MATHEMATICS

Paper 0444/13

Paper 13 (Core)

Key Messages

To succeed on this paper, candidates need to have fully studied all topics in the syllabus. They should read questions carefully and answer precisely what is asked.

General comments

The standard of performance was generally quite high.

The question on proportion was the least well answered. Many candidates do not appear to understand bearings. The majority of candidates showed working out, although on the fractions question several candidates did not show all the steps of their working as requested in the question. Some candidates appeared not to have access to rulers and compasses.

Careful checking of the wording of the questions would help to reduce errors. For example, when a question asks for the answer as a fraction, credit is not given for answers given as decimals or percentages.

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

Comments on Specific Questions

Question 1

This question was well answered. The most common error was to omit the zero or to include it twice.

Answer: 6054

Question 2

The majority of candidates were able to give an answer within the acceptable range. Several appeared not to have a ruler, while others did not measure in centimetres.

Answer: 6.7

Question 3

Many candidates appeared not to understand the term ‘rotation symmetry’. Some added to the diagram while others gave the answer 1, 2, triangle or hexagon. A significant number of candidates did not answer this question.

Answer: 3

Question 4

Many candidates were able to round correctly. Common errors were 170.0, 17 and 169. Other responses included more than two non-zero figures.

Answer: 170

Question 5

Almost all candidates gave the correct answer.

Answer: 4

Question 6

The majority of candidates gave the correct answer. Of those who did not, many knew the answer was 6, but wrote it as $\frac{6}{30}$.

Answer: 6

Question 7

(a) Almost all candidates were able to give the correct answer. A small number only gave one factor.

(b) The majority of candidates gave the correct answers, with a small number losing a mark for listing only one number or for including one extra.

Answer: **(a)** 12,15 **(b)** 11,13.

Question 8

(a) Almost all candidates were able to give the correct answer.

(b) This was less well answered with confusion between the rule and the expression. Some candidates wrote $-4n + 25$, while others wrote $n - 4$.

Answer: **(a)** 5 **(b)** subtract 4

Question 9

This question was not well answered. Several candidates had problems with the negative terms, the most common error being $5 - 3u$.

Answer: $5 - u$

Question 10

(a) This part was generally well answered.

(b) This part was also correctly worked out by most candidates.

Answer: **(a)** 2 **(b)** –9

Question 11

The majority of candidates gave the correct answer. The most common error was to write d as the denominator.

Answer: $tv - d$

Question 12

Many candidates were able to give the correct answer. Many found the correct factors but then listed them without including the multiplication symbols or included addition symbols. Many candidates used factor trees, but not always down to just primes. Some just wrote a pair of factors.

Answer: $2^3 \times 3^2$

Question 13

(a) Many candidates scored 1 rather than 2 marks as arcs were not used. Many appeared to have used a protractor.

(b) Again few arcs were seen, with many candidates measuring the angle.

Question 14

This was generally answered correctly, with a few candidates calculating the mean.

Answer: 10.5

Question 15

The majority of candidates understood how to calculate the volume of a cuboid, although a small number attempted to find the surface area. The majority gave the correct units.

Answer: $240\,\text{cm}^3$

Question 16

All candidates were able to give the correct answer.

Answer: $\frac{7}{12}$

Question 17

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

(b) The majority of candidates gave the correct factorisation, with others scoring 1 mark for partial factorising almost always for $x(2 - 4x)$. Only a small number gave answers unrelated to factorising.

Answer: **(a)** $3x + 21$ **(b)** $2x(1 - 2x)$

Question 18

(a) Many candidates did not demonstrate a good understanding of bearings. Common incorrect answers were 130° and 140°. A small number gave the distance rather than the bearing.

(b) Many candidates did not attempt this part of the question. Several candidates scored 1 mark, usually for the distance.

Answer: **(a)** 230

Question 19

(a) This part was often correct, with a small number of candidates using a positive index and giving the answer as 17000. There were some errors with the number of zeros after the decimal point. A small number of candidates gave the answer as a fraction.

(b) This was generally well answered with only a small number of candidates unable to give the correct figures from the calculation. Some errors were made with the index.

Answer: **(a)** 0.00017 **(b)** 7.5×10^{-4}

Question 20

(a) Many candidates clearly know angle facts and were able to give the correct answer. Many others scored 1 mark for 84°, the fourth angle in the quadrilateral. The most common error was 112 using alternate angles. A small number did not know that the internal angles of a quadrilateral add to 360°.

(b) Only a small number of candidates were able to give the correct answer. Some had little understanding of how to approach this question.

Answer: **(a)** 96 **(b)** 1800

Question 21

(a) This question was not well answered. Many candidates tried to find a solution using Pythagoras' theorem. Those who knew proportion often gave the correct answer. Some simply added or subtracted 4 (the difference of the given sides).

(b) Generally only the candidates who scored in part **(a)** scored the marks in this part.

Answer: **(a)** 12 **(b)** 4.8

Question 22

(a) This part was correctly answered by the majority of candidates. Candidates need to be reminded to read the question carefully; the answer needed to be written as a fraction so no credit was given for an answer of 90°.

(b) Many candidates got the correct answer.

Answer: **(a)** $\frac{90}{360}$ **(b)** 50

Question 23

There was a good response to this question, with many candidates scoring full marks. Others made some progress but manipulating negative numbers was usually the major problem. Some candidates knew they had to equate the coefficients but often forgot to multiply one or more of the terms.

Answer: $x = 4$, $y = -6$

Question 24

A few candidates were able to give a correct reason.

Answer: No, because a single value of x results in two different values of y

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. There was no evidence that candidates were short of time, as almost all attempted the last few questions.

Candidates showed some good number work in **Questions 1**, **2**, **3, 5** and **15**; a good understanding of algebraic simplifying in **Questions 6** and **17**; and an understanding of cumulative frequency in **Question 24**. Candidates particularly struggled with volume scale factor in **Question 14**; rearranging the equation in **Question 16**; inverse proportion in **Question 18**; and vectors in **Question 26**.

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

Comments on Specific Questions

Question 1

The majority of candidates gave the correct value of 170. Common incorrect answers were 170.0, 17, 169 and 160.

Answer: 170

Question 2

Most candidates understood the order of operations to arrive at the correct answer. 25 was a common incorrect answer, where candidates had treated 8 – 3 as having brackets around it.

Answer: –7

Question 3

The vast majority of candidates were able to write down the correct value. The most common error was to treat it as a positive power, giving 17 000.

Answer: 0.00017

Question 4

Almost all candidates answered this correctly. Sometimes an answer of $\frac{6}{30}$ was incorrectly given.

Answer: 6

Question 5

Almost all candidates answered both parts of the question correctly. Occasionally, only 1 of the 2 numbers was given or an extra number was given, most commonly 15 in part **(b)**.

Answers: **(a)** 12, 15 **(b)** 11, 13

Question 6

The majority of candidates simplified the expression correctly. Errors were made by those who did not look at the signs carefully, the majority of errors being made when dealing with $–2u + u$, which often resulted in $\pm 3u$ or $+u$. Similarly, ± 3 was often seen in place of 5.

Answer: $5 – u$

Question 7

The factorisation was carried out correctly by the majority of candidates. Others gained 1 mark for a partial factorisation, although a common error when taking just the 2 outside the brackets was to give 2(x – 2x). Some candidates could not deal with the factor of 2x to give 1 inside the bracket, leading to an answer of 2x(−2x). Some candidates did not understand the concept at all and were combining terms to give answers such as $8x^2$, $6x^3$ and $8x^3$.

Answer: $2x(1 – 2x)$

Question 8

There were some correct answers to this question but the majority of candidates could not demonstrate a correct method. The most common misconception was to use proportion with a shape they knew, for example, 1440° from two hexagons or 1080° from three squares. The answer 360° was seen a number of times as was the use of $n – 1$ rather than $n – 2$ in the formula.

Answer: 1800

Question 9

The majority of candidates gained 1 mark for the correct amplitude; the period proved more problematic with answers of $\frac{1}{2}$, 180 and 90 commonly seen.

Answer: 2 and 720

Question 10

Many candidates knew the necessary rules to deal with these evaluations. In part **(a)**, the most common errors were to equate it to 5^4 or to work out 5^6 and then give an answer $\sqrt{15625}$. Some candidates were also using 2.1 or 2.2 as the square root of 5 and then carrying out multiple calculations to raise it to the power of 6. Candidates should bear in mind that extensive calculations such as this would not be required in a non-calculator paper and that they should be recalling efficient methods to deal with this sort of question.

Part **(b)** was dealt with slightly better. The most common incorrect answer was $\frac{1}{9}$; also frequently given were ± 27 and $-\frac{1}{27}$.

Answer: **(a)** 125 **(b)** $\frac{1}{27}$

Question 11

Part **(a)** was well attempted by the majority of candidates. There was a large variety of incorrect answers given, the most common being $\frac{2x}{2}, x\frac{x}{2}, \frac{x^2}{2}, 3x, 3x^2$ and $\frac{3x^2}{2}$. Part **(b)** caused more difficulties for candidates, although the majority did arrive at the correct answer. Again there were many different incorrect answers given, including $\frac{2+x}{x}, \frac{2x^2}{x}, \frac{2x}{x}$ (often cancelling to 2), and $x\frac{2}{x}$.

Answers: **(a)** $\frac{3x}{2}$ **(b)** $\frac{x^2+2}{x}$

Question 12

Most candidates scored at least 1 mark for this part. Where the answer was incorrect, candidates often gained 1 mark for an answer containing the figures 54, such as 5.4×10^9 or 5.4×10^{11}. The approach by the majority of candidates was to write out the numbers in full and then carry out the calculation, often leading to the correct answer but also causing errors with the number of zeros. A misconception often seen was an answer of 6×10^1 or 60.

Answer: 5.4×10^{12}

Question 13

This was a well attempted question and many candidates scored both marks. The most common incorrect first step was to add 3 to both sides. The other common error was to forget to reverse the inequality sign when dividing by -2.

Answer: $x < 2$

Question 14

This proved to be a challenging question with few candidates gaining any marks. Most candidates assumed a linear relationship between the ratio of volumes and the ratio of lengths, leading to an answer of 10.7. Many candidates were again carrying out lengthy divisions and multiplications involving decimals unnecessarily.

Answer: 6

Question 15

Candidates were adept at dealing with the addition and subtraction of fractions with the majority gaining full marks. The most efficient denominator of 12 was seen most often but other denominators were also correctly used. Many added the first two fractions to get $\frac{5}{6}$ or $\frac{15}{8}$ and then utilised a common denominator of 24 or 72 in the second step of their working. Marks were occasionally lost through arithmetic errors but clear working meant that at least 1 mark was usually scored in this case.

Answer: $\frac{7}{12}$

Question 16

The most successful candidates showed clear succinct working to gain all 3 marks in this rearrangement. Most gained at least 1 mark for demonstrating a correct step even if wasn't displayed in a simplified form. Many isolated the term in *a* correctly for 1 mark but struggled to deal with multiplying by 2 and/or dividing by t^2. When dealing with the $\frac{1}{2}$, many did not multiply every term by 2 and many left their answer as a fraction within a fraction, i.e. $\frac{s-ut}{\frac{1}{2}t^2}$ which gained 2 marks. The main misconception was to treat at^2 as $(at)^2$, hence square rooting and then dividing by *t* at a later stage. Candidates should be aware that they need to show each line of working clearly as it is possible to gain marks even following incorrect work. Many have a tendency to show multiple steps within one line of working or combine what they intend to do in their next step on the current line; these interim steps cannot gain credit if a correct line of working is not seen.

Answer: $\frac{2(s-ut)}{t^2}$

Question 17

There was a good spread of candidates across the whole range of marks in this question. The powers were generally dealt with well and it was the 16 that caused the most problems, commonly resulting in $\frac{x^{16}}{4y^4}$. In some instances, candidates had some of the correct terms in a fraction but then went on to incorrectly cancel the power of *x* with the power of *y*.

Answer: $\frac{x^{16}}{2y^4}$

Question 18

This was amongst the more challenging questions of the paper and candidates either dealt with it correctly to gain all 3 marks or more usually, did not understand the concept and scored zero. The inverse relationship and/or the squaring were commonly ignored. There were a few common answers from those who did not score, with $(4 + 2)^2$ followed by an answer of 36, being the most common. This was sometimes followed by dividing by 9, from $(1 + 2)^2$. An answer of 8 also came from a simple proportional relationship of $2 = 1k$ and $y = 2 \times 4$.

Answer: $\frac{1}{2}$

Question 19

There were a reasonable number of candidates who could deal with surd notation, with many scoring some marks throughout the question. In part **(a)** many gave $\sqrt{12}$ as the answer instead of 12. The other common incorrect answer was 6 from working such as $2\sqrt{3}^{\,2} = \sqrt{x}^{\,2}$, $2 \times 3 = x$, $x = 6$. In part **(b)** a common answer was either 78 or $\sqrt{78}$ and often seen in workings were $4\sqrt{6}$ and $9\sqrt{6}$ or $6\sqrt{4}$ and $6\sqrt{9}$.

Answer: **(a)** 12 **(b)** $5\sqrt{6}$

Question 20

Many candidates understood how to use a tree diagram and some of these gave the correct answer. The most common error amongst those who were using the tree diagram correctly was to omit the route of finishing both runs, resulting in an answer of 0.32. However most of these candidates showed sufficient working and so gained 1 mark for this. There were just as many candidates who did not appear to understand the diagram and showed no multiplication of probabilities. 0.8 was common as a final answer with no other working, as well as 0.8×3. Other common answers were $\frac{1}{2}$ and $\frac{3}{4}$ where candidates had simply considered the number of routes.

Answer: 0.96

Question 21

Many candidates recognised that the quadratic formula would be the best approach to take here and correctly showed the substitutions into it to gain 2 marks. There were very few who then realised that they could divide through by 2 to reach the required values of p and q. There were many candidates who could not recall or only partially recall the formula but 1 mark was sometimes awarded for a correct required part. Care should be taken with the fraction line and square root sign to demonstrate that the candidate is using the formula correctly. There were many candidates who did not know how to approach the question.

Answer: $p = -2$, $q = 3$

Question 22

This simplification proved challenging for most candidates. The most common correct method seen was to divide the top and bottom of the fraction by 2 to give $\frac{2+5w}{4-25w^2}$. Many gained 2 marks for reaching the first stage of this method and leaving this as the final answer, or going on to do incorrect steps from here. The majority of candidates did not score any marks on this question as they were incorrectly cancelling common factors from individual terms, such as dividing the 4 and the 8 by 4 and the $10w$ and $50w^2$ by 10 and w.

Answer: $\frac{1}{2-5w}$

Question 23

Many candidates made a correct start by rearranging the equation to isolate y on one side and gained 2 marks for carrying this out correctly. Few understood the relationship between the gradient of a line and one perpendicular to it but many went on to gain a third mark by keeping c in their $y = mx + c$ at 2. There were a significant number of candidates who simply changed the x and y values and/or the signs leading to answers such as $5x + 2y = 10$ and $-2x - 5y = -10$.

Answer: $y = \frac{5}{2}x + 2$

Question 24

Candidates demonstrated a good understanding of cumulative frequency. Part **(a)** was answered correctly by the vast majority of candidates. The most common error was to read off 50 rather than 50% for the median, which resulted in an answer of 6.5. Part **(b)** was the least successful part of the question and although most did understand that they were reading from the cumulative frequency at 24, a significant number simply read from the graph at 30 resulting in an answer of 5.9 or 6. Part **(c)** was carried out correctly by almost all candidates.

Answers: **(a)** 6.2 **(b)** 5.8 **(c)** 70

Question 25

This proved to be a very challenging question with relatively few marks being scored. There were a number of nil responses and many with very little working. Where marks were gained, it was usually for showing the area of the sector and sometimes for the length of *OC* or *BC*. The use of circumference and the volume of a cone were often seen. There were many responses with working which was very erratic and difficult to decipher so candidates should look to write down clear step by step workings.

Question 26

Only the most able candidates gained marks throughout this question. In part **(a)** it was very common to see the vector re-written with positive values i.e. $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$ demonstrating a lack of understanding of the terminology. Other common answers were 7, 12, 1 and –1. In part **(b)**, if candidates understood the concept, it was usually carried out correctly. The most common misconception appeared to be taking $\overrightarrow{AB}$ as $\pm\mathbf{b}$ resulting in, e.g. $-\mathbf{a}+\mathbf{b}-\frac{2}{3}\mathbf{b}$. Many answers were not actually vectors as they included terms such as **ab**, $\mathbf{a}^2$ or $\mathbf{b}^2$ or the addition of a numerical value, usually 1, 2, $\frac{1}{3}$ or $\frac{2}{3}$. In part **(ii)** some candidates gained marks for a correct follow through, either simplified or by demonstrating the need to add **a** to their answer in part **(i)**. Part **(b)** had many nil responses, perhaps demonstrating that candidates did not understand the terminology here. Candidates should be advised that clearly setting out a route would be a good starting point in this type of question.

Answer: **(a)** 5 **(b)(i)** $\frac{1}{3}(-\mathbf{a}+\mathbf{b})$ **(ii)** $\frac{2}{3}\mathbf{a}+\frac{1}{3}\mathbf{b}$

MATHEMATICS

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

This paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates attempted all of the questions, with only the occasional part question being omitted. The standard of presentation was generally good. Many candidates showed 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 answer space provided. The formulae used, substitutions and calculations performed, are of particular value if an incorrect answer is given. Premature approximation remains an issue, for example, rounding to one decimal place in the working when an answer to two decimal places is required.

Centres should encourage candidates to read the front cover of the question paper carefully and to use the correct value for π.

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

Comments on Specific Questions

Question 1

(a) (i) Many candidates gave the correct answer. A few gave answers of 6700 or 7000 or 680.

(ii) Nearly every candidate gave the correct answer. A few candidates gave a percentage instead of a fraction. It is essential that candidates read the question carefully to see how the answer should be displayed.

(iii) Nearly every candidate gave the correct answer. The most common errors included 60, 0.06%, $\frac{6}{100}$.

(iv) Most candidates gave the correct answer. The common error was 687×10^6.

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

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

(iii) The majority of candidates gave the correct answer. The common incorrect answers were 8 and 0.

(c) (i) Candidates generally gave the correct answer. The common error was to incorrectly change the signs of terms when moving from one side of an equation to another. The most common incorrect answers were 47 and –11.

(ii) Candidates generally gave the correct answer. The common errors included $8y + 24 = 164$, $8y + 28 = 656$ and $2y + 7 = 164 – 4$.

(d) Many candidates gave the correct answer. The most common errors were $48x^4$, or trying to factorise.

Answers: **(a)(i)** 6800 **(ii)** $\frac{1}{4}$ **(iii)** 6 **(iv)** 6.87×10^8 **(b)(i)** 9 **(ii)** 343 **(iii)** 1 **(c)(i)** 11 **(ii)** 17 **(d)** $48x^5$

Question 2

(a) Many candidates gave the correct answer. Some candidates made errors with counting on and subtracting, often losing or gaining one hour. Candidates could be encouraged to draw a careful time line to show whether to add or subtract.

(b) (i) Most candidates gave the correct answer. A small number of candidates made arithmetic errors.

(ii) Many candidates gave the correct answer. Some candidates gave an answer of 85% with no working. Since the general rubric requires three significant figures, these candidates lost marks.

(iii) A substantial number of candidates gave the correct answer. A few candidates gave an answer of 96.28 .

(c) (i) Most candidates gave the correct answers in the correct spaces.

(ii) Generally all candidates drew the bar chart and completed the scale on the frequency axis very carefully. Some candidates did not choose the most appropriate scale to enable accurate bars to be drawn. Candidates need to be encouraged to look at the largest frequency and work out how high this could sensibly go up the *y*-axis. Most candidates were careful in ensuring the bars had equal gaps or widths.

Answers: **(a)** 9 hours 5 minutes **(b)(i)** 12 034 **(ii)** 84.9 **(iii)** 9628 **(c)(i)** 3, 5, 10, 4, 8

Question 3

(a) The majority of candidates gave the correct answer, with or without working. Candidates should be aware that there is no ability to gain part marks when no working is shown. The common method errors were to divide 21 600 by 2 then 3 then 4, or to just divide 21 600 into 3 equal parts.

(b) (i) Many candidates gave the correct answer. The main error seen was copying 14 000 inaccurately as 1400. Candidates should be encouraged to look at their answers in general to check for inaccurate copying.

(ii) Most candidates gave the correct answer. The common error was to not simplify the fraction to its lowest form as required.

(iii) Some candidates gave the correct answer. Many candidates did not take off all of the parts, 4200, 8000 and 600.

(c) A large number of candidates gave the correct answer. The common errors were only calculating $\frac{17280}{21600} \times 100 = 80\%$ or dividing by 17 280 to reach 25%.

(d) Although there were a few correct answers given, a number of candidates did not answer this part. Those candidates that did attempt this part generally used compound interest. The most common errors were to either round too soon, losing accuracy, or to give 5922.89 as the answer. Some candidates accurately found the interest each year but omitted the final step of adding them together.

Answers: **(a)** 4800, 7200, 9600 **(b)(i)** 4200 **(ii)** $\frac{4}{7}$ **(iii)** 1200 **(c)** 20 **(d)** 422.9[0]

Question 4

(a) Most candidates made an attempt at giving an explanation.

(b) (i) For those candidates who tried to plot the points, most plotted all points accurately.

(ii) Many candidates calculated the mean distance correctly.

(iii) Most candidates plotted a reasonable line of best fit. Some did not also plot the mean point nor draw a line of best fit through it. Care should be taken that a balance of points occurs on each side of the line. Some candidates joined all the points. It should be emphasised that the line does not need to go through the end points of the data.

(iv) The majority of candidates stated the correct answer. Some embellished the answer with words such as 'weak'.

(c) Many candidates, with or without a correct line of best fit, were able to come up with a sensible answer.

Answers: **(a)(iv)** negative **(c)** 50 to 56

Question 5

Candidates found this the most challenging question of the paper. Many did not answer part (b) or only gave the value of the angles without correct or no explanation. Candidates would benefit from working examples to include the reasoning for the correct answers.

(a) (i) Candidates struggled with the reasons in this part. Of those who knew the reasons, it was more common to show a calculation than give the reason in words. A number of candidates measured the angles. Few used the word 'semi-circle'.

(ii) Many candidates omitted the word 'angles'.

(iii) Follow through marks were awarded a number of times. The reason was very rarely correct.

(iv) Follow through marks were awarded a number of times. The reason was given correctly a few times.

(b)(i) Many of the candidates gave the correct answer, although 'radio' and 'ratio' were seen commonly.

(ii) Very few candidates answered this correctly. Incorrect words included 'diameter', 'segment', 'tangent' and 'rope'.

Answers: **(a)(i)** 90° angle [in a] semi-circle **(ii)** 25° angles [in a] triangle [add to] 180° **(iii)** 65° angle [between] radius and tangent is 90° **(iv)** 65° alternate angles **(b)(i)** radius **(ii)** chord

Question 6

(a) (i) Many candidates gave the correct colour.

(ii) Nearly all candidates wrote the correct probability. However, a few candidates spoilt their answers by writing 2 to 16, 2 out of 16, 2:16 or $\frac{16}{2}$.

(b) (i) Many candidates knew how to find an area. However, the most common error was to round too soon in the working, causing a loss of marks, especially if no working was shown.

(ii) The common error in this part was to use an incorrect radius, 0.9 instead of 1.5. There was evidence of premature approximation in the working. A substantial number of candidates did not give an answer.

(iii) Many candidates gave the correct answer. Some candidates forgot to find the change, only working out the amount spent.

Answers: **(a)(i)** blue **(ii)** $\frac{2}{16}$ **(b)(i)** 4.52 **(ii)** 9.42 **(iii)** 2.6[0]

Question 7

(a) (i) A substantial number of candidates gave the correct answer. There were few arithmetic errors and no clear apparent common error.

(ii) Some candidates obtained the correct answer following an incorrect answer in the previous part, suggesting that candidates may have started again.

(b) (i) Nearly all candidates gave the correct answer.

(ii) **(a)** Most candidates used the correct formula. A few candidates did not half the length *BC*.

(b) Many candidates used the correct formula. Use of the sine or cosine formulae was seen but only a few candidates used Pythagoras' theorem.

Answers: **(a)(i)** 8 **(ii)** 6 **(b)(i)** [trapezoidal] prism **(ii)(a)** 49.6 **(b)** 52.49 to 52.5[0]

Question 8

(a)(i) Many candidates gave a correctly rotated triangle. Some, however, used the wrong centre.

(ii) Some candidates drew the correct reflection. However, a few candidates reflected the triangle in $x = k$ or $y = -1$.

(iii) Candidates found this part particularly challenging. Only a few gained full marks. The centre of enlargement was often inaccurately stated due to drawing lines from shapes and writing (7.5, 3.5) or (4,7). The scale factor was often stated as 'half the size'.

(b) (i) Candidates generally gave the correct answer but sometimes gave answers such as (5, 2) or (–5, –2).

(ii) Although some candidates gave the correct answer, many had problems with the signs in the vector. Some candidates wrote the previous answer as a column vector.

(iii) Many candidates found this challenging. *Z* was seen marked in a variety of places but commonly at (–5, 1).

Answers: **(a)(iii)** enlargement, [scale factor] 0.5, [centre] (7, 4) **(b)(i)** $(5, -2)$ **(ii)** $\begin{pmatrix} -3 \\ -5 \end{pmatrix}$

Question 9

(a) (i) The majority of candidates gave the correct answer. However, many candidates calculated the values involving negative signs incorrectly.

(ii) The majority of candidates carefully plotted and drew the curve smoothly. There was little evidence of joining the points with straight lines.

(iii) Some good responses were seen, with scales read accurately. However, a common error was to read the scale backwards from '–1', so instead of –0.4, –1.6 or similar was seen. A few candidates used the quadratic formula and tried to answer this algebraically. They often gave roots that were very accurate but commonly both positive, or the signs the wrong way round.

(b) A few candidates gave the correct answer. Most candidates were unable to find the gradient and others misunderstood the different scales on the two axes.

Answers: **(a)(i)** 10, 3, −5 **(iii)** −0.5 to – 0.4 and 4.4. to 4.5 **(b)** $5x + 3$

Question 10

(a) Nearly all candidates gave the correct answer.

(b) (i) Although many candidates gave the correct answer, a few gave a numerical answer rather than an expression in terms of n. The most common error was $n + 5$.

(ii) Those candidates who wrote $5n$ for part **(b)(i)** generally got this right. Very few candidates who got part **(b)(i)** incorrect realised that they needed to add 1 to the previous answer.

(c) A large majority of candidates gave the correct answer.

Answers: **(a)(i)** 15, 20 and 16, 21 **(b)(i)** $5n$ **(ii)** $5n + 1$ **(c)** 100, 101

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 gave the opportunity for candidates to demonstrate their knowledge and application of a wide variety of topics. The majority of candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates attempted all of the questions with the occasional part question being omitted by individuals. The standard of presentation was generally good with many candidates showing all necessary working. However, some candidates provided answers with little or no working or didn't carry out calculations to sufficient accuracy and consequently lost marks. Centres should continue to encourage candidates to show all working clearly in the answer space provided. When incorrect answers are given, method marks are usually awarded for the correct use of formulae, correct steps in algebraic questions and for calculations performed. The poor use or omission of brackets in algebra questions often resulted in the loss of marks. Candidates should take the time to read the questions carefully to understand what is actually required in each part, for example, giving an answer correct to the nearest dollar, when asked to do so.

Comments on Specific Questions

Question 1

(a) (i) The vast majority of candidates obtained the correct answer. A common error involved division of \$2.60 by 5, falsely assuming that \$2.60 was equivalent to the total cost of the biscuits and water. A few divided by 3.

(ii) Many candidates obtained $\frac{13}{18}$ with a significant minority leaving their answer as $\frac{6.5}{9}$, whilst some wrote their answer as a percentage. An error in part **(i)** was often followed through in this part. Some less able candidates, realising a fraction was required, sometimes wrote down $\frac{2.6}{9}$ as these were the amounts given in the question.

(iii) A small majority of candidates linked \$9 with 37.5% and went on to obtain the correct answer. Two common incorrect methods were seen, namely linking \$9 with 62.5% and increasing \$9 by 62.5%.

(b) The majority of the most able candidates opted to use the repeat percentage formula and almost always obtained \$109. For the significant number who opted to do the calculation year on year, unclear method and arithmetic errors were frequently made, resulting in a loss of marks. Many of the errors resulted from a calculation for 9 years, and occasionally 11 years, rather than 10. A sizeable minority lost the final mark by not giving their answer to the nearest dollar. Other common errors involved division by 1.08^{10} or a total depreciation of 80%, leading to an answer of \$50.

Answers: **(a)(i)** 3.90 **(ii)** $\frac{13}{18}$ **(iii)** 24 **(b)** 109

Question 2

(a) (i) Most candidates understood translation and earned full marks. Many of the others earned one mark for a correct translation in either the horizontal or vertical direction.

(ii) Candidates were slightly less successful with the reflection. Errors usually involved reflection in the line $x = -1$ or in a horizontal line other than $y = -1$, usually $y = 1$ or the x-axis.

(b) (i) The inclusion of more than one transformation was rarely seen and many candidates earned full marks, usually for the rotation rather than the alternative enlargement. The use of vector notation, reverse co-ordinates or giving an equation of a line, resulted in the loss of a mark for the centre of rotation. The most common incorrect transformation was reflection.

(ii) Although this was not as well answered as the previous part, a majority were able to score full marks. Many of the others were able to correctly identify reflection as the transformation but could not match it to the correct line of reflection. Common errors usually involved $y = x$ as the line of reflection or no line being given.

(iii) Candidates were slightly more successful in this part. Only a minority were able to give a fully correct description but others earned two marks, usually forgetting to state the invariant line.

Answers: **(b)(i)** Rotation, 180º, (–1, 0) **(ii)** Reflection, $y = -x$ **(ii)** Stretch, factor 3, x-axis invariant

Question 3

(a) Many candidates were successful in calculating the volume. Some calculated the area of the cross-section using the formula for the area of a trapezium, while others attempted the area of a rectangle and triangle(s), which sometimes led to errors. Others calculated volumes of cuboids and triangular prisms, which also led to some errors. A few candidates appeared to return to the question after answering part **(b)**. They crossed out the correct answer replacing it with 39 600, falsely believing that if the depth of water was half the height of the trough then the volume of water would be half the volume of the trough.

(b) (i) Success in this part depended on a correct method being used to find the width of the surface of the water. Many recognised that it would be the average of 25 and 35 but a significant number of candidates used methods such as similar triangles and trigonometry. Some earned no marks by using a circular method, using the given volume to find the 30 cm and then using this to confirm the volume.

(ii) Most candidates were able to earn this mark by calculating the correct percentage or following through from a previous incorrect answer. A few lost the mark for not giving their answer to a sufficient degree of accuracy.

(c) Most candidates understood what was required and went on to earn full marks. For some, the conversion from cubic centimetres to litres proved problematic with factors of 10 and 100 being common errors. Most candidates calculated the time in hours and then converted to minutes. Many candidates who made errors were able to obtain a mark by successfully converting their time in hours to a time in hours and minutes.

(d) Fewer fully correct answers were seen in this part. Quite a number of less able candidates didn't work with the correct formula for the volume of a cylinder. Some of those starting with the correct equation struggled to deal with the algebra and many simply square rooted to eliminate the square term. Even when candidates obtained r^3, some went on to square root.

(e) Although many correct answers were seen, the conversion between grams and kilograms proved difficult for some.

Answers: **(a)** 43 200 **(b)(i)** $0.5 \times (25 + 30) \times 6 \times 120$ **(ii)** 45.8 **(c)** 1 h 39 min **(d)** 12.8 **(e)** 21

Question 4

(a) The vast majority of candidates were able to complete the table of values correctly. Two errors were very common: evaluating $-1 - \frac{1}{2\times -1^2}$ as $-1 + \frac{1}{2\times 1^2}$ leading to –0.5; and treating $2x^2$ as $(2x)^2$ leading to values of –1.25 and 0.75.

(b) A small majority of candidates were able to plot their points accurately and draw a smooth curve through their points. A significant number were unable to plot (–0.3, –5.9) and (0.3, –5.3) accurately; they seemed to struggle with both *x* and *y* co-ordinates. In general, the curves were good with few straight line segments seen and with few candidates joining together the separate parts of the curve.

(c) Many candidates began by clearly drawing the line $y = 1$ before reading the scale correctly for the *x*-value. Marks were usually lost as a result of incorrect plotting of co-ordinates.

(d) Many candidates didn't understand what was required in this part. Many of the incorrect answers involved numbers such as –0.5, –1.5, or positive integers such as 1, 2 and 3.

(e) (i) The method required to find the straight line equation was not known or understood by the vast majority of candidates and many made no attempt at all. Of those that attempted this part, $y = 2x - 2$ and $y = c$ (for random values of *c*) were common incorrect answers along with a lot of confused working.

(ii) It was extremely rare to award full marks but some candidates earned marks for correctly plotting the graph of their straight line equation.

Answers: **(a)** –1.5, 0.5 **(c)** 1.25 to 1.35 **(d)** –1 **(e)(i)** $2 - x$ **(ii)** 1.15 to 1.25

Question 5

(a) The cosine rule was understood by the majority of candidates and many of these gained full marks. Loss of marks usually resulted from treating the rule as $(b^2 + c^2 - 2bc)\cos A$, forgetting to square root after obtaining a^2, and simple slips from one line of working to the next. Less able candidates were unable to use the correct formula or treated triangle *KDC* as right-angled.

(b) Candidates were more successful with the sine rule and many correct answers were seen. Others lost the final mark due to premature approximation in the working. Having quoted a correct version of the sine rule some struggled to rearrange it correctly to find sin *KMC*. Another common error was to separate sine from its angle or include terms such as sin 2380.

(c) The bearing of *M* from *C* proved challenging for many candidates, with only a minority earning full marks. Some were able to find the bearing of *C* from *M* but were unsure of the required step to find the reverse bearing. Some subtracted the bearing from 180° or 360° instead of adding 180°. Many of the less able candidates gave angle *KCM* as their bearing.

(d) (i) Most candidates obtained the correct time.

(ii) Candidates were generally successful in calculating the speed and many earned both marks. Writing 2 hours 24 minutes as 2.24 hours was a common error.

Answers: **(a)** 2180 **(b)** 78.7 **(c)** 309 **(d)(i)** 23 39 **(ii)** 650

Question 6

(a) Calculating the mean from a grouped frequency table was well answered, with many candidates earning full marks. Some had a partial understanding and multiplying the frequencies by the class widths or the bounds of the interval were common errors. However, very few candidates simply added the frequencies or class widths before division by 4.

(b) Despite a lack of working, many correct histograms were seen. Candidates scoring two marks usually made an error with the width of the first bar, often drawn over the interval 20 to 80 and sometimes from 0 to 80.

(c) Most candidates obtained the correct probability, usually as a fraction.

(d) (i) Although candidates were slightly less successful in this part, many correct answers were seen. Errors usually stemmed from candidates ignoring the phrase 'without replacement' and a denominator of 160 for the second probability was a common error. Adding the two probabilities, with or without replacement, was another common error.

(ii) This proved to be more of a challenge for many of the candidates and fully correct answers were far less frequent. As in the previous part, some candidates ignored 'without replacement', some only considered one of the products and some added the individual probabilities or multiplied the products. Some candidates used a tree diagram to help but they were not necessarily more successful than those who managed without a diagram.

Answers: **(a)** 101.5625 **(c)** $\frac{40}{160}$ **(d)(i)** $\frac{1560}{25440}$ **(ii)** $\frac{4000}{25440}$

Question 7

(a) Success in this part relied on candidates working with consistent units throughout. Many candidates opted to set up an equation but often the costs of the cakes and loaves were in cents and the total cost in dollars. This usually led to an answer of 4.03 and seemingly not raising any concerns for candidates. Those that worked with consistent units were almost always successful.

(b) Many candidates used correct expressions for the areas of the rectangle and triangle and were able to form and solve a correct equation to gain full marks. Expressions with errors involving brackets were common, e.g. $y \times y + 3$, $2y + 1(y + 1)$ and $0.5 \times 2y^2 + 3y + 1$. Answers were usually given as fractions with decimals less common. A few gave decimal answers to only 2 significant figures.

(c) Again, success in this part relied on candidates working with consistent units throughout. Most candidates understood the need to set up at least one equation. This was achieved in a number of ways: equating expressions for the number of bottles of milk and the number of bottles of water; equating expressions for w in terms of the number of bottles; setting up simultaneous equations for the total cost of the milk and of the water. Those that worked with consistent units in part **(a)** did so again and were generally successful. Those working with inconsistent units gained only part marks. Less able candidates made little progress, often setting up equations based on costs and ignoring the number of bottles.

(d) (i) Many candidates correctly equated an expression for the area of the triangle with 2.5 and rearranged it into the correct form. Most used '$\frac{1}{2} \times$ base $\times$ height' and a few used '$\frac{1}{2}ab\sin C$' and were also successful. Some started with $u(3u - 2) = 5$, others with $3u^2 - 2u = 5$, both of which were unacceptable for a question requiring candidates to show a particular result. As in part **(b)**, a few candidates had an error with brackets, e.g. $\frac{1}{2} \times 3u^2 - 2u = 2.5$. Some misinterpreted the requirements and instead solved the equation, usually using the formula.

(ii) Many successful attempts at factorisation were seen. Common errors usually involved reversed signs within otherwise correct brackets or $u(3u - 2) - 5$. A small number of candidates attempted to use fractional values, rather than integers, within the brackets.

(iii) Those candidates who substituted $\frac{5}{3}$ often gained full marks. Some rounded their decimal values to 1.66 or 1.67 before the use of trigonometry, resulting in a loss of accuracy in the final answer. Others gained marks for correct substitution of their positive value, while less able candidates simply stated tan = $\frac{u}{3u-2}$ and could go no further. A few used Pythagoras' theorem to calculate the hypotenuse of the triangle and then used the sine ratio to reach a final answer.

Answers: **(a)** 83 **(b)** $\frac{1}{3}$ **(c)** 25 **(d)(ii)** $(3u - 5)(u + 1)$ **(iii)** 29.1

Question 8

(a) (i) This proved challenging for many candidates. Those candidates who stated that angle *A* was common and that as angle *ADB* = angle *ABC* then angle *ABD* = angle *ABC*, usually didn't state a reason. Those who gave angles summing to 180° in both triangles were more successful. They were able to pair up the equal angles in their equations and correctly reach angle *ABD* = angle *ACB*. Others used properties such as exterior angles = sum of interior opposite angles to help set up sums where equal angles could be matched up. Some simply stated the reason was similar triangles without any proof.

(ii) This was answered correctly by the majority of candidates. There was a range of incorrect answers including isosceles, scalene, congruent and equal.

(iii) Few correct answers were seen. As the required triangles were not drawn in the same orientation, candidates had difficulty matching up the corresponding sides. A common error was $\frac{12}{16} \times 12 = 9$. Other methods used included trigonometry, Pythagoras' theorem and the sine and cosine rules.

(b) (i) As reasons were not required in part **(b)** it is difficult to draw conclusions as to where candidates went wrong. Many incorrect answers were seen and several candidates made no attempt.

(ii) Fewer correct answers were seen in this part. Some candidates wrote angle *OAB* = 20º on the diagram, showing an appreciation of triangle *OAB* being isosceles, but were unaware that the angle between the tangent and the radius was 90º.

(c) This proved to be the most challenging question for most candidates. Very few fully correct answers were seen. A number of candidates gained some marks by showing a variety of correct angles, in terms of *m*, on the diagram but often a link could not be deduced from these. Some believed the two given angles added to 180°, leading to an answer of 60°. Others formed an equation from the angles in a quadrilateral, which simplified to 0 = 0. Many candidates incorrectly thought that the obtuse angle *POR* was twice angle *PQR*. A few introduced extra lines, the most successful being the radius *OQ*, giving two isosceles triangles, which led some to obtain a correct equation in *m*.

Answers: **(a)(ii)** Similar **(iii)** 8.25 **(b)(i)** 75 **(ii)** 70 **(c)** 36

Question 9

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

(b) Again, many correct answers were seen with the majority finding the value of g(0.5) = 2 and using this in the function f. Very few attempted to find the function fg(x), in terms of x, as their first step.

(c) A majority of candidates obtained the correct inverse function. Common errors included an incorrect rearrangement following a correct first step, leading to $\frac{x-1}{2}$, and leaving the answer as $\frac{y+1}{2}$. Only the less able candidates didn't earn any marks.

(d) Many correct answers were seen. Some candidates earned 1 mark only, making a sign error when simplifying $4x - 2 - 1$ as $4x - 1$. The most common error was to square f(x).

(e) A majority of answers were correct but errors in squaring $(2x - 1)$ resulted in a loss of marks. Omission of the x terms and errors with the signs were the common errors. A significant number of candidates attempted to square $(2x + 1)$.

(f) This proved challenging for most candidates and it was rare to award the mark. A common incorrect answer involved 2 to the power 2^x.

(g) The majority of answers were correct but there was a good number of answers indicating f and h. There were several candidates who made no attempt and a few who stated that none of the statements were true.

(h) Few correct answers were seen. Incorrect answers usually involved a combination of two or three of the functions f, h and their inverses. Several candidates made no attempt to answer the question.

Answers: **(a)** 8 **(b)** 3 **(c)** $\frac{x+1}{2}$ **(d)** $4x - 3$ **(e)** $4x^2 - 4x + 7$ **(f)** x **(g)** $g^{-1}(x) = g(x)$ **(h)** $f(h(x))$

Question 10

Completing the table for the 5th and 6th terms proved straightforward for the majority of candidates. Errors usually involved the power series or slips with the arithmetic. The nth term of the linear sequence, usually in its simplest form, was found correctly by a large majority of the candidates. Candidates were slightly less successful with the sequence of fractions and the sequence based on the square numbers. For the former, some didn't pick up on the fact that the numerators and denominators could be treated as two separate linear sequences. Sequence D, based on powers of 3, proved the most challenging and only the most able candidates obtained the correct answer. Incorrect answers were often based on n^3 but in many cases no answer was offered at all.

Answers: **A** –13, –20 $22 - 7n$ **B** $\frac{9}{22}, \frac{10}{23}$ $\frac{n+4}{n+17}$ **C** 26, 37 $n^2 + 1$ **D** 162, 486 $2 \times 3^{n-1}$