidates calculated the 40 and then added 60 to get 100 because they treated the shape as a parallelogram.

Question 7

Many candidates only used the linear property of 100 centimetres in 1 metre and divided by 100 to give 4570.

Question 8

When multiplying out the brackets candidates usually only multiplied the first two terms together and the last two terms together, giving $2\sqrt{2} \times 2\sqrt{2}$ + 9, with then final answers often being a = 4 or 8 and b = 9 .

Question 9

Most candidates were able to convert both fractions into improper fractions and then correctly multiply them. The final answer given was often $\frac{12}{5}$ as many candidates did not understand how to convert it to a mixed number, or did not realise that the question had requested the answer in that form. Some candidates attempted to work in decimals and a few just gave the correct answer with no working shown at all.

Question 10

The most common correct method was elimination. Those who correctly reached $20y = -10$ sometimes gave the value of y as -2. The method of substitution was seen less and when seen, was less successful. Most candidates who did not resolve the equations correctly scored credit for giving two values that solved one of the equations.

Question 11

(a) The most common error was to do 120 ÷ 12. Candidates then attempted 10 × 7 and not 5 so giving an answer of 70.

(b) This part was not answered well. Some candidates did convert $\frac{2}{3}$ to $\frac{16}{24}$ but they did not know what to do with 24. A common answer was 8 where candidates had not taken away the initial 5 green discs.

Question 12

(a) This was answered well, with some candidates giving the answer in the form $\frac{5}{1}$. A few gave the answer 5x.

(b) Many correct answers were seen, usually in decimal form. Incorrect responses often gave the answer of (0, 12) from the working 5(0) + 12.

(c) This was not answered as well as the previous two parts, with common incorrect responses being an answer of 5 or −5.

Question 13

This question was well answered. The most commons errors were to subtract 8 from 25 to get 17 minutes and to count from 21 00 to 07 00 and get 10 hours.

Question 14

There was very little working shown by most candidates and very few attempted to use the indices. Some wrote $2^4 \times 3^2 \times 7^6$ or $\sqrt{2^4 \times 3^2 \times 7^6}$. Common answers which gained some credit were 50421, 201684 and $\frac{1}{806736}$.

Question 15

Subtracting $2p$ first was the most common approach which then invariably led to the two correct steps resulting in the correct answer in the form $y(m-2p)^2$. The expanded form of the correct answer, $m^2y-4mp+4p^2$ was sometimes seen, though it was unnecessary to go to this stage. The most common error was attempting to square each term independently as a first step. Another common error was, having attempted squaring, candidates then multiplied only two of their terms by *y*. We often saw first the stage $m^2=4p^2+\frac{x}{y}$ and then the step $m^2y=4p^2+x$. Sometimes they did not make the length of their root sign $\sqrt{\frac{x}{y}}$ long enough and this then caused an error in the next step.

Question 16

The most common answer given was 36, found by 27 × 4 ÷ 3. Only a few candidates gave the correct answer. Some used the cube root rather than the cube and some attempted to use the square of the scale factor giving 48.

Question 17

Few candidates found the correct answer. The most common incorrect method was an answer of 217.80 arising from 180 × 1.10 leading to 198 × 1.10. A few calculated 10 per cent of 180 as 18, doubled this and added the total to 180 giving an answer of 216 .

Question 18

(a) Many candidates gave the correct answer without any working shown. Most incorrect answers showed at least one of the three terms correct such as $4xy^6$ and $12x^3y^6$.

(b) $\frac{2}{3}$ was the most common form of the correct answer. In decimal form, we needed to see at least three correct figures. For example, 0.67 was not accepted as a correct figure.

Question 19

(a) Very few candidates answered this part correctly, some gave the answers as just 5 and 95.

(b) Here some were able to work systematically and arrive at the answer 3 or a few did show the equation 7*n* = 20 and they would give 2.85… or 3 as their answer.

Question 20

Many left this expression partially factorised such as 3*x* + 8*y* – 2*a*(3*x* + 8*y*) without realising that there is a common factor in 3*x* + 8*y*. Some wrote the sign inside the bracket as a minus and then they did not have a common factor.

Question 21

There were a few fully correct answers. The common errors included arithmetic errors in otherwise correct working, using direct proportion rather than inverse proportion, working with *y* inversely proportional to *x* or to the square of *x*, rather than to the square root of *x*

Question 22

(a) This part was not well answered. It was common to see *OP* calculated but not subtracted from the radius, *OA*, to find the required expression.

(b) Most candidates could not answer this part. Most incorrect answers came from those who used incorrect trigonometry, treated the required area as a circle with radius AP or treated the required area as a right-angled triangle. Some attempted to find the height of the right-angled triangle before finding the area, which increased the errors they made.

Question 23

(a) There were many completely correct answers with a smaller number of candidates showing fully correct working but with arithmetic errors. Common errors included using the end points of the intervals and working out the total frequency from the table and obtaining a total other than the 100 that had been given in the question. Some candidates worked with class width rather than values within the intervals or they worked with frequency density.

(b) This question proved challenging for most candidates with many unable to make a meaningful start on the calculations. Where incorrect attempts were seen it appeared that these did not take into account the use of frequency density and worked as though the question related to a bar chart.

Question 24

This question was answered well. Candidates found the numerator reasonably easy to factorise. The common problem was in factorising the denominator where they needed to get $x - 5$ as one of the factors in order to get the correct answer.

Question 25

(a) The answers for this question were very varied. Only some candidates correctly used the triangle to work out the 'missing' side.

(b) Candidates struggled with this part, with most candidates subtracting their answer in **(a)** from 180.

MATHEMATICS (US)

Paper 0444/33
Paper 33 (Core)

There were too few candidates for a meaningful report to be produced.

MATHEMATICS (US)

Paper 0444/43
Paper 43 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the extended syllabus.

The recall and application of formulae and mathematical facts and the ability to apply them in both familiar and unfamiliar contexts is required, as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Work should be clearly and concisely expressed with answers written to an appropriate degree of accuracy.

Candidates should show full working with their answers to ensure that method marks are considered.

General comments

The standard of performance was variable with some candidates making no attempt at a significant number of the question parts. In some cases, candidates showed working with clear steps that could be easily followed but it was common for important steps were omitted and important calculations not shown. For some candidates, improving their presentation would help, as there were instances where candidates miscopied their own figures.

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.

Some candidates lost marks by approximating values prior to the final answer. This was apparent, for example, in **Question 2(b)(iii)** and **2(c)(i)**.

The topics that proved to be accessible were population density, ratio, transformations, probability of a single event, box plots and simple functions.

Topics that challenged most candidates included reverse exponential increases, conditional probability, circle geometry, proving triangles are similar, differentiation, cubic functions, simplifying algebraic fractions, vector geometry and harder function work.

Comments on specific questions

Question 1

(a) (i) Many correct rotations were seen. The most common error was a rotation clockwise about the given centre. The occasional wrong centre was used and sometimes the wrong angle of rotation, usually 180°.

(ii) Although fewer correct responses were seen here, the majority of candidates correctly translated triangle *A*. Translations with a correct displacement in just one of the two directions were sometimes seen. Some candidates treated the translation as $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$.

(b) Many correct descriptions were seen. The most common error usually involved an incorrect centre, or the omission of the centre. Only a few responses suggested two transformations with a translation almost always being the second transformation.

Question 2

(a) (i) Some candidates were successful in writing the surface area correctly in standard form. Common errors included 5101×10^5, 510.1×10^6 or 51.01×10^7. A small number rounded the surface area to 3 figures or less.

(ii) Candidates fared better in this part and more correct answers were seen. It was difficult to award method marks when the answer was incorrect as a significant number of candidates did not show their method.

(b) (i) This was often correct with the occasional incorrect answer resulting from miscopying the data from the table.

(ii) Many correct answers were seen. Errors usually arose from miscopying the figures from the table, using a country other than The Maldives, or from multiplying the two areas.

(iii) Those candidates that understood the method needed usually went on to obtain the correct percentage. Rounding to fewer than three significant figures or truncating to three figures produced a significant number of incorrect final answers. Other errors included forgetting to convert to a percentage, performing the division in the wrong order and finding the difference in areas as a percentage.

(iv) With population density defined in the question many candidates were able to obtain the correct answer.

(c) (i) Candidates found this more challenging and only a small minority obtained the correct percentage increase. More candidates began by expressing the population in 2017 as a percentage of the population in 2000 with some others finding the increase as their first step. The former group tended to be less successful, often rounding the initial percentage to three figures before subtracting 100 and giving a final answer with too few figures. A common error involved finding the increase in the population as a percentage of the population in 2017.

(ii) This proved challenging and very few correct responses were seen. Some showed the correct calculations but incorrect processing on the calculator led to incorrect answers. A small number simply divided the previous answer by 17 and some divided the populations by 17. A higher proportion of candidates made no attempt at a response.

Question 3

(a) (i) This was almost always correct.

(ii) This proved challenging and only a minority of correct answers were seen. Common errors included giving the probability of picking a B and a Y in any order, adding the two probabilities or evaluating the probabilities with replacement.

(iii) Finding the probability of two letters the same proved a lot more challenging with few candidates obtaining the correct answer. Some calculated the probability of both letters being S, others the probability that both letters were I. Some weaker candidates started from the 5 letters that were S or I and mistakenly gave probabilities of $\frac{5}{11}$ or $\frac{5}{11} \times \frac{4}{10}$. Only a few worked with replacement.

(b) (i) Some correct answers were seen. Common errors included $\frac{1}{11} \times \frac{1}{10} \times \frac{1}{9}$ and answers such as $\frac{3}{11}$ and with weaker candidates attempting $\frac{5}{11} \times \frac{4}{10} \times \frac{3}{9}$.

(ii) More successful responses were characterised by a methodical approach to the various outcomes. A few attempted a partial tree diagram while some attempted to list the possible outcomes. In both cases, some of the possible outcomes were missing, especially when outcomes were listed as SSP, SSO, SSI, etc. rather than SSx, etc. Errors were often made when considering the probabilities of the different orders, eg P(I, I, x) correctly calculated as $\frac{3}{11}\times\frac{2}{10}\times\frac{8}{9}$ but P(x, I, I) given as $\frac{11}{11}\times\frac{3}{10}\times\frac{2}{9}$.

(iii) Candidates who realised the three events in **part (b)** were mutually exclusive earned some credit for a correct method and almost always earned both marks if the previous two parts were correct. Most candidates did not spot this connection and a variety of incorrect methods such as lists, partial tree diagrams, etc. were seen. A common error was to assume that the probabilities of all three letters being the same and all three being different were mutually exclusive.

Question 4

(a) Most candidates seemed unfamiliar with the angle properties related to the circle and fully correct responses were rare. Candidates were more successful in finding angle *x*, using angles in an isosceles triangle and the fact that the tangent is perpendicular to the radius. Some earned partial credit for angle *ADC* = 57.

(b) (i) Candidates found this very challenging and only a minority earned all three marks. In many cases some or all of the equal angles were identified but, more often than not, reasons were not given or were incorrect. Many attempts involved a mention of the parallel lines, a shared angle or point and therefore the triangles were similar.

(ii)(a) Candidates fared a little better on this part and a small majority obtained the correct ratio. The ratio 4 : 3 was a common incorrect answer. A higher proportion of candidates made no attempt at a response.

(ii)(b) Few candidates were able to calculate the correct area of the quadrilateral or triangle *PQR*. Most incorrect answers involved the use of the linear scale factor leading to the common answer of 15cm^2. Some of those using the correct area factor stopped after finding the area of triangle *PQR*. A significant number of candidates made no attempt at a response.

Question 5

(a) (i) Many correct answers were seen, with 58 as the most common error.

(ii) This was almost always answered correctly.

(iii) Candidates were less successful in this part and only a minority gave the correct interquartile range. Some left their answer as 58 – 71, others gave the overall range and other errors were due to numerical slips.

(b) Candidates fared a little better in this part and some demonstrated a good understanding of speed, obtaining the correct answer. Some did not realise that conversion of units was required and answers of 22.2 were also seen.

Question 6

(a) Candidates had some understanding of inequalities and fared well, with a number of correct answers seen. Common errors usually involved giving just the largest value and/or the smallest value while some rearranged the inequality to $1 < x \leqslant 5$ and went no further.

(b) (i) A majority of candidates obtained the correct answer. Some candidates earned credit for a partially factorised expression, usually for taking *y* as the only factor.

(ii) Although candidates were less successful in this part, some correct answers were seen. The most common error was $(y - 3x)^2$.

(c) This part proved to be very challenging and fully correct responses were rare. Errors usually involved incorrect working with the negative terms. Some candidates found the correct numerator and denominator but then made errors when expanding and simplifying the brackets.

Question 7

(a) (i) A sizeable minority understood what was required to find the total surface area and were often successful, although others forgot to allow for the equal opposite faces. Many of the incorrect responses involved calculations based around the volume and a few candidates gave answers based on perimeters of the faces.

(ii) Many of candidates obtained the correct mass or followed through correctly from their incorrect surface area.

(b) (i) Some candidates were able to calculate the mass of the rod using their previous answer. For some candidates the mass in the previous part was greater than 300 grams and so they could not obtain the correct answer for this part. A common error involved dividing the length of the rod by the total mass.

(ii) Few candidates demonstrated a good understanding of three-dimensional Pythagoras but those that did were able to calculate the length of the internal diagonal *AG*. Not all of these candidates gave an adequate conclusion. Some were able to demonstrate that the rod would fit by calculating the face diagonal *AF*. Some drew diagrams to show how the rod could fit but did not support this with any calculations. Many others made no attempt at a response.

(c) Few candidates were able to calculate the required angle. Of those that did, most opted to use the tangent ratio with a few using the sine ratio, usually in cases where the diagonal *AC* had been calculated in the previous part. A significant number treated the base of the cuboid as a square and gave the answer of 45°. A significant proportion of candidates made no attempt in this part.

Question 8

(a) (i) Factorising the product proved challenging because of the negative square term. As a result, only a minority were able to find the correct factors. Some changed all the signs in the quadratic, obtained the factors $(x + 3)(x – 8)$ but then forgot to allow for the original change of signs.

(ii) This question produced a full range of marks with some candidates earning all three marks. A few reversed the values of *a* and *b*. Not all candidates understood the link with the previous part and attempts to solve the quadratic using the formula were seen. A higher proportion of candidates made no attempt at a response.

(iii) Most candidates struggled to progress with the question and, in many cases, did not realise the need to equate the quadratic expression with 18. Some of those that did then went on to obtain the correct solutions, either by the quadratic formula or by factorisation. The most common incorrect answer was 18. Many candidates made no attempt at a response.

(b) This proved to be one of the more challenging questions on the paper. A very high proportion of candidates made no attempt and those that did struggled to make any progress. Some gave answers with no supporting evidence and some attempted substitution but were unable to reach a viable set of simultaneous equations. No candidate linked the coordinates of the *x*-axis-intercepts to the possible factors of the cubic expression.

Question 9

(a) (i) A large minority of candidates dealt with the vectors correctly and obtained the correct answer. Common errors included $\overrightarrow{BC} - \overrightarrow{AB}$, multiplying the components of the vectors or numerical slips such as $–1 + 5 = –4$.

(ii) Candidates performed less well on this part. A very common error involved $\overrightarrow{BC} + \overrightarrow{DC}$.

(iii) Candidates were generally less successful in this part and only a minority obtained the correct magnitude. A significant number gave the answer as a column vector involving the components 2 and 5, either way round with different combinations of signs. Some of those that did use Pythagoras slipped up by evaluating $5^2 - 2^2$.

(b) (i) Although correct answers were seen several candidates did not appear to understand the topic and answers such as ab, a, b and a – b were very common. A higher proportion of candidates made no attempt at an answer.

(ii) Candidates were less successful in this part. Some with an incorrect answer were able to earn part marks for a correct method. Candidates would be well advised to be methodical and their first step should be to identify a correct route for the required vector. There was an increase in the number of candidates making no attempt at a response.

(iii) Candidates found this part extremely challenging and few correct answers were seen. As in the previous part, a methodical approach to the question was needed but, in most cases, was not seen. Finding $\overrightarrow{CD}$ or $\overrightarrow{BD}$ was crucial and proved too difficult for many candidates. Some did have a correct expression for at least one of the vectors but candidates did not always provided evidence of their method. There was a significant number of candidates that made no attempt at a response.

Question 10

(a) Correct answers were seen although some candidates multiplied the two functions together to get an answer of –18.

(b) Candidates did not fare so well in this part and fewer correct answers were seen. Some candidates started correctly but made errors in manipulating the algebra, usually involving a negative sign. Some left their answers in terms of y and a few answers of $\frac{1}{4-3x}$ were seen. Some attempted flow diagrams but without much success.

(c) (i) Many candidates were able to substitute an expression into the function and a good number of correct answers were seen. Errors with a negative sign resulted in some incorrect final answers, often $1 - 6x$. Another common error in the manipulation was to treat $4 - 3(1 - 2x)$ as if it was $(4 - 3)(1 - 2x)$.

(ii) This part proved more challenging as a lot more manipulation of algebra was required. Only a minority of candidates were able to obtain the correct answer of $20 - 36x$. Some started by writing $(4 - 3x)^2 + x - 9(x^2 + x)$, incorrectly writing x instead of $4 - 3x$. Other common errors included incorrect expansion of $(4 - 3x)^2$ and $-9(x^2 + x)$, usually involving an error with a negative sign or giving $16 - 9x^2$ as the expansion of the first of these.

(d) This proved very challenging and few correct solutions were seen. In most cases, if candidates understood manipulation of indices they went on to earn both marks. Occasionally 3^{2kx} was seen and earned partial credit. Common incorrect solutions included $\frac{1}{2}$ and ± 2. A higher proportion of candidates made no attempt at a response.

(e) This question proved challenging for many and few candidates earned any credit. Most incorrect vectors had elements linked to the two factors of the quadratic, the two solutions of the quadratic or the final two coefficients when the brackets were expanded.

Question 11

Some sequences proved more challenging than others. Candidates were quite successful in finding the fifth term, apart from sequence B but in finding the nth terms they were less successful for all sequences. For the linear sequence, the fifth term was almost always correct and some nth term expressions were correct. A common error gave the answer as $n + 5$. Candidates had least success with the cubic sequence with few correct answers seen for the fifth term and for the nth term. Very few candidates attempted the method of differences. For the power sequence, the fifth term was often correct. For the nth term, those that spotted the

common ratio of 4 usually earned some credit but the majority appeared to have no strategy. A common incorrect answer was $4 \times n$. For the final sequence, the fifth term was often correct and some nth term expressions were also correct. Writing the term-to-term rule or giving the ninth term were common errors for all sequences.