MATHEMATICS (US)

Paper 0444/11
Paper 11

Key Messages

It is most important for candidates to read the questions with care and make sure that they are clear about what is required. Full coverage of the syllabus and knowledge of the basic perimeter and area formulae are essential.

General comments

Candidates must check their work for sense and accuracy and show all working to enable method marks to be awarded. This will also help the candidates' checking of their own work. This is vital in 2-step problems, in particular with algebra where each step should be shown separately to maximise the chance of gaining method marks in, for example in **Questions 11** and **19(b)**.

The questions that presented least difficulty were **Questions 3b**, **5**, **6**, **7**, **13(c)**, **14(a)**, **20(a)(i)** and **(ii) and 21(a)**; this includes questions on all sections of the syllabus. Those that proved to be the most challenging were **Questions 2**, **4a**, **10**, **12**, **15**, **16**, **17(b)**, **19, 20(c) and 21(b)**. This list includes an explanation question, construction and algebra questions. In general, the number of questions with no responses was low compared to past sessions. The questions that showed the highest number of blank responses were by far, **Question 2**, the conversion from metres to centimetres and **Question 17(b)**, the equation of a line; this latter topic is a part of the syllabus that many candidates find challenging,

Comments on specific questions

Question 1

There were many incorrect answers to this question which was expected to be a simple start to the paper. Candidates often missed out the 0 and often the last digit was given as 0 rather than the correct 2.

Answer: 121 042

Question 2

Although this question was accessible to many candidates, there were some incorrect conversions with answers such as 2500 and 0.025 seen. A number of candidates produced responses that did not show any real understanding of the situation.

Answer: 250

Question 3

In **part (a)**, the most common errors were to round to the nearest 100 or 10 000 or to truncate the given number to 41 000. Often in **part (b)**, candidates gave the number of people remaining at the football match rather than those leaving.

Answers: **(a)** 42 000 **(b)** 10 381

Question 4

Often, 4 or 1 was given as the answer to **part (a)** but this part was generally well answered.
Part (b) was less well answered with only one of the correct lines drawn or two lines that were horizont vertical. A few candidates gave the answer as the word infinity as they did not appreciate the diagram w more than just a circle.

Answers: **(a)** 2

Question 5

This question was answered correctly by most candidates. Candidates that gave $x = 4$ and $y = 1$ in the answer space for **part (a)** gained no marks. The most common error was to reverse the x and y co-ordinates in both parts of the question but some candidates reversed the co-ordinates for one part only.

Answers: **(a)** (4, 1)

Question 6

Most candidates knew what 'simplify' meant but the signs caused difficulties for some. Most candidates were able to collect the terms in a, but some were unable to deal with the terms in b. The most common incorrect answer was $3a – 2b$ but $7a – 4b$ was also seen; both of these scored 1 mark as one set of terms was dealt with correctly.

Answer: $3a – 4b$

Question 7

This question was well answered with many candidates showing working and a good number using the diagram so a method mark could be awarded where understanding had been shown. The most common errors were to give an answer of 55° or of 135° following an arithmetic slip with the subtraction.

Answer: 125

Question 8

For this question, more candidates were successful in finding the y co-ordinate of the mid-point than the x co-ordinate of B. Applying the theorem directly gave y, but finding x needed a deeper understanding of the theorem as it was a co-ordinate of one of the end points. Some candidates reversed their answers in the answer space and this was worth a special case mark, but if a question asks for two answers, candidates should check they have them in the correct order as reversed answers do not always get any credit.

Answer: 18, 7

Question 9

For some candidates, this question to find a percentage caused many difficulties both with the method to be used as well as arithmetic slips. Candidates must appreciate the difference between finding a percentage of an amount and expressing one number as a percentage of another. If the full correct method was shown, it was possible to get a method mark even if the candidate made an arithmetic slip. Some answered with 66 or 660 with no working and it was not clear if this was due to a method error, conversion to grams or an arithmetic error.

Answer: 6.6

Question 10

This question was not answered well with more candidates being successful with **part (b)** w common incorrect answers were 0 or 6. Not many candidates got **part (a)** correct with $\frac{-4}{3}$ being by fa most frequent incorrect answer. This has been a section of the syllabus that candidates have found challenging in the past. Candidates have done better with questions that use positive exponents & that area of the topic must be well established before negative and fractional exponents are explored.

Answers: **(a)** $\frac{3}{4}$ **(b)** 1

Question 11

The most common difficulty experienced by candidates was dealing with signs correctly, producing equations such as x = – 24 or 5x = 14. Almost all of the candidates who were able to collect the terms went on to produce the correct solution. Candidates tried to do two steps in one instead of dealing with one movement at a time which might have helped clarify what to do.

Answer: 4.8

Question 12

A common error was to attempt to give a general definition of an isosceles triangle, without answering the question about Yim's triangle. The term isosceles was not widely understood, with descriptions stating that an isosceles triangle has a right angle, no equal angles or all angles equal being seen quite frequently. Some candidates referred to the sides throughout their explanations instead of the angles as indicated in the question. Many candidates did not score because they did not recognise that a calculation or diagram was required in their explanation. Relatively few candidates suggested the alternative of 84°. Many candidates suggested that Yim's error was to imply that only one of the other angles was 66°; these candidates were usually able to give a clear explanation that showed why two angles of 66° were required.
Candidates should be encouraged to use precise language in their explanations and need to be exposed to the full range of triangles of all sizes and orientations so that they can become proficient at naming, recognising and using their properties in calculations.

Answer: Other angle could be 84

Question 13

Many candidates were confident finding the mode of the list of numbers but fewer were successful calculating the range, with some answers having arithmetic slips as well as showing misunderstanding of the range. Sometimes the answer was 15 which is the maximum value. The last part, the median, was the best answered of the three parts.

Answers: **(a)** 4 **(b)** 13 **(b)** 7

Question 14

Most candidates gave the probability in the correct form although **part (b)** was frequently written as a fraction and some answers were greater than 600. Some candidates gave $\frac{1}{6}$ as the probability and scored a follow through mark in **part (b)** for the answer, 100. A small number answered with $\frac{1}{5}$ reflecting the misunderstanding that the number of different letters is needed instead of the total number of letters. Candidates must realise that it is perfectly acceptable to leave a probability as a fraction, if the question does not say what form to use, as candidates often make errors trying to convert to decimals or percentages and do not give enough figures. The number of candidates who use ratios is getting less each year; answers in that form do not gain any marks.

Answers: **(a)** $\frac{2}{6}$ **(b)** 200

Question 15

Questions on interest have various aspects for candidates to consider; is this compound or simple in the answer just the total interest earned or the total amount, should the final answer be rounded nearest cent? This time, the question wanted the total amount Bruce has after earning simple interest for years and there is no need to round as the answer is an exact number of dollars. Apart from candidates no considering the aspects above, errors included finding the interest correctly for one year then adding it to \$800 and multiplying this by 6, some subtracted the correct amount of interest from \$800.

Answer: 944

Question 16

Many candidates struggled with these constructions. In both parts, the correct lines were often accompanied by incorrect or spurious arcs which appeared to have been added after the line had been drawn. Many candidates understood 'a line perpendicular' in **part (a)** but did not draw it through point *P* or simply drew a line connecting *P* to *C*. In **part (b)** some just drew the angle bisector without the arcs.

Question 17

Candidates found this whole question challenging but were more successful with **part (a)**. Occasionally, a figure 7 appeared in their answer. In general, candidates were not confident of the form their answer to **part (b)** should take.

Answers: **(a)** -1 **(b)** $y = 11 - x$

Question 18

Here, the common problem was not to show all the steps of working which is vital for method marks to be awarded if the final answer was incorrect. The question asked for answers to be given in their lowest terms and this was forgotten by many candidates. Candidates should not try to convert to decimals but work in fractions throughout. In **part (b)**, candidates occasionally inverted the second fraction, or tried to use a common denominator.

Answers: **(a)** $\frac{2}{3}$ **(b)** $\frac{2}{5}$

Question 19

In **part (a),** many candidates were able to give a partial factorisation of the expression but did not realise that $6b$ was a factor, rather than just $3b$ or $2b$. **Part (b)** caused more problems, mostly because candidates tried to do all the rearranging in one line rather than dealing with one variable at a time. Those that moved *k* to the left hand side first, often didn't realise *n* needed to multiply both variables not just one.

Answers: **(a)** $6b(a - 4c)$ **(b)** $n(j + k)$

Question 20

Part (a)(i) was answered correctly by the majority of candidates but the most common incorrect answer was 31, from continuing the sequence in the wrong direction. Sequences always go from the left to the right. For the next part, many did not seem able to clearly express what they had done to find the next term. Equivalent expressions to 'subtract 4' were accepted. In **part (b),** there were few completely correct answers. A wide variety of answers was seen with one of the more common errors being to give -2, 2, 6 as the three terms. This is the result of substituting $n = 0$ for the first term rather then $n = 1$. Some wrote $4n - 2$, $4n - 3$ and $4n - 4$ or even 4, *n*, -2 in the three spaces. A few candidates started with 2 but then continued with 4 and 6. For **part (c),** some wrote 11, the value of the next term. Of those who tried to use algebra, $n + 3$ was the most common incorrect answer. Several candidates tried, with only limited success, to use the formula for the *n*th term of an Arithmetic Progression.

Answers: **(a)(i)** 11 **(ii)** subtract 4 **(b)** 2, 6, 10 **(c)** $3n - 4$

Question 21

In **part (a)** many candidates were able to write down the values of *a* and *b*. However, drawing th over the correct domain, as indicated by the context, caused difficulties. Most of the candidates that d graph, could read off *x* when f(*x*) = 72.

Answers: **(a)** 8, 10 **(c)** 7.75

MATHEMATICS (US)

Paper 0444/13
Paper 13: Core

Key Messages

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

General comments

The vast majority of candidates could attempt all the questions. It is important, however, that candidates read the questions carefully in order to understand what is required. Careful checking would help to reduce the number of errors.

Generally presentation was good. Many candidates showed method and were able to earn partial credit if they did not obtain the final answer, although as always, a lack of working did cost some candidates marks. The majority of candidates are showing working especially in, for example, the question which said "show that". On constructions it appears a small number of candidates did not have access to, or were not able to use a pair of compasses correctly. Some candidates were unable to distinguish between significant figures and decimal places.

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. A small number of candidates gave the calculation rather than the value. The common incorrect answer was 176, which was the mean.

Answer: 84

Question 2

This question was well answered with the majority of candidates giving the correct answer. A small number attempted to simplify the expression as $3a^2$.

Answer: $a(2a - 5)$

Question 3

This was also well answered with the majority of candidates giving the correct answer. A small number gave the answer –29.

Answer: 29

Question 4

This question was generally not well answered. Many candidates wrote + or – 6 and + or – 7, but no in the correct place. The values 1 and 4 were often seen in the brackets and some candidates w matrix, while others inserted a fraction line.

Answer: $\begin{pmatrix} 6 \\ -7 \end{pmatrix}$

Question 5

Many candidates were able to give the correct answer while others appeared to understand what to do but errors occurred from the incorrect use of decimals e.g. 45 minutes is equal to 0.45 hours. Many multiplied 52 by 45 and stopped or divided by 100 rather than 60.

Answer: 39

Question 6

(a) This was generally well answered with just a few candidates rounding to 2500 or just 600.

(b) This part was less well answered. It was very common to see 0.06 or 5.84. Candidates need to understand the difference between significant figures and decimal places.

Answer: **(a)** 2600 **(b)** 0.058

Question 7

(a) Many candidates were able to give the correct answer but several gave the answer $\frac{5}{11}$ suggesting they had not read the question carefully and counted the letters with curved parts, despite the question stating in bold "**no** curved parts".

(b) Many candidates were able to mark a point in the correct range, although some marked 0.5. Candidates must ensure their answer to questions such as this are clearly marked as many were ambiguous.

Answer: **(a)** $\frac{6}{11}$

Question 8

Most candidates managed to score at least 1 mark for this question, usually for the point (20,8), with others gaining both marks for also writing, in most cases (12,24). It was rare to see (**–** 4, 0). Common incorrect answers were (8,20), (12,12) and (24,24).

Answer: Any two of (20,8), (12,24), (– 4, 0).

Question 9

(a) The majority of candidates gave the correct number of lines of symmetry, although 2 and 6 were seen.

(b) This part was also well answered. A few gave the answer 2 and some gave a direction or angle.

Answer: **(a)** 3 **(b)** 3

Question 10

(a) In general candidates showed a lack of understanding of correlation for a question pres words rather than a graph. It was common to see the answers reversed or to see the same a for both parts. A significant number of candidates were describing the labels e.g. distance/time giving answers unrelated to correlation such as balanced, bar graph, time taken, increase in speed.

(b) As with part **(a)** this was also not well answered, with responses such as increased line, proportional, length, close and minutes and metres.

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

Question 11

Many candidates were able to score full marks. Those that did not often scored 1 mark for usually the correct distance from *A*. The most common incorrect bearing was 228°.

Question 12

The majority of candidates were able to give the correct answer, with many showing working.

Answer: 1.75

Question 13

This fractions question was generally well answered with the majority of candidates showing each step of working. Some of the less able candidates did not appear to understand the need for a common denominator.

Answer: $\frac{61}{35}$ or $1\frac{26}{35}$

Question 14

There was a high number of correct answers seen to this question. Candidates are showing a greater understanding of simultaneous equations, and a large number showed working. Less able candidates often attempted a method, but showed little understanding of what they were doing with some adding or subtracting the equations without finding a common coefficient. There were large variations in the working seen - some just multiplied one or both equations but were unable to make further progress, others made errors in deciding or executing the addition or subtraction of their equations. Some candidates who had reached $x = 3$ often did not correctly substitute to find $y = -2$. Very few candidates used the substitution method.

Answer: (x =) 3, (y =) −2

Question 15

(a) The majority of candidates were able to answer this correctly. Some scored 1 mark, usually for 3×10^k. Some clearly did not fully understand scientific notation.

(b) Some candidates were able to correctly calculate the answer, but the common error was to add 3 and 1.2 ignoring the power, leading to an answer with the figures 42.

Answer: **(a)** 3×10^4 **(b)** 3.12×10^{5}.

Question 16

(a) Many candidates drew rather than constructed a line of symmetry, with few showing a... Candidates are required to use a straight edge rather than freehand lines.

(b) Few candidates scored both marks on this part. The majority understood the term hexagon, but not regular. The other common error was to draw rather than construct a hexagon inside, rather than on, the circle.

Question 17

The majority of candidates gave answers in the range 21 to 80.

(a) The multiple was generally correct.

(b) This was generally correct with 25 being a common incorrect answer as some candidates had not noted the word even.

(c) The cubic number was mainly correct with 21 being the common incorrect answer.

(d) There were many correct answers seen, but some candidates gave the answer 26 or 36 as they had not read or understood that the answer had to be a prime number.

Answer: **(a)** 35 or 70 **(b)** 36 or 64 **(c)** 27 or 64 **(d)** 31 or 41 or 61 or 71

Question 18

(a) This part was generally well answered with candidates often giving the fully correct answer. Some were confused by the signs but many were able to earn a mark for one correct term.

(b) Many candidates were successful although many scored partial marks, usually for $8a - 12b$. $3a - 22b$ was a very common incorrect answer.

Answer: **(a)** $11x - 7y$ **(b)** $3a - 2b$

Question 19

(a) (i) Many candidates did not read this question carefully and gave the full total distance rather than the part walked, despite the word walk being in bold. The answer 1600 was commonly seen as the answer.

(ii) This part was well answered by the majority of candidates, although few showed any working.

(iii) Almost all candidates were able to answer this part correctly.

(b) (i) Many candidates were able to draw the correct line, with only a small number not using a ruler. Lines from (1110, 1600) to somewhere on the *x*-axis after 1110, often 1125, 1130 or 1140 were often seen. Some candidates drew a line from 1600 with a positive gradient or a line back to (1030,0). Very few candidates showed the calculation.

(ii) The majority of candidates scored the mark for this question for either the correct answer or from following through from their line.

Answer: **(a) (i)** 1000 **(ii)** 80 **(iii)** 20 **(b) (ii)** 1135

Question 20

(a) (i) The majority of candidates were able to answer this correctly.

(ii) This part was less well answered with a significant number not attempting the question.

(b) Candidates found this question challenging with many not making an attempt.

(c) This part was answered better than part **(b)** with the common incorrect answer being 6.

(d) Very few candidates understood what was required here and many did not make an attempt.

Answer: **(a)(i)** $-\frac{2}{8}$ **(ii)** 4 **(b)** $\frac{1}{x}$ **(c)** $\frac{2}{6}$ **(d)** scale factor 4, *x* axis invariant.

MATHEMATICS (US)

Paper 0444/21
Paper 2: 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 level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as all attempted the last question. Candidates showed evidence of good work in percentages, fractions and solving equations. Candidates found challenging the topics of converting between area and length scale factors, including a change of units, and in working with speed and distance, also including different units. Candidates also found working with the surface area and volume of a hemisphere, vector notation and working with the amplitude and period of a function particularly challenging. Not showing clear working and in some cases any working is still occasionally an issue. When there is only an incorrect answer on the answer line and no relevant working the opportunity to earn method marks is lost.

Comments on Specific Questions

Question 1

The majority of candidates correctly answered this question. The most frequent incorrect answer was 64.80 where candidates found 72% of 90. A method with a good success rate was to write the fraction $\frac{72}{90}$ cancelling it to $\frac{4}{5}$ or $\frac{8}{10}$ before converting to a percentage. Some candidates attempted to calculate 7200 ÷ 90, usually successfully.

Answer: 80

Question 2

In this question the calculation was almost always carried out in the correct order with nearly all candidates gaining at least one mark for getting as far as 0.5 ÷ 0.2. The errors occurring were usually in the attempt to do the division and these were generally place value errors. The best candidates eliminated the decimals before attempting to divide i.e. $\frac{0.5}{0.2} = \frac{5}{2}$.

Answer: 2.5

Question 3

The majority of candidates correctly answered this question on angles. Little use was made of the diagram or of showing any working, which is inadvisable in a 2 mark question. Candidates are advised that in angles questions, method marks can sometimes be gained by marking other known angles on diagrams; of those not gaining 2 marks the ones who showed working on the diagram were often able to gain a mark for correctly marking another 55° or 125° angle in any correct position.

Answer: 125

Question 4

The majority of candidates were able to correctly obtain the answer of 6.8 to this percentages questi… was rare to see an incorrect answer. In a small minority of cases candidates then went on to spoil th… method by adding 6.8 to 40 or subtracting it from 40 therefore increasing or decreasing by 17%, this resulted in no marks being awarded. Careful reading of the question and checking answers would have helped candidates here. The candidates with the most success were those who converted 17% to the decimal 0.17 and then multiplied this by 40.

Answer: 6.8

Question 5

This question on equations was answered correctly by most candidates. The most frequent errors seen were in dealing with the negative signs, particularly for those candidates who showed the least amount of working or who attempted to do more than one step in one line of working. The most common incorrect answers were 24 and 2.8, arising from the incorrect starting points $5 = 3x - 19 - 2x$ and $-2x = 3x - 19 + 5$ respectively.

Answer: 4.8

Question 6

The majority of candidates answered this question on probability well. The most common incorrect answers in part **(a)** were $\frac{1}{6}$ and $\frac{1}{5}$, where the candidate did not take into account the fact that the letter S appears twice. In part **(b)**, candidates should note that in this case the answer must be an integer. It was quite common to see the answer incorrectly presented as a probability fraction equivalent to $\frac{2}{6}$ e.g. $\frac{200}{600}$. Those who wrote $\frac{1}{6}$ or $\frac{1}{5}$ in part **(a)** gained the mark in part **(b)** for the correct follow through answers of 100 and 120 respectively.

Answer: **(a)** $\frac{2}{6}$ **(b)** 200

Question 7

It was rare to see an incorrect answer in this question involving scientific notation. Candidates rarely used the more efficient method of converting the form of the calculation e.g. by using 11×10^{12} or 0.2×10^{13}, preferring instead to write the numbers out in full with occasional inaccuracies in the number of zeros written.

Answer: 9×10^{12}

Question 8

The majority of candidates left this answer blank. Of those who did attempt an answer, it was rare to see a correct answer, with the amplitude mark scoring more frequently than the period mark.

Answer: 3 120

Question 9

This question on simple interest was generally well answered. The best candidates approached this by using the formula $I = \frac{PRT}{100}$ going on to correctly substitute and rearrange this accordingly, those using the formula $I = PRT$ were more likely to forget that the interest rate given needed to be expressed as a decimal, going on to wrongly use 4 or 0.4 instead of 0.04 for R. The four most common errors were to use the compound interest formula; to treat the $26 as the principal amount; to forget to divide by 100; or to use

T = 1 instead of 5. Another misunderstanding was to think that the $26 included the capital s
$26 = x + \frac{x \times 4 \times 5}{100}$ was sometimes seen. Candidates are advised to consider the common sense o
resulting from place value issues, such as 13 or 1.3 where the interest greatly exceeds the initial invest
after such a short time at such a low rate.

Answer: 130

Question 10

This question on sequences proved challenging for many candidates. The majority of candidates wrote down the next term in each of part **(a)** and part **(b)** rather than the *n*th term, so $\frac{6}{8}$ and 35 were frequent incorrect answers. It was common to see incorrect use of formulae such as $a + (n - 1)d$ to find the *n*th term in part **(a).** Candidates are advised in fractional sequences, such as this, to consider the *n*th term of the numerator and denominator separately. Part **(b)** was generally answered with a little more success than part **(a)** with some candidates seeing that the sequence was quadratic using the method of looking at the first and second common differences and seeing that the second common difference was consistent.

Answer: **(a)** $\frac{n}{n+2}$ **(b)** $n^2 - 1$

Question 11

The majority of candidates scored one or more marks on this question on rearranging formulae, with a large number of correct answers. One common misconception was to separate the a^2 and b^2, incorrectly dealing with the square root, i.e. converting $\sqrt{a^2 + b^2}$ to $\sqrt{a^2}$ + $\sqrt{b^2}$, consequently followed by $c = a + b$. Or with a similar misconception, having the correct answer b= $\sqrt{c^2 - a^2}$ spoilt by the subsequent working $b = c - a$. Some candidates also square rooted c as a first step, instead of squaring. The best candidates showed full working with only one rearranging step completed in each line of working; those who attempted to complete two steps in one line of working often made mistakes.

Answer: $[\pm]\ \sqrt{c^2 - a^2}$

Question 12

This question on the volumes of proportional shapes was one of the most challenging questions on the paper, with the correct answer of 40 rarely seen. Some candidates did not notice the change in units; they are advised to read questions very carefully looking out for unit changes in their final checks. Some candidates were seen to underline the different units in the question once they had noted that the units were different, which is good practice. For those candidates who did notice the different units they still struggled to convert them, a common error was to use the conversion from m to cm, i.e. multiplying by 100 instead of multiplying by 100^2 to get from m^2 to cm^2 or multiplying by 1000. Few realised that they needed to find the square root of the area ratios to get the length ratios, some that did realise this often forgot the unit conversion.

Answer: 40

Question 13

This question on angles in circles was well answered by some of the candidates, with more success in part **(a)** than in part **(b)**. A common misconception in part **(a)** was the belief that opposite angles in a cyclic quadrilateral are equal rather than supplementary, and the working 42° + 28° followed by an answer of 70° was sometimes seen. Other misconceptions were to assume that *CD* and *AB* were parallel or to assume that certain triangles were isosceles, and consequently it was common to see angle *ACD* labelled as 31° and *BDC* labelled as 28° or both of these labelled as 29.5°. Candidates are advised not to assume facts just by looking at a diagram, in the same way that they cannot measure diagrams because diagrams are clearly labelled as not to scale. Candidates were much better at marking missing values of angles on the diagram in this question than in **Question 3** and often gained credit for this. The most common mark in part **(b)** was to award one method mark for candidates correctly calculating one of the three angles *DAC*, *AC* ... this was usually angle *ACB* as 79°.

Answer: **(a)** 110 **(b)** 79

Question 14

Approximately half of the candidates gained the available mark in part **(a)** of this question on indices, with the two most common incorrect answers being $\frac{4}{5}$ and $3^{\frac{5}{4}}$. Some candidates attempted to use logs to solve part **(a)**, rather than knowledge of powers and roots. Part **(b)** proved to be more challenging with a mark of one being the most common, usually for y^6, with a mistake being made in the coefficient. This was commonly incorrectly given as 204.8 (from $\frac{32^2}{5}$), 12.8 (from 32 × $\frac{2}{5}$) or simply 32. The answer in part **(b)** was also sometimes seen as $\sqrt[5]{1024y^{30}}$ or $\sqrt[5]{32y^{30}}$.

Answer: **(a)** $\frac{5}{4}$ **(b)** $4y^6$

Question 15

The subtraction part of this question on algebraic fractions was problematic for a high proportion of candidates, with the most common error being in the handling of the -(t + 2). Many candidates dealt correctly with the 3 and the best candidates used a single common denominator of $t - 1$, i.e. $\frac{3(t-1)-(t+2)}{t-1}$ with brackets clearly around the whole of t + 2, to show that the entire expression was being subtracted. Consequently, the first mark was often scored and the second mark sometimes scored. It was less common to see the third mark awarded. The most common incorrect answer, often seen, was $\frac{2t-1}{t-1}$ arising from the incorrect working $\frac{3(t-1)-t+2}{t-1}$. If candidates obtained the correct answer it was rare to see it spoilt by an incorrect attempt at cancelling terms involving t, although this did occasionally happen. Occasionally, attempts were made by candidates to turn the expression into an equation which they subsequently tried to solve e.g. $\frac{3(t-1)}{t-1} = \frac{(t+2)}{t-1}$.

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

Question 16

This question on manipulating fractions was generally well answered by the majority of candidates. Most candidates showed all their working. The majority worked with 12 as their common denominator in part **(a)**, a few used 48, occasionally the answer was not fully cancelled. In part **(b),** the multiplication was also well answered although a few candidates thought that they needed a common denominator to multiply the fractions. These candidates were usually less successful because the common error here was to not multiply the denominators as well as the numerators. Another misconception in part **(b)** was to think $2\frac{1}{2}$ meant $2\times\frac{1}{2}$, consequently a common incorrect answer was $\frac{4}{25}$. It was rare to see answers with no working or attempts at using decimals.

Answer: **(a)** $\frac{2}{3}$ **(b)** $\frac{2}{5}$

Question 17

Few candidates answered part **(a)** of this question on coordinates and vectors correctly, with the space frequently left blank, and the most common incorrect answer being to use the coordinates of $\begin{pmatrix}7\\7\end{pmatrix}$. It was also very common for the answer space in part **(b)** to be left blank, demonstrating a lack understanding of the notation used. Other common misconceptions in part **(b)** were to use Pythagoras' theorem incorrectly e.g. subtracting the two squares rather than adding; to write down the coordinates (8, 6); or to write the mid-point of the line segment *AB*. Few candidates correctly answered part **(c)**. There was a lack of appreciation that point *B* was the mid-point of *AC* and the most common misconception and the most common answer by the majority of candidates was to double their answer to part **(a)**.

Answer: **(a)** $\begin{pmatrix}8\\6\end{pmatrix}$ **(b)** 10 **(c)** (15, 13)

Question 18

In part **(a)** of this question on factorising, lots of candidates were able to score at least one mark for a correct attempt at partial factorisation. Many candidates stopped at $a + b + t(a + b)$, with the step to $1(a + b) + t(a + b)$ beyond them, although many did manage two marks in going from $a + b + t(a + b)$ straight to a correct answer. Of those who had $a(1 + t) + b(1 + t,)$ it was rarer to see an incorrect answer. Part **(b)** was generally answered with more success, with many obtaining the correct factorisation. Some then went on to spoil this work with subsequent working, i.e. writing on the answer line $x = 6$ or $x = -4$. Occasionally, the answer was given with incorrect signs or incorrect values that either added to -2 or multiplied to give -24, rather than both, demonstrating a partial understanding of the correct method.

Answer: **(a)** $(a + b)(1 + t)$ **(b)** $(x – 6)(x + 4)$

Question 19

This question on the surface area and volume of a hemisphere was the most challenging question on the paper and it was very rare to see a fully correct answer or answers gaining more than 1 mark. The two most common errors were for candidates to forget to include the flat surface of the hemisphere, equating the 243π with $2\pi r^2$ or equating the 243π with $4\pi r^2$ because they also forgot to halve the sphere. As a result of these two errors, the most common incorrect answers were 893 and 315. In many cases these candidates were able to gain a method mark for correctly substituting their value of *r* into the volume formula $\frac{1}{2}\times\frac{4}{3}\pi r^2$, however a large proportion again did not take the hemisphere into account and lost this mark for forgetting to halve and so another common incorrect answer was 631.

Answer: 486

Question 20

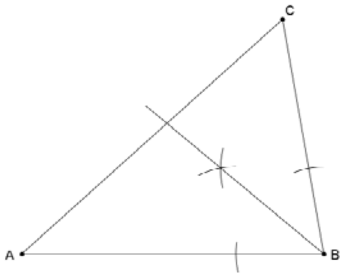
Quite a few candidates found the correct speed in part **(a)**. The most common errors here were converting into metres multiplying by 100 instead of 1000; only dividing by 60 instead of 3600; not taking the time conversion into account; or multiplying by 3600 instead of dividing. Many gained a mark in part **(b)** for dividing a length by their speed, however a large number of candidates did not link the two parts of the question together and started from scratch in their working. Only the best candidates were able to work out that the correct distance the train had to travel was 140 m. 120 m or 20 m were used far more frequently and it was also very common to see candidates thinking that 120 x 20 was a distance.

Answer: **(a)** 20 **(b)** 7

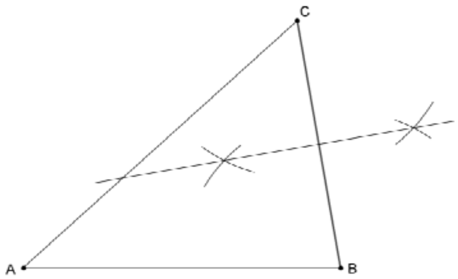
Question 21

The constructions in this question were generally carried out accurately and construction arcs were the majority of cases. Candidates should be encouraged to make arcs for an angle bisector further from the vertex as they can lead to inaccuracies when too close. Sometimes candidates had one set of a missing from the perpendicular bisector where they had measured the mid-point of line *BC* to make one poi on the bisector. Candidates are advised that measuring is not correctly constructing the perpendicular bisector and that is why the instruction in the question is to use a straight edge rather than a ruler. Another common error was when candidates did not set their compasses at a wide enough length and sometimes construction arcs touched at the mid-point of *BC* making the line impossible to draw or overlapped only very slightly, making drawings inaccurate.

Answer: **(a)**



(b)



Question 22

This question on the properties of a kite proved challenging for many and correct answers were rare. In part **(a)** many candidates were unable to correctly recall the area of a kite formula. There were some attempts at splitting the shape into triangles to work out the area that way, but often this was unsuccessful because candidates did not realise that one diagonal of a kite bisects the other. Part **(b)** was also very challenging with the majority of candidates leaving the answer blank; it was rare to see tan60 = $\sqrt{3}$ written and the most common incorrect answer was 6 arising from assuming that triangle *ABX* was isosceles.

Answer: **(a)** 150 **(b)** $2\sqrt{3}$

Question 23

This question on probability proved challenging for many and correct answers were rare. In part **(a)** the most common incorrect working was $\frac{4}{11}\times\frac{7}{11}$ rather than $\frac{4}{11}\times\frac{7}{10}+\frac{7}{11}\times\frac{4}{10}$ and there were similar misconceptions in part **(b)** with the denominators of fractions generally remaining as 11, rather than decreasing to 10 and 9 as in the correct working $\frac{7}{11}\times\frac{6}{10}\times\frac{4}{9}$.

Answer: **(a)** $\frac{56}{110}$ **(b)** $\frac{168}{990}$

MATHEMATICS (US)

Paper 0444/23
Paper 2: Extended

Key Messages

This is a non-calculator paper and therefore most questions will not involve extensive calculations. It is better to use fractions rather than convert numbers into decimal form.

General Comments

There were some topics which most candidates did not know at all and those included the work on transformations and that on the graphs of trigonometric functions. It would have been helpful if they could apply the rules of indices better.

A lot of unnecessary calculations were attempted rather than dealing with fractions or surds because there was a tendency to change numbers into decimals. Examples include **Question 1** where it was easier to write 45 minutes as ¾ (h) and use that, in **Question 6(b**) where 25 × 36 is equivalent to 100 × 9 and is easier than doing the long multiplication, in **Question 11** where they should realise that the calculation of √306 shows an error because this is a non-calculator paper and in **Question 16(b)** they should use the rules of indices rather than try to convert these powers to ordinary numbers. It would be helpful if working was set out more logically with labels identifying the different stages of work.

There was evidence that some candidates did not have the necessary equipment such as a ruler and compasses.

Comments on Specific Questions

Question 1

Most candidates answered this question on time correctly. There were a range of different methods from 52 × 45 ÷ 60 to 52 × ¾. The most common error seen was from those who assumed that there were 100 minutes in an hour.

Answer: 39

Question 2

A common error in this coordinates question was to write the *x* and *y* coordinates the wrong way around. Common wrong answers also included (12, 20), (24, 20), (8, 4), (20, 12), (16, 8).

Answer: Any two of (20, 8) (-4, 0) (12, 24)

Question 3

The majority of candidates answered this question on solving an equation well. The most common error was to incorrectly subtract 1, usually getting $2x = -14$ leading to an answer of -7.

Answer: -8

Question 4

Many candidates did not realise that cube is the inverse of cube root in this question on solving eq and some of those who did multiplied by three rather than cubing the number.

Answer: 64

Question 5

Some could write down the range in this question on functions but very few could express the domain correctly. There was evidence that many understood the terms though.

Answer: (domain) $0 \le x \le 3$ and (range) 2

Question 6

(a) Some candidates squared 60 whilst others multiplied by 100 rather than 100^2 in this question on converting between units of area. Some divided by powers of 100 instead.

Answer: 600 000

(b) Some candidates thought there are 100 m in 1 km. The correct method was to multiply by 60^2 and divide by 1000 but many did these calculations the wrong way round.

Answer: 90

Question 7

Those who knew how to answer this question on reverse percentages usually obtained the correct answer. The common incorrect method was to find 20% of \$24 and then to add this to the \$24 to get \$28.80.

Answer: 30

Question 8

The best solutions to this question on a quadratic equation usually involved factorisation and the realisation that for *d* to be prime, the other factor had to be 1. Some candidates substituted 1 into the equation instead and obtained the correct answer. There was also a variety of other methods used, many of which would not lead to a correct answer.

Answer: 5

Question 9

The main errors seen in this question on proportionality involved the setting up of the initial equation; candidates either omitted the 'cube' or worked with inverse proportion. Some candidates found a value for *k*, but then did not substitute it correctly back into their equation, omitting the cube power.

Answer: 1600

Question 10

(a) In this question on expanding brackets it was common to see $a^2 + ab + ab + b^2$ written out correctly and then incorrectly simplified. Some candidates gave $a^2 + b^2$ as their answer. *bb* for b^2 was also seen.

Answer: $a^2 + 2ab + b^2$

(b) There were very few candidates who realised that these two parts were linked and so there were many different methods with no common approach.

Answer: 22

Question 11

Some obtained the correct answer in this question on Pythagoras' Theorem whilst the most comm was to add the two squares and so attempt $\sqrt{(15^2 + 9^2)}$. A very few recognised the Pythagorean triple which this came.

Answer: 12

Question 12

(a) Some could write down the amplitude but few could correctly write down the period in this question on the graphs of trigonometric functions. Many incorrect responses were seen.

Answer: (amplitude) 2 and (period) 360

(b) There were few correct answers, the common error being 2 sin 2*x*.

Answer: 4 sin *x*

Question 13

(a) This question on rotation symmetry was usually answered correctly; the most common incorrect response was 1.

Answer: 2

(b) Most candidates were able to gain credit for drawing a line of symmetry, however significantly fewer did not use intersecting arcs to identify the location of the line of symmetry, drew freehand arcs or drew arcs which touched rather than intersected. A number of candidates included lines joining diagonally opposite corners as well as the line of symmetry.

Answer: One line of symmetry with the correct arcs

Question 14

(a) This question on standard form was usually answered well except for those who, having worked out 4 800 000, then could not write it correctly in standard form, usually counting the zeros for the power of 10.

Answer: 4.8×10^6

(a) Again many could write the answer correctly in normal form but not write it correctly in standard form.

Answer: 9.3×10^7

Question 15

(a) There were many correct answers to this question on angles in circles. Some gave 48° as their answer, which was the value of angle *MOC.*

Answer: 24

(a) Those who got part **(a)** correct usually answered part **(b)** correctly. Otherwise credit was awarded for a follow through if both answers added to 48°. A common wrong answer was 48°.

Answer: 24

Question 16

(a) There were a wide variety of responses seen to this question on indices. The vast ma candidates attempted the question and generally were able to identify that the power ½ equivalent to square root. The -2 as the power of q caused confusion as some candida associated this with both the 64 and the q, whilst other candidates identified 8 and q^{-1} but gave 1/(8q) as their answer.

Answer: $8q^{-1}$

(b) This part was answered well but sometimes √25 or √0.4 were attempted.

Answer: 0.2

Question 17

(a) There were quite a number of incorrect responses seen to this question on transformations which used (1,1) or (0,0) as the centre of rotation.

Answer: triangle at (0, 2) (0, 4) and (– 1, 2)

(b) Many candidates thought that this was an enlargement, rather than a stretch.

Answer: stretch with x-axis invariant and (factor) 2

Question 18

This question on cross-sectional area and volume was an effective differentiator, as only a few were able to obtain the correct answer. The method for calculating the area of the triangle varied between the candidates with some opting to split the triangle into two right angled triangles and others using ½absin C even though they clearly did not know the value of sin 120 in surd form. It was in finding the area of the triangle that most errors were made, many candidates were able to find the area of at least one sector. In the triangle some used the ½ × base × height but the height was not the perpendicular height. The method was not always clear and much of the work was haphazard with expressions written all over the page.

Answer: (c =) 6 and (d =) 9

Question 19

(a) The most common issue seen in this question on cumulative frequency was to misread the scales on the axes and this error was common to all parts of the question. Most candidates did know how to find the median.

Answer: 19 – 19.1

(b) Some did not subtract their reading from 50 to find the required answer.

Answer: 3

(c) Many candidates did not know how to find the quartiles and many having identified 37.5 and 12.5 then subtracted these two numbers to get 25. Some only read one of these whilst others misread the scales again.

Answer: 4.9 to 5.7

(d) There were a lot of readings of 5 seen and some did not subtract this from 50. Some wrote the final answer incorrectly so '45 out of 50' was seen.

Answer: $\frac{45}{50}$ oe

Question 20

(a) The most common error in this question on functions was to reverse the order of operatio incorrect answer seen was 225 from $(2 \times 6 + 3)^2$.

Answer: 75

(b) Those who started correctly by writing $(2x + 3)^2 = 100$ then made errors in the expansion of the brackets such as $(2x)^2 = 2x^2$. The expansion of these brackets was unnecessary to the solution of this equation. Those who did take the square root path then forgot to write down both roots and it was common to see just 10 used leading to the answer 3.5 and so the other answer was given as -3.5.

Answers: 3.5 -6.5

(c) This was often answered well but quite a few did not know the method of rearrangement so instead would write $1/(2x+3)$.

Answer: $\frac{x-3}{2}$ oe

(b) Many candidates missed the subtlety of this question and calculated the composite function by using an incorrect inverse function or reversed the order of operations again.

Answer: 5

MATHEMATICS (US)

Paper 0444/31

Paper 3: 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 all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time, and there was an improvement in the number of candidates who were able to make an attempt at all questions, in comparison to previous years. Few candidates omitted part or whole questions. The standard of presentation was generally good and clear evidence that candidates were using the correct equipment to answer the questions, e.g. compasses, ruler and protractor. There was an improvement on the number of candidates who showed clear workings and so gaining the method marks available. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates have made substantial improvements, this year, in using the correct value for pi, the calculator value for π or 3.142. However some candidates continued to use 3.14 or 22/7 which led to inaccurate answers. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

Comments on Specific Questions

Question 1

This question gave candidates the opportunity to show their number skills.

(a) (i) This was the most successfully answered question on the paper with the vast majority of candidates able to correctly identify a factor of 120. The most common answers were 2 and 60. Some candidates gave answers as a multiplication sum, e.g. 2x60, which did not gain the mark as it did not show a full understanding of what a factor of a number is.

(ii) This question again showed that candidates understood what a factor of a number is and most were able to give a common factor of the two values, although this proved more difficult for less able candidates. A small number gave the LCM instead of the HCF.

(b) (i) All candidates attempted this question but many continued in finding factors instead of a multiple. Just over half of the candidates were able to identify the correct multiple with the remaining candidates giving a factor instead.

(ii) This question was well answered by the vast majority of candidates who showed a good understanding of square numbers. The most common incorrect answers were giving a square number not from the list, 7 because seven squared is 49, and 24 because it divides by 4.

(iii) Successful candidates understood the difference between the cube root and the cube of a number. The most common incorrect answer was 512. Candidates need to be encouraged to read carefully each question and to check they have answered the question set.

(c) (i) The vast majority of candidates attempted this question with most successfully giving a correct example to disprove the statement. A successful answer needed to include the two values being multiplied together and the answer to their product. A large number of candidates found correctly two values but did not give the result of the product.

(ii) Most candidates showed understanding of the question and what was needed to disprove the statement but the vast majority found it difficult to correctly present their answers. Most candidates omitted the essential brackets which are required to show that the negative value is being cubed, not the positive value cubed with a negative sign in front of it; e.g. $(-3)^3 = -27$ gained the mark, however $-3^3 = -27$ did not.

(d) (i) This question was attempted by all candidates and correctly by the majority. Workings out of each part of the inequalities were seen by the successful candidates who were then able to identify the correct inequalities symbol.

(ii) This question was found to be more difficult however those that showed workings out generally were able to give the correct symbol.

(iii) This part proved the most challenging of the three, with many candidates seeming to believe they had to use one of each symbol in the question, despite instructions at the beginning of the question that they did not. As a result the most common incorrect answer was = because candidates had used > and < in the previous two parts. Candidates should be reminded to read all parts of the question including the introductory sentences.

Answers: **(a)(i)** any other factor of 20 **(a)(ii)** 60 **(b)(i)** 60 **(b)(ii)** 49 **(b)(iii)** 2 **(d)(i)** > **(d)(ii)** > **(d)(iii)** <

Question 2

(a) Successful candidates recognised that there were 60 minutes in an hour rather than using a decimal calculation. Many candidates tried to perform a "normal" subtraction, e.g. 16.10 – 8.45 = 7.65, which often led to 8 hr 5 min or 8 hr 55 min.

(b) (i) Most candidates identified that they should multiply to do the conversion but many did not recognise the context and as a result did not round correctly to 2 decimal places, either leaving their answer to 3 decimal places or rounding to the nearest whole euro. A number of candidates divided 167 by 0.769.

(ii) Most candidates correctly recognised the need to divide and as the answer was exact, gained full marks. Those candidates who had divided in part **(b)(i)** tended to multiply in part **(b)(ii)**.

(c) Candidates who gained marks on this question were able to correctly identify which trigonometric ratio they needed to use to solve the problem. These candidates were generally able to substitute the correct values into the ratio but very few continued to rearrange and find the missing length.

(d) This complex question required candidates to convert metric units, substitute into the formula for the volume of a sphere and then to rearrange to make the radius the subject. The candidates who attempted this question gained a method mark for equating the formula to their volume but most had not converted it from litres to cm^3. This question proved the most challenging on the paper.

Answers: **(a)** 7 (hours) 25 (minutes) **(b)(i)** 128.42 **(b)(ii)** 80 **(c)** 20 **(d)** 52(.0)

Question 3

This construction and measuring question was more successfully answered than in previous years. The vast majority of candidates used the correct equipment to construct a triangle and the most successful candidates showed a good understanding of scales. Bearings still proves to be a question which candidates find challenging.

(a) (i) Candidates measured accurately with a ruler. However a large number gave their answer in cm. Candidates again need to be reminded to carefully read the question and to check their answers. Some other common errors were to try and convert their answer in cm to mm but with errors e.g. 450 mm.

(ii) The bearings question again proved one of the most challenging on the paper. Candidates who attempted the question generally gave an angle however had not identified the correct angle to measure. The most common error was to measure in an anti-clockwise direction ar... an answer in the range 120˚ to 140˚. Another common incorrect method was to measu... angle but then not to add it to 180˚. Some candidates had clearly measured in the correct... the correct direction but gave the answer of 230˚, which indicated poor measuring skills.

(b) (i) An improvement in candidates' construction skills were seen this year with the vast majority of candidates correctly using a pair of compasses and a ruler to correctly construct the triangle. Most candidates successfully converted the given measurements using the scale however some candidates did not leave their construction arcs or just used a ruler thereby only gaining 2 of the 3 marks. A small number of candidates drew both lines 6 cm or 8 cm.

(ii) The calculation of the area of the candidate's triangle proved to be one of the hardest questions on the paper. A large number could quote the correct formula; measure the correct height of their triangle, convert using the scale and substitute into the formula to calculate the correct area. As this was a complex question many candidates made errors in at least one of these parts. The most common error was to use the sides of the triangle to calculate the area, e.g. 0.5 x 550 x 300, or assume a right angle between their constructed sides. Most candidates correctly applied the scale to their height, however some did not measure with enough accuracy to gain a mark. Some candidates chose to work in cm and correctly found the area of the triangle in cm² but were then unable to convert to m². Another method used by more able candidates was to divide the base into two parts and to use Pythagoras' theorem to calculate the height; this proved successful as long as they had accurately measured the original length.

Answers: **(a)(i)** 44-46 **(a)(ii)** 231-235 **(b)(ii)** 52250 to 60500

Question 4

All candidates were able to attempt most parts of this transformations question.

(a) (i) Most candidates were able to correctly identify that the transformation was a translation and more able candidates were able to identify the correct vector, given as a column vector or described in words. Common errors were to not indicate that the shapes had moved left and down by using negative values in their vector or to reverse the values. Candidates need to be encouraged to use correct notation when describing a translation as many gave their vector in co-ordinate form. Very few candidates described the transformation using two transformations which is an improvement on previous years.

(ii) The description of the enlargement proved to be more challenging with few candidates giving the full description of an enlargement. Enlargement was identified by the majority of candidates, however many did try to convey the idea that the shape had got smaller by using terms such as 'shrunk' or 'disenlargement' which gained no marks. The centre of enlargement was found by more candidates this year and given as a co-ordinate or the word origin. The scale factor proved to be the most difficult part of the description with many candidates giving it as 2 or -2. More candidates gave two transformations in this part of the question, enlargement followed by a translation, than in part **(i)**.

(b) (i) Most candidates were able to correctly reflect the shape in the y-axis. Some candidates did reflect in the x-axis whilst others drew the shape one square to the left or right of the correct position.

(ii) The rotation proved to be more challenging to the candidates. More able candidates could identify the correct orientation and position required whereas less able candidates could correctly rotate the shape 90˚ anti-clockwise but used the wrong centre of rotation. The most common error was to rotate using a corner of the original shape as the centre of rotation.

Answers: **(a)(i)** Translation, $\begin{pmatrix} -7 \\ -8 \end{pmatrix}$ **(a)(ii)** Enlargement, 0.5, (0,0)

Question 5

This question was accessible to most candidates.

(a) Nearly all candidates attempted this question. Some candidates did not fully understand that fence only went round three of the sides and calculated the cost of a fence surrounding the whole garden. Candidates who rounded their answers to one decimal place or to the nearest whole dollar lost the final mark but were able to gain a method mark if they had shown correct working.

(b) (i) Most candidates correctly calculated the area of the garden. The vast majority of candidates showed their workings and gained a method mark even if their final answer was incorrect.

(ii) This ratio question was successfully answered by candidates of all levels of ability. A full method was given by most candidates with few making errors; the most common was to divide by 5, then 3 and then 4.

(c) This Pythagoras' theorem question proved to be the most challenging part of the question although was well answered by the majority of candidates. Full workings were seen in most solutions with clear indication to square root seen throughout. Less able candidates either did not recognise the use of Pythagoras' theorem or chose to subtract instead of add.

(d) (i) The calculation of the area of the circular pond was attempted by most candidates with the majority identifying the correct formula although some less able candidates used the formula for the circumference. There was a significant improvement on previous years on the number of candidates who used the correct value for pi, however use of 3.14 and 22/7 was seen on a number of occasions.

(ii) This part of the question was not attempted by a large proportion of the candidates. Those who had correctly answered part **(i)** generally recognised the need to double their previous answer. Some candidates chose to start the question again using the formula for the volume of a cylinder. Candidates who had used the formula for the circumference in part **(i)** commonly used the same formula in part **(ii)**.

Answers: **(a)** 252.56 **(b)(i)** 510 **(b)(ii)** 170, 102, 136 **(c)** 34.5 **(d)(i)** 63.6 **(d)(ii)** 127

Question 6

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

(a) Candidates answered this part well with the majority of candidates correctly calculating 3 or all 5 missing values. Candidates found calculating the value for $x=-1$ most challenging with $y=2$ being a common mistake, from $-(1)^2$ instead of $(-1)^2$.

(b) Candidates plotted their values from the table well with the majority of candidates scoring 3 marks for plotting the correct or follow through points. The quality of curves drawn has improved again this year with very few straight lines drawn and few with very thick lines or broken lines. Some candidates continue to draw a straight line between the bottom two points. Candidates need to be reminded what the requirements of a smooth curve are.

(c) Identifying the correct line of symmetry proved very challenging especially if errors had previously been made in parts **(a)** and **(b).** Successful candidates remembered that vertical lines start with x=, however a number of candidates identified the correct line on the graph but only wrote 0.5 as their answer. This part proved to be the question not attempted by the most candidates.

(d) (i) The line $y=9$ was drawn correctly by the majority of candidates with very few diagonal or vertical lines seen.

(ii) Many candidates were able to link the drawing of the curve and the straight line with the solution of the equation. However more than half of the candidates tried to solve the equation using the quadratic formula and only a very small number of candidates could do so correctly.

Answers: **(a)** 14, 4, 2, 8, 14 **(c)** $x=0.5$ **(d)(ii)** -2.15 to -2.25, 3.15 to 3.25

Question 7

All candidates were able to attempt all or part of this question as it offered a wide range of ques various areas of mathematics.

(a) (i) All candidates attempted this question and the vast majority correctly identified the month. A sma number of candidates gave the highest temperature instead of the month.

(ii) Most candidates could calculate the difference between a negative and positive temperature. Some less able candidates found dealing with negative numbers difficult.

(iii) All candidates who attempted this question clearly identified that they needed to use the values 2.7 and 12.3. However a significant proportion of the candidates subtracted in the wrong order.

(b) (i) This question asked to show the total was 600 so candidates had to use the fact that the angle in the pie chart was 90˚ and that the number of tourists travelling by boat was 150 to reach the conclusion that the total number was 600. Most candidates who attempted this question used the 600 given in the question to either show the angle on the pie chart was 90˚ or the number of tourists who travelled by boat was 150. In questions which require candidates to show something is true they must use the other facts given in the question to prove the statement rather than the other way round.

(ii) Candidates had to be able to measure accurately the angle for tourists who travelled by plane and then use this fraction with the total number of tourists taking part in the survey, which many candidates did.

(c) Many candidates found calculating a percentage decrease of a group of items challenging. Most were able to gain one mark for calculating 12% of the total amount or reducing the cost of one ticket by 12% but many solutions were left at this stage without understanding the need to calculate the total cost of all the tickets after the discount. The vast majority of candidates did show some working so were able to gain one or both of the method marks available.

(d) (i) Standard form again proved challenging for many candidates this year. More able candidates gave the correct form, however many candidates made errors such as $448\text{x}10^4$ or $4.480\text{x}10^{-6}$.

(ii) Calculating the percentage increase of a population proved challenging to all candidates apart from the most able. The size of the figures given caused some candidates difficulty although the most common error was to divide by the final population rather than the original population. A large proportion of the candidates correctly identified the increase to be 440000, but many candidates' solutions stopped there or continued by dividing by the wrong value. Many candidates used the other approach of dividing the two populations with the successful candidates able to divide in the correct order and then convert to a percentage increase. However most candidates divided in the wrong order and gained no marks on this question.

Answers: **(a)(i)** July **(a)(ii)** 10.9 **(a)(iii)** -9.6 **(b)(i)** $150 \div \frac{90}{360}$ **(b)(ii)** 250 **(c)** 11682 **(d)(i)** 4.48×10^6 **(d)(ii)** 9.82

Question 8

This question offered the candidates the opportunity to demonstrate their understanding of circle theorems.

(a) (i) Candidates showed that they knew some of the names of parts of a circle with the most common correct answer being radius. Candidates found identifying the chord more difficult with a large proportion leaving this answer blank.

(ii) Most candidates showed some understanding of the circle theorem regarding the tangent of a circle. The majority were able to correctly identify the required angle. The reasons given were varied in their detail and only the most able gave the detail required to gain the mark. To gain full marks candidates had to quote the circle theorem they have used rather than giving a commentary on what calculations were done.

(iii) Similarly to part **(ii)** candidates showed some understanding of the circle theore correctly find the required angle. Many candidates correctly calculated the angle bu reason as a commentary on the calculations used. Less able candidates thought that the in the question was isosceles and gave the incorrect answer of 24˚.

(b) (i) This was the most successfully answered part of this question with the majority of candidates correctly identifying the shape. Common incorrect answers were hexagon and heptagon.

(ii) This part proved the most challenging part of the question as candidates were reminded to show all their working. Most candidates made a correct start to the question calculating the external angle of the octagon or the total of the internal angles; however few made much further progress. More able candidates found the correct answer but had not shown intermediate stages, e.g. how they had found the 45˚. Candidates should be reminded that when asked to show all working they must show every calculation made in reaching their answer.

(c) The more able candidates correctly found the number of sides. A variety of methods were seen which resulted in incorrect answers and less able candidates generally chose to make no attempt at this question.

Answers: **(a)(i)** Chord, Radius **(a)(ii)** 12 **(a)(iii)** 66 **(b)(i)** Octagon **(b)(ii)** 67.5 **(c)** 15

Question 9

Most candidates were successful in answering this algebra question, with all candidates attempting all or some of the questions.

(a) (i) This question proved accessible to most candidates and was correctly answered by the vast majority. The number of candidates showing their substitution, and not simply writing the answer, improved from previous years and this should be encouraged in all candidates.

(ii) This part proved more challenging to solve as many candidates believed they had to use their answer to part **(i)** to solve this part. Many candidates simply wrote the answer, which in most cases was correct, however the best solutions showed the method used.

(b) (i) The vast majority of candidates correctly solved this one step equation, realising the need to divide by 3. A very small number of candidates subtracted 3 or cube rooted to find their answer.

(ii) This equation was very well answered by most of the candidates. A far greater number of candidates showed their method for this question, which should be encouraged. A significant number of candidates however did subtract 4 from both sides instead of add 4.

(iii) This more complex equation was answered well by the majority of candidates. Many presented their method with very few candidates only giving the answer. The expanding of the bracket proved the most challenging part of the solution with many wrong answers coming from an incorrect expansion of $4(5q - 2)$, with $20q - 2$ being seen often. However a large proportion of candidates were able to gain a mark by correctly solving their resulting equation.

(c) This simultaneous equations question proved very challenging this year, with many less able candidates choosing not to attempt it or only able to attempt the first part of the solution. The higher co-efficients and answers to the equations led to a number of numerical errors. However candidates generally were able to choose the correct method to eliminate one variable and therefore were able to score 2 out of the 4 marks available. It was the manipulation of the terms involving negative co-efficients that seemed to prevent the candidates reaching a successful conclusion. Far more candidates chose to use the substitution method of solving simultaneous equations than in previous years. Many were successful in rearranging and substituting into the other equation, gaining two method marks, however most got no further than this.

Answers: **(a)(i)** 230 **(a)(ii)** 252 **(b)(i)** 9 **(b)(ii)** 3.5 **(b)(iii)** 4 **(c)** $x = 1.5$, $y = -5$

MATHEMATICS (US)

Paper 0444/33
Paper 33: Core

Key Messages

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

General Comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates attempted all of the questions with the occasional part question being omitted by individuals. The standard of presentation was generally good. A substantial number of candidates did show all necessary working. However, many 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 being used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on Specific Questions

Question 1

Candidates showed a good understanding of angles. However, their answers could be improved by understanding which theorems should be used in a particular case and given practice at writing down suitable reasons why an angle has a particular value.

(a) (i) Some candidates gave the correct answer. The common incorrect answer was 140°.

(ii) More candidates gave the correct answer or the correct follow through from the previous part.

(b) (i) Candidates appeared to be equally divided between those who gave the correct answer, those who gave an answer of 66° and those who did not give an answer.

(ii) More candidates gave the correct answer in this part. A common error was to assume that the triangle was isosceles.

(iii) Many candidates either gave the correct answer or gained the mark by subtracting their previous two answers from 180°.

(c) Some candidates understood that this answer was the same as **(b)(iii)** or 90° – **(b)(ii)**. However, very few candidates could complete the statement. Many understood that it was to do with tangents but did not connect it to the radius/diameter.

Answers: **(a) (i)** 40 **(ii)** 140 **(b) (i)** 90 **(ii)** 24 **(iii)** 66 **(c)** 66

Question 2

Most candidates answered this question.

(a) The vast majority of candidates understood how to obtain the values from the information giv When an error was made the final addition was usually carried out correctly for the candidates values.

(b) (i) Only a minority of candidates understood that you cannot use the final value to show that this final value is \$2040. Starting from $\frac{2040}{17}$ is incorrect; the correct starting point is $\frac{600}{5}$.

(ii) Many candidates did get this part correct even if they did not succeed in part **(a)**. However, some candidates found this challenging and did not appear to know which values to use.

(c) Most candidates understood the principle of calculating percentage profit but many used the incorrect denominator or didn't subtract the original amount in the numerator.

(d) The vast majority of candidates used the compound interest formula. Very few candidates used simple interest. Fewer candidates used the direct method formula for the calculation, the majority using the year by year approach. Some candidates lost marks for providing insufficient details or not working to sufficient accuracy. A common incorrect answer was 1761.36.

Answers: **(a)** 240, 900, 1640 **(b) (ii)** 30 **(c)** 43.1 **(d)** 261.36

Question 3

Candidates appeared to understand the different transformations although many did not understand in part **(b)(iii)** that only one transformation can be used. When two transformations were given the second transformation tended to be "then move ...". Part **(c)** was very challenging for candidates; many didn't show sufficient working or used premature approximations so marks were lost.

(a) Although about half the candidates gave the correct answer many alternatives were given such as quadrilateral and rhombus.

(b) (i) Few candidates gave all three pieces of information needed to describe the transformation. When three pieces of information were given some candidates did not say the 90^o was clockwise.

(ii) More candidates got this correct than the other parts. Some candidates gave the vector as the number of squares moved left and down.

(iii) Many candidates attempted to describe this by using several transformations such as enlargement and a rotation.

(c) (i) Some candidates produced very good work to show this result but didn't show their square root value to sufficient accuracy - a value of 3.162 was required.

(ii) Most candidates attempted this part but few produced solutions that included a calculated 1.41. Many appeared to have measured the diagram.

(iii) Although many candidates did multiply their previous answer by 3, some started again and made the same errors as in the previous part.

Answers: **(a)** Kite **(b) (i)** Rotation, 90^0 clockwise, about origin **(ii)** Translation $\begin{pmatrix} -2 \\ -10 \end{pmatrix}$ **(iii)** Enlargement, scale factor -3, centre (-3,4) **(c) (ii)** 9.15 **(iii)** 27.45

Question 4

Candidates found parts of this question on trigonometry challenging. In particular candidates woul from practice on the reasons why triangles are similar etc.

(a) (i) Candidates generally understood the need for a trigonometric expression, with many using the correct one. However, common errors were to either use the wrong trigonometric function or to use insufficient accuracy.

(b) Most candidates understood the need to use the formulae for areas and squares. Common errors were to either use the diameter as stated rather than the radius, or only work out the area of the circle, or not state the units.

(c) (i) Candidates found this very challenging with few giving a correct statement. The common error was to note that both triangles had a side of the same length and both had a right angle. Candidates can improve by understanding that triangles are similar when the ratio of the sides is the same for each pair of sides associated with an angle in the triangle.

(ii) A few candidates gave the correct answer but in general this part was often left unanswered.

Answers: **(a)** 2.82 **(b)** 2.23 m^2 **(c) (ii)** $\frac{4}{3}$ or $\frac{3}{4}$

Question 5

Candidates showed good ability at graphs and understood how to read them. Candidates could improve their answers by taking care to draw smooth continuous curves and not using straight lines instead of curves.

(a) (i) The majority of candidates completed the table correctly. The common error was +3 at x=-1, most probably arising from incorrect use of brackets around the -1.

(ii) Many candidates plotted their points accurately. Although many then drew good curves for their points some candidates' curves were too thick or just straight lines between the points.

(b) Some candidates read the graph correctly to find the intersections with the x-axis. Candidates showed a good understanding of how to use the scale and negative values. However, many candidates attempted to use the quadratic formula and because the equation was in 'reverse' order (constant first instead of last) this almost always did not yield the correct answer.

(c) (i) A slight majority of candidates recognised and drew the line of symmetry whilst many did not give an answer. Candidates could improve their answers by clearly labelling the line of symmetry.

(ii) Most candidates who drew the line of symmetry gave an answer, often the correct answer. The most common error was to write y=1.5 or y equals a quadratic.

(d) (i) Many candidates drew the correct line accurately although a few attempted freehand lines or drew a non-continuous line.

(ii) Candidates were challenged by this part. Most used the difference in y divided by difference in x. However, many inverted the formula or didn't take account of the difference in the scale between the two axes. Most candidates did take account of negative values correctly.

(iii) When the candidate obtained the correct answer for the previous part they normally wrote down the correct answer here. The common error was to give an incomplete answer, either omitting the constant term or simply writing 'c'.

Answers: **(a) (i)** 1, 7, 1 **(b)** -1.1 to -1.3 and 4.1 to 4.3 **(c) (ii)** x=1.5 **(d) (ii)** 1 **(iii)** x+2

Question 6

A majority of candidates showed a good understanding of statistics and pie charts. They could im clearly understanding the difference between mean, mode etc. Some candidates gave the correct an but in the wrong spaces.

(a) (i) Many candidates gave the correct answer. The common error was poor ordering, including just using the terms in the order given.

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

(iii) Generally candidates understood the necessary calculation but didn't show sufficient working so method marks couldn't be given if errors had been made in the calculation.

(b) This proved challenging to many candidates. There were good clear answers but many gave a general response about the scores without mentioning the mean or median. Quite a few candidates did not answer this part.

(c) (i) In general candidates gave correct answers in the table.

(ii) The candidate's answers were then translated accurately to the pie chart with correct labelling.

(d) Some candidates gave the correct answer although some did not recognise the answer had to be in its simplest form. A common error was to misread the question and give an answer of $\frac{3}{5}$.

Answers: **(a) (i)** 18 **(ii)** 7 **(iii)** 25 **(c)** Frequencies 3, 2, 1; angles 72°, 48°, 24° **(d)** $\frac{2}{5}$

Question 7

Candidates showed a reasonable understanding of trigonometry but less understanding of three dimensional objects.

(a) Most candidates recognised the need to calculate the length *DE*. Although many candidates understood and wrote down the correct expression they lost marks for accuracy. A number of candidates believed they needed to use Pythagoras' theorem.

(b) Many candidates gave the correct answer, often without showing any working. When working was shown, the two alternative ways of calculating the area were used equally by the candidates.

(c) A few candidates understood that the answer here was twice the answer to the previous part. However, a large number of candidates did not answer this part.

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

(ii) Some candidates gave the correct answer. The most common error was to misread the question and find the number of boxes that were not faulty.

Answers: **(a)** 36.9 **(b)** 1.875 **(c)** 3.75 **(d) (i)** 0.96 **(ii)** 10

Question 8

Although candidates were generally able to calculate specific values, writing expressions was challenging. Candidates could improve their answers by having further practice on writing general expressions.

(a) Many candidates gave the correct answer. The common error seen was hexagon.

(b) The vast majority of candidates gave completely correct answers. When full marks were not earned it was usually the vertices rather than the lines which were inaccurate.

(c) (i) Only some candidates gave the correct answer. There did not appear to be any co... with many candidates not showing an understanding of expressions.

(ii) A significant number of candidates got the correct answer even though they may not have... correct answer, or an answer at all, to the previous part. Many of these candidates showed th... working as writing down each pattern up to the pattern required. Sometimes this included an error which meant no marks could be scored.

(d) Only some candidates gave the correct answer. There did not appear to be any common errors with many candidates not showing an understanding of expressions.

(e) Very few candidates gave the correct answer. The common error was to subtract the vertices from the lines.

Answers: **(a)** Octagon **(b)** 20; 22; 26; 29; 44; 50 **(c) (i)** $6n+2$ **(ii)** 140 **(d)** $7n+1$ **(e)** $n-1$

Question 9

Some candidates showed an understanding of rearranging and substituting into formulae. Candidates can improve their answers by practise and understanding that multiplication and division go together whilst addition and subtraction go together.

(a) (i) A few candidates rearranged the formula correctly. The common errors were to leave a three tier division or to move a letter incorrectly (subtracting instead of dividing for example).

(ii) Many candidates started again instead of using the formula they had obtained in the previous part. A common error was not to show sufficient accuracy after the square root had been taken to allow for rounding to the answer 3.

(b) Some candidates gave the correct answer. The common error was to use the formula for area instead of circumference.

(c) A few candidates gained full marks. Many candidates gave an answer of 2 with or without working. Common errors were to divide the volume by the cost or to not give an answer to one decimal place.

Answers: **(a) (i)** $r = \sqrt{\frac{3V}{\pi h}}$ **(b)** 18.9 **(c)** 1.9

MATHEMATICS (US)

Paper 0444/41
Paper 41 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.
The accurate statement and application of formulae in varying situations is always required.
Work should be clearly and concisely expressed with an appropriate level of accuracy.
Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so examiners can give credit when appropriate.
Straight lines in graphs should be accurately ruled with the correct intercepts on the axes. Curves should be drawn with a single curved line.

General comments

This paper proved to be accessible to many of the candidates. There were however some candidates who were not able to attempt a number of the questions and did not appear to have the knowledge and skills for this extended paper and would have been more appropriately entered at the core tier.

The more able candidates showed well-structured answers with clear method and answers given to appropriate accuracy. Candidates should record all of their working and solutions inside the question booklet provided. There were more candidates this year who showed minimal or no working and a number that gave answers only. As a general point, candidates should be encouraged to cross out any incorrect/redundant work and replace it rather than writing over it.

The questions/parts of questions on arithmetic (percentages, ratio etc.), speed/ time graphs, curved surface area and volume of a cone, rotation and reflection, calculating an estimate of the mean and drawing a cumulative frequency diagram, making predictions about the next pattern in a sequence were very well attempted. The questions involving finding sector angles, general trigonometry, aspects of functions, matrix transformations, setting up and solving an equation in context, describing a region using inequalities and generalising patterns in a sequence proved to be the more challenging aspects on the paper.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least 3 significant figure accuracy unless specified was noted by most candidates and only a few approximated to 2 significant figures in their working. A few candidates lost accuracy marks in **Question 2** by not following the instructions on the front of the question paper concerning the values to use for π. Those that chose to use $\frac{22}{7}$ or 3.14 gave answers outside the required range for accuracy.

Words printed in bold, e.g. **integer** in **Question 5(a)(iii)** are intended to help candidates focus on the requirement. This was ignored in a few cases when candidates gave a decimal answer.

Comments on specific questions

Question 1

This question involving application of number work in a context was generally well answered.

(a) (i) Most candidates had few problems and gave the fraction in its simplest form. A few gave an answer of $\frac{2}{3}$ from $\frac{80}{120}$ rather than starting with $\frac{80}{200}$. Some others gave a decimal or percentage answer such as 40%.

(ii) Most candidates also did well with this question, with a few incorrectly going on to fu... the ratio to 1: $\frac{2}{3}$ or 1.5: 1 which does not earn credit. A few used the values 80 and 2... than 80 and 120 in their ratio.

(b) (i) Most candidates were successful with this money problem and found the total cost of the oranges first before subtracting this from the total \$86.38. A few candidates made errors in transcribing their values from one method line to the next and care needs to be taken as this type of error will lose the final mark for the accuracy.

(ii) Answers to this reverse percentage problem were mixed. Quite a number calculated 20% and then subtracted this from 1.56 to arrive at 1.25. Those that associated 1.56 with 120% as their first step almost always went on to complete the method correctly.

(c) A range of answers were given to this problem on profit. Many showed full working, subtracting 314.2 from 667 before dividing by 10.5. A number mistakenly divided by 10.3 instead of 10.5. Some did not subtract the cost of 314.20 and simply divided 667 by 10.5.

Answer: **(a) (i)** $\frac{2}{5}$, **(ii)** 3: 2; **(b) (i)** 1.22, **(ii)** 1.30; **(c)** 33.60.

Question 2

The more straightforward parts on surface area and volume of a cone were answered very well.
Conversion of units and the problem solving aspect of finding a sector angle was only answered well by the more able candidates.

(a) (i) This part was well answered. Virtually all candidates knew how to find the curved surface area of the cone but a few used incorrect values of $\frac{22}{7}$ or 3.14 for π which resulted in an answer that was out of range.

(ii) The majority of candidates recognised that Pythagoras' theorem should be used to find the vertical height of the cone. Most were able to obtain 12 cm correctly but a number incorrectly added the squares of the slant height and the radius to get 13.9 cm and did not apply Pythagoras' theorem correctly to this problem.

(iii) Most candidates were successful in calculating the volume of the cone. Some again used incorrect values of $\frac{22}{7}$ or 3.14 for π which resulted in an answer that was out of range.

(iv) Many candidates struggled with the conversion factors involved and a common error was to divide by 100 or 10 000, and not 100^3 and a few even multiplied by these incorrect conversion factors. Some who used the correct conversion factor did not record their answer in standard form as required. Candidates should always re-read the question before writing their final solution to avoid this type of error.

(b) This question proved to be a good discriminator as only the more able candidates were able to give fully correct solutions. Some used their answer to part **(a)** and the area of the full circle to find the angle required, while others used the circumference of the full circle and the arc length of the sector to find the angle. Many were able to score 1 mark for identifying either $\pi \times 13^2$ or $2\times\pi\times13$ as part of their method. Quite a large number incorrectly used entirely trigonometrical methods to find the angle. Of those who attempted a 'correct' method for areas or lengths of arcs, many used a sector radius of 5 cm rather than 13 cm.

Answer: **(a) (i)** 204, **(ii)** 12, **(iii)** 314, **(iv)** 3.14×10^{-4}; **(b)** 138.

Question 3

This question involving application of trigonometry and area scale factors proved challenging fo candidates, in particular the use of area scale factors.

(a) Most candidates recognised the use of the cosine rule for this problem and many were able to arrive at a correct solution using this method. There were errors by a number of candidates who, having quoted the cosine rule correctly and made the correct substitution, did not follow the correct order of operations to complete the problem and calculated $(70^2 + 55^2 - 2 \times 70 \times 55) \cos 40$. A few could not recall the formula for the cosine rule and could not score as a result.
A significant number incorrectly used trigonometry methods for right-angled triangles despite there being no right angle and scored no marks.

(b) Many candidates recognised the use of the sine rule to calculate *BC*. Those that used the sine rule usually went on to give an accurate answer but there was sometimes a premature approximation of the sin 32 and sin 40 within the method, resulting in an answer that was out of range. Some candidates quoted the sine rule and then went straight to the answer and Centres should advise candidates to show each stage in their working. A few did not recognise that angle *BDC* was 40°.
Less able candidates incorrectly used trigonometry methods for right-angled triangles as in part **(a)**.
Quite a number dropped a perpendicular from *B* to *DC* and used longer methods in this part.

(c) (i) There were two successful strategies to find the area of the playground. The first was to find the sum of the areas of triangle *ABD* and triangle *BCD*. The second was to calculate the length of *DC* and then find the area of the trapezium *ABCD*. The first method was more successful than the second as candidates often made incorrect assumptions about the length of *CD* such as $CD = 2 \times 55$.
Errors in previous parts did not affect the method marks here but some were unable to achieve the final accuracy mark because of previous errors. Many found this question very challenging and were unfamiliar with how to find the area of a general triangle and did not score at all.

(ii) This question proved to be one of the hardest parts of the paper. Only a few were able to interpret the scale 1 : 200 with the area scale factor and divided part **(c)(i)** by 4. The majority divided by 2 or 200.

(d) Many candidates were well prepared for this and drew a perpendicular line from *A* to *BD* before correctly using trigonometry. Fewer used an area method using the area of triangle *ABD* and the base of 70 m. The most common error was to assume that the perpendicular from *A* to *BD* divided *BD* into two equal lengths of 35 m.

Answer: **(a)** 45.0; **(b)** 84.9; **(c)** **(i)** 4060, **(ii)** 1020; **(d)** 35.4.

Question 4

This question on transformations and vectors was answered well in parts with matrices and drawing geometric conclusions from vectors the most challenging areas.

(a) (i) The reflection was done well by most candidates. A few used an incorrect mirror line usually $y = k$ with $k \neq 5$.

(ii) This was less well done than part **(a)(i)**. Some used an incorrect centre of rotation, but were able to rotate the shape 180° to earn partial credit. A number of candidates did not understand how to rotate the shape at all.

(iii) Not many candidates were successful in enlarging the triangle. Some enlarged by scale factor 4 but had the image in the incorrect position.

(iv) Some candidates recognised the transformation as a stretch but fewer were able to describe the stretch correctly using the correct terminology of *y*-axis invariant and factor 2. Others gave enlargement or translation as the transformation.

(b) (i) This part was well answered by many who recognised that the position vector of *Q* was *OQ*. Those that recognised this, but were unable to give the correct vector in terms of **p** and **s**, were given partial credit. It is important on vector questions for candidates to show some worki method mark can be earned. A few did not do this.

(ii) This part proved slightly more difficult for candidates than part **(b)(i)** but many were succ again. A number were unable to get to the final answer but earned partial credit for corre describing a vector route from *S* to *R* or for having an answer of the form **s** + *k***p** or *k***s** + ½**p**.

(c) Only a few of the most able candidates were able to give a correct complete answer to this part. Many made the observation about 'parallel' but did not mention that *OQ* = 2*SR*.

Answers: **(a)(iv)** Stretch, *y*-axis invariant, factor 2; **(b)(i)** **p** + 2**s**, **(ii)** **s** + ½**p**, **(c)** parallel and *OQ* = 2*SR*

Question 5

This question on functions proved challenging for many candidates who struggled with the function notation used.

(a) (i) There were mixed responses to this part with a very common error of 2.2 from f(*x*) = 2 rather than f(2), misunderstanding the function notation used in the question.

(ii) More candidates were successful here in reading the graph correctly and interpreting the function notation used to get an answer of 1.2. A common error was to give an answer of 0.

(iii) Only a few of the more able candidates were able to give a correct integer answer. Others knew where to take the reading but gave a non-integer solution such as –0.7 or –0.8. Many did not understand what was being asked.

(iv) Candidates also found this question challenging with many not being able to draw the graph of *y* = *x* accurately on the grid; indeed a number did not recognise that a line needed to be drawn. Many did not interpret the scale on the axes correctly and drew *y* = 2*x* and then gave the intercepts of this line with the graph of *y* = f(*x*). A number drew no line at all and appeared to pick 3 random values.

(b) (i) Many candidates were well prepared for this question on composite functions and had little difficulty in finding h(3) before substituting the result into g(*x*). Some attempted the calculation as $1 – 2(3^2 – 1)$ but this sometimes led to arithmetic errors when expanding the bracket. A number found that h(3) = 8 but then tried to multiply this with g(*x*) and did not understand the requirements of the question.

(ii) The inverse function was done well by over half of the candidates. Some used the correct method but then lost a negative sign when rearranging. A number did not understand the requirements of an inverse function and gave answers such as $\frac{1}{1-2x}$. Those that tried to use a reverse flowchart method struggled with this function by not realising that "take from" is self-inverse.

(iii) Most candidates were able to earn a method mark for stating that $x^2 – 1 = 3$ and many were able to go on to solve this simple quadratic to give both the positive and negative solutions. However a number of candidates did not recognise the simple method of rearranging and then finding the square root of 4, with many treating this as a trinomial quadratic and in error trying to use the quadratic formula to solve the equation.

(iv) Interpreting the function notation correctly was crucial to solving this problem. Those that stated that 1 – 2(3*x*) = 2*x* usually went on to solve the problem correctly although a number were unable to collect *x* terms correctly with a common error being to arrive at 1 = 4*x*. For those that did not interpret the initial statement correctly, 3g(*x*) = 2*x* giving 3(1 – 2*x*) = 2*x* was the common error made.

Answer: **(a)** **(i)** 1.4 to 1.6, **(ii)** 1.15 to 1.25, **(iii)** -1, **(iv)** -2.25 to -2.1, -0.9 to -0.75, 2.2 to 2.35;
(b) **(i)** -15,; **(ii)** $\frac{1-x}{2}$, **(iii)** -2, 2, **(iv)** $\frac{1}{8}$

Question 6

This question involving statistics and graphs was generally well answered.

(a) This part was well answered. The method for finding an estimate of the mean is well underst by most candidates. There were a few arithmetic errors or rounding errors seen such as giving answers as 24.6 within an otherwise correct method. Some candidates used the lower or upper bound, or in some cases, the class width of 10 rather than the mid-interval values for their calculations. There were very few finding the sum of the mid-interval values and then dividing by 6 in this session.

(b) (i) This was well answered with the majority of candidates able to complete the cumulative frequency table correctly.

(ii) Most candidates were able to draw an accurate cumulative frequency graph and most used a curve to connect the points. A few had difficulty in interpreting the vertical scale when plotting the points. A few plotted the values at the mid-interval of the class rather than the upper bound. Some did not understand that points should be plotted and joined and drew a 'bar type' graph.

(iii) The values were often read accurately but some had difficulty in reading the vertical scale of the graph. Some read the 60^{th} percentile as the 60^{th} value and not 60% of 120. A few left their answer to the 60^{th} percentile as 72 rather than taking a reading at this value.

(c) (i) This part was well answered with most being able to record 50 and 30 in the table.

(ii) This part was also well answered, with almost all candidates using the correct widths for the blocks of the histogram. There were some errors with the heights of the bars where candidates did not appreciate the significance of finding the frequency density for the height of the bar and a common error was to divide both values from the table by 10 to get the heights.

Answer: **(a)** 24.7; **(b) (i)** 50, 90, 114, **(iii)** 21.5 to 23, 15 to 16.5, 24 to 26; **(c) (i)** 50, 30.

Question 7

This question on solving equations and proportion was answered well in parts where standard techniques were applied. Part **(c)** involving setting up an equation to solve from a problem proved challenging for many.

(a) This part involved solving a quadratic equation giving the solutions to a specified accuracy. Many candidates answered this well. For some the common errors were made such as minus signs and brackets in the wrong place, e.g. $-(11)^2$ leading to -121 or -11 instead of $-(-11)$. Quite a few candidates showed correct working but either approximated their results incorrectly (e.g. 2.04 from 2.046/7) or gave one or both answers not to 2 decimal places, with a common error to write 2.04 and/or -0.672. There were other errors with the full division line not extended below the $-(-11)$ or the square root not fully extended.
Only a few candidates used the completing the square method and were often unsuccessful with this. When solving quadratic equations using the formula it is important that candidates show full complete correct working as the correct solutions alone can be obtained from a calculator and do not earn full credit.

(b) This part was well answered generally. Once candidates had established that $y = k\sqrt{x}$, correct answers were usually obtained. Common errors were to read the proportional relationship as $y = kx$, $y = kx^2$ or $y = \dfrac{k}{\sqrt{x}}$.

(c) This part was one of the more challenging questions for candidates, with a larg f incorrect answers. The better solutions were where the initial equation was const algebraic manipulation correctly done. Some candidates successfully used a longer forming simultaneous equations and then using substitutions to arrive at the correct a However, many candidates faltered at the start, multiplying x by 2.5 and (x -14.5) by 0.5, instea dividing, to form an equation = 19. Even then, the algebraic manipulation was not always accurate. A very few obtained the correct answer with no algebra to earn one mark only as the question required an equation to be set up and solved.

Answer: **(a)** -0.67 and 2.05; **(b)** 132; **(c)** 20.

Question 8

This question involving inequalities and regions varied in the quality of the responses.

(a) Answers to this part were mixed with the equation for L_1 the best answered of the three lines. L_2 was often correct but common incorrect answers included $y = 2x + k$, where k was not zero, $y = x$ or $y = \frac{1}{2}x$. L_3 was the weakest answered of all of the lines with common errors being $y = \frac{1}{2}x + 5$, or $y = 2x + 5$. Few candidates gave answers only, where they could just look at the lines and read off the values required, spotting gradients and intersections. Many wanted to use co-ordinates to arrive at the equations and errors were often made.

(b) The three inequalities were only occasionally given all correctly. Errors in part **(a)** had an impact here, as well as many that were unable to enter the correct inequality sign. The use of strict inequalities was condoned in this part. There were errors in the notation with some placing inequalities before the equations and others introducing a variable R rather than y.

(c) (i) This part was better answered and many were able to determine the correct number of bushes and trees to give a total cost of $720. Some attempted trials to find the answer and a number used points that were not in the shaded region and so misunderstood the instructions given in the question.

(ii) Those that were successful in the previous part usually answered this well also and many gave the correct values with no working shown. Some attempted trials and again used points that were not in the shaded region. This was not understood by many.

Answer: **(a)** $y = 2$, $y = 2x$, $y = -\frac{1}{2}x + 5$; **(b)** $y \geq 2$, $y \leq 2x$, $y \leq -\frac{1}{2}x + 5$; **(c) (i)** 4, 3, **(ii)** 2, 4, 860.

Question 9

This question was on number patterns with extremes, containing some of the easier and the most difficult parts of the question paper, parts **(a)(i)** and **(b)(i)** being the easier and **(a)(v)** the most difficult.

(a) (i) Many candidates found giving the next line of the pattern straightforward. A few did not earn the mark as they gave an incomplete answer of 1 + 2 + 3 + 4 + 5 for example.

(ii) Some approached this as a verification using substitution with the value $k = 2$ rather than establishing that $k = 2$. Those that used $k = 2$ to show that the pattern worked with this value scored one mark only. Those that substituted values of n into the expression and then formed an equation by making this equal to the total for the pattern and then went on to establish that $k = 2$ from their equation scored both marks.

(iii) Many candidates used the previous result with $n = 60$, to find the correct sum of the first 60 integers. Others showed no working and had an incorrect answer.

(iv) This part was reasonably well answered. Some candidates set up an equation with 465 and were able to arrive at an answer of 30. Others set up a correct quadratic equation but then were unable to solve it. Some used trial and improvement to arrive at the answer 30.

(v) Very few candidates were able to make the link between the structure of sum of the pattern given in terms of n and the value of x required. Many omitted this part while others often quoted the expression given for the sum as their answer.

(b) (i) This part was well answered with most candidates scoring both marks for co... statement.

(ii) This was only well answered by the more able candidates. Many misunderstood the pattern and gave the general result for the sum of the cubes as the cube rather than the square of previous result for the pattern in part **(a)**. Many did not make the link between parts **(b)(i)** and **(ii)**.

(iii) This was slightly more successfully answered than the previous part and some of those who obtained an incorrect general rule in part **(ii)** were able to get this correct by using the longer method of adding all of the first 19 cubes together. A common error was to give the value 190 from using n = 19 in the formula $\frac{n(n+1)}{2}$.

Answer: **(a) (i)** 1 + 2 + 3 + 4 + 5 = 15, **(iii)** 1830, **(iv)** 30, **(v)** $n - 8$; **(b) (i)** 225, 15, **(ii)** $\left(\frac{n(n+1)}{2}\right)^2$,

(iii) 36100.

Question 10

Responses were mixed and the final part proved challenging for all.

(a) This part was well answered, with the majority of candidates able to use the multiplier method and not lose accuracy to give an answer correct to the nearest dollar. A few tried a staged calculation in five parts that did lead to a loss of accuracy.

(b) Answers were more mixed for this part. A number of candidates recognised the stages and did the compound calculation for the first two months correctly before adding the amount for the second month to this. A few did the first calculation only and did not consider the extra $100 invested in the second month.

(c) Candidates found this part very challenging and it appeared to be an unfamiliar topic for many.

Answers: **(a)** 4724; **(c)** $2^n - 1$

MATHEMATICS (US)

Paper 0444/43

Paper 4: Extended

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.
The accurate statement and application of formulae in varying situations is always required.
Work should be clearly and concisely expressed with an appropriate level of accuracy.
Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so examiners can give credit when appropriate.
Straight lines in graphs should be accurately ruled with the correct intercepts on the axes. Curves should be drawn with a single curved line.

General Comments

The paper gave candidates an opportunity to demonstrate their knowledge and application of Mathematics. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity and difficulty with topics rather than shortness of time. As always the standard of work was variable, with marks covering a wide range. Presentation of work was often good with some scripts showing working that was clearly set out. For less able candidates, working tended to be more haphazard and difficult to follow. Candidates need to be aware of the need to retain sufficient figures in their workings so that their final answer is accurate; a number of marks were lost due to premature approximation of values.

Comments on Specific Questions

Question 1

(a)(i) A large majority of candidates were able to calculate the correct number of pages. A common source of error was thinking the 63 was the total number of pages and division by 12, rather than 7, led to a final answer of 26.25.

(ii) Candidates were more successful in this part of the question, finding sharing in a ratio a simpler task. The common error was thinking the 56 referred to the number of review pages which led to division by 9, multiplication by 5 and an answer of 31.1. A few candidates either worked out the number of review pages or gave both correct values.

(iii) Roughly equal numbers of candidates chose to work with the annual price as with the price of an individual copy. A minority of candidates lost the accuracy mark by giving their final answer to two significant figures. Candidates working with the price of an individual copy were more likely to lose the final accuracy mark due to premature rounding of the price to 3.75. Another common source of error was calculating the saving of 14.9 as a percentage of the subscription cost rather than the actual cost of 13 issues.

(b) Only a minority of candidates obtained the correct answer of 128. For these candidates a variety of approaches was used. Most tended to work with percentages or fractions leading to 28.125% or $\frac{9}{32}$ representing the 36 pages of reviews. Almost all went on to calculate the total number of pages correctly. Some started with 37½% representing the reviews and calculated the remaining number of pages (96) before calculating the total number. A few attempted to set up an equation but not always successfully. A small number attempted trial and improvement. A large majority of the unsuccessful candidates mistakenly thought the percentage for features was 62.5% of the total.

Answers: **(a)(i)** 45; **(ii)** 20; **(iii)** 23.4; **(b)** 128

Question 2

A wide variety of responses were given to this question. Candidates that scored well used efficient but many candidates made incorrect assumptions about the diagram and used incorrect values i calculations. Parts of this question were often not attempted.

(a) The vast majority of candidates attempting this part were able to write the sine rule correctly with very few attempting an alternative method. As candidates were required to show that *AC* rounded to 119.9 it was expected that they would give their answer with at least one more significant figure. Not doing so lost some candidates the final mark.

(b) A majority of candidates realised that the cosine rule was required and most were able to write a correct statement and evaluate it correctly. Rather than using the given answer of 119.9, some candidates rounded to 119 or 120 earning the method marks but losing out on the accuracy marks. Some candidates attempted less efficient methods but not always successfully. Incorrect assumptions such as angle *ABC* = 90° and using Pythagoras' theorem, assuming triangle *ABC* was isosceles and using *B* as 65° and assuming a cyclic quadrilateral and writing angle *ACB* as 57° and angle *ABC* as 58° were sometimes seen.

(c) It was expected that candidates would find the area of the triangle using ½ × 62 × 119.9 × sin 32. Those that did almost always achieved the correct answer. A significant number chose less efficient methods, often losing the final mark because of premature rounding and in some cases all the marks because of errors in the method. A few candidates found the area of triangle *ACB* instead. Candidates lost marks by not using a correct value for *AC*.

(d) Those candidates using an efficient method for the area of triangle *ABC* often went on to obtain the correct cost. A significant number didn't calculate the total area of the field, simply multiplying their answer to part **(c)** by 4.50. Those using less efficient methods lost marks either for lack of accuracy because of premature rounding or for using incorrect methods to find a perpendicular height. A small number divided their area by 4.50.

Answers: **(a)** 119.94; **(ii)** 109; **(iii)** 1970; **(b)** 22 300

Question 3

(a) Almost all candidates obtained the correct expressions for the length and width of the box. Only occasionally were answers such as $2x - 9$ and $2x - 7$ or $9 - x$ and $7 - x$ seen.

(b) If candidates were successful in the previous part they almost always earned the first mark for an expression for the volume. Some didn't score the second mark because of algebraic errors when multiplying out the brackets, usually involving an incorrect power or sign.

(c) Almost all candidates completed the table correctly.

(d) The plotting of the points was generally very good. Most curves were drawn accurately. However some candidates used a pen, rather than a pencil, making it difficult to correct errors. Very few graphs involved the use of ruled line segments.

(e) The answer $V \geq 30$ or its equivalent was seen quite often. However, a number between 0.65 and 0.75 was seen regularly, sometimes within a fully correct inequality.

(f) (i) Most candidates earned the mark for an answer in the range 36 to 37.

(ii) Answers of 36 in part **(i)** tended to lead to an incorrect answer of 1.5 in this part. A minority obtained a value in the acceptable range.

Answers: **(a)** $9 - 2x$, $7 - 2x$; **(c)** 24, 20; **(e)** $0.7 \leq x \leq 2$; **(f)(i)** 36 to 37; **(ii)** 1.2 to 1.4

Question 4

(a) Candidates usually scored both marks in this part. Loss of marks was usually the arithmetical slips.

(b) More able candidates were only slightly less successful in this part. Less able candidates often struggled, sometimes with the number of sides in a pentagon, sometimes finding an interior angle and sometimes an exterior angle.

(c) This proved to be the most challenging part of the question. Only the more able candidates realised that the problem could be solved simply by summing the angles at seven points and subtracting the interior angles of the pentagon and quadrilateral. Some assumed that the polygons were regular, using this to calculate the interior and exterior angles at the seven vertices, but the angles at *f* and *c* usually proved to be the stumbling block. A significant number of candidates made no attempt at all.

(d) (i) A majority of candidates realised they needed to work with the sum of the interior angles and were able to show the equation $7x + 4y = 390$. Less able candidates misinterpreted the question and used the solutions of the equations to show that $7x + 4y$ evaluated to be 390.

(ii) Fewer candidates realised that the interior angles at *A* and *B* added to give 180. Those that did had no difficulty in reaching the required equation. As in the previous part some used the solutions to show that $2x + 3y$ evaluated to be 195. A significant number of candidates made no attempt at all.

(iii) A large majority of candidates were able to solve the two equations. A greater number multiplied the equations in order to eliminate a variable than chose to use a substitution method. However, both methods were generally successful. Common errors included adding the equations instead of subtracting and arithmetical slips often resulting from multiplying the second equation by 3.5 in order to equate the coefficients of *x*. With the method of substitution, dealing with a denominator caused a few problems for some candidates.

(iv) Most of the candidates successful in solving the equations usually went on to find the sizes of the angles of the trapezium.

Answers: **(a)** 48, 84 and 66, 66; **(b)** 540; **(c)** 1620; **(d)(iii)** $x = 30$, $y = 45$; **(iv)** 65, 65, 115, 115

Question 5

(a) (i) The large majority of candidates knew the method, found the correct midpoints, showed clear working and gained full marks. A few lost the final mark by giving their answer to only two significant figures. Some added the frequencies and divided by 80 or sometimes 6.

(ii) Histograms were well drawn with a large majority of candidates earning all four marks. Less able candidates did not appreciate the need to use frequency densities and attempted to draw blocks with heights of 19, 13 and 12. As a height of 19 would fall off the grid they often left it at 16. However, they did gain a mark for correct widths. Other errors usually involved incorrect heights for 9.5 and 6.5. A small number subdivided each block with vertical lines one centimetre apart.

(b) (i) Many candidates were able to complete the tree diagram successfully. The first branch probability of $\frac{2}{5}$ was almost always correct but the second branches were sometimes interchanged or denominators of 5 used.

(ii) More able candidates earned full marks, choosing either the sum of three probabilities or one minus the probability that neither used the internet in roughly equal numbers. Less able candidates sometimes calculated the probability that only one candidate used the internet. Attempts at adding the probabilities was another common error.

(iii) This proved to be a straightforward question for a majority of candidates. A common ... was multiplying $\frac{3}{5}$ by 3 and occasionally $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3}$ was seen.

Answers: **(a)(i)** 3.81; **(b)(i)** $\frac{2}{5}, \frac{1}{4}, \frac{3}{4}, \frac{1}{4}$; **(ii)** $\frac{18}{20}$; **(iii)** $\frac{27}{125}$

Question 6

This proved to be a challenging question and it was rare to see candidates earning full marks. Most candidates attempted to use appropriate formula but often made significant errors in their application. With the exception of part **(a)**, each part had many candidates making no attempt at all.

(a) Most candidates realised that they needed to use πr^2 but this did not always lead to a correct answer. Not dividing πr^2 by 2, problems identifying the correct radius and adding all three semicircles meant that many candidates lost marks in this part. Less able candidates sometimes used the formula for circumference.

(b) Many found this part challenging and several incorrect methods were seen. Most candidates attempted to use πd but again there was confusion about the value of the radius or diameter that needed to be used. Some simply repeated their method of part **(a)** and subtracted the small semicircle. Not dividing by 2 also caused problems. Those that managed to find a correct curved surface area often treated the container as closed and added the area of the cross section twice.

(c) Candidates were far more successful in this part of the question, realising the need to multiply their answer from part **(a)** by 35 with many going on to earn all three follow through marks. A few did not know how to convert their answer into litres and division by 100 instead of 1000 was seen. A few candidates made the question more difficult, with much working, by restarting from the beginning instead of using their answer from part **(a)**.

(d) (i) Candidates found this very challenging. The vast majority made no connection with similar triangles and most simply wrote 40 ÷ 20 but didn't connect this with $\frac{h}{2}$.

(ii) Only the most able candidates made good progress in this part of the question. Attempts usually started by equating $\frac{\pi r^2 h}{3}$ with their volume from part **(c)**. Some could rearrange this to get $r^2 h$ but were unable to go any further. Others realised that $r = \frac{h}{2}$ and were able to gain a mark for $\frac{1}{3}\pi\left(\frac{h}{2}\right)^2 h$ equated to their volume. Some then made an error by writing $\left(\frac{h}{2}\right)^2$ as $\frac{h^2}{2}$. Even when continued correctly some didn't take the cube root, often using square root instead, and lost the final mark. Some candidates substituted $h = 2r$ and were slightly more successful. A few chose a scale factor method but some forgot to cube root and simply multiplied their answer by 40.

Answers: **(a)** 330; **(b)** 2970; **(c)** 11.5; **(d)(ii)** 35.3

Question 7

This proved to be another demanding question and it was rare to see candidates earning full marks. In part **(b)** a significant number of candidates ignored the instruction to give their answer in its simplest form and lost marks unnecessarily. Yet again, in each part of the question, many candidates made no attempt at all.

(a) (i) A large majority of candidates achieved the correct slope. The most common error was calculating change in x divided by change in y. Other incorrect answers were often the result of arithmetic errors in calculating the change in y and/or x.

(ii) A small majority were able to obtain the correct equation, most of these using the co-ordinates of one point along with $y = mx + c$. Some candidates earned one mark for either m or c correct in an equation. Less able candidates struggled to make any progress and a significant nu attempt at all.

(iii) Only a minority of candidates obtained the correct column vector. Many incorrect stemmed from candidates referring back to part **(i)** and answers such as $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$ w common, along with a variety of other components following errors in part **(i)**. A significant number gave their answer as a 2 by 2 matrix, the elements of which were the co-ordinates of P and Q.

(iv) As the answer was dependent on the answer in part **(iii)**, candidates were less successful in this part. Those candidates that realised that magnitude referred to the size (or length) of PQ made good progress in applying Pythagoras' theorem and usually obtained the correct answer. Many appeared unfamiliar with the term 'magnitude' and some simply divided the x-component by the y-component. A significant minority of candidates made no attempt at this part.

(b)(i)(a) A majority of candidates achieved the correct answer with 4**a** + 3**b** the most common error.

(i)(b) Candidates were generally less successful in this part of the question. Many could define a correct route for vector AR but simplifying $-\,4\mathbf{a} + \frac{1}{5}(12\mathbf{a} + 6\mathbf{b})$ proved a step too far for many. Some candidates treated vector AO as 4**a** rather than – 4**a**.

(i)(c) Many candidates worked with the correct route but some did not simplify 1.5 × 4**a**.

(ii) To earn this mark candidates were expected to conclude that OR and OT were parallel which was dependent on vector OT being correct. Some were able to express a numerical relationship between the vectors OR and OT but were unable to state the consequences of the relationship. Many others referred to similar triangles or referred to OA and BT being parallel.

(iii) Some candidates realised that $\frac{3}{2}$ was the ratio of the corresponding sides and went on to square it correctly. However, many more left the answer as $\frac{3}{2}$. Many other candidates gave fractions with numerators and denominators involving complex vector expressions, sometimes squared.

Answers: **(a)(i)** $\frac{3}{2}$; **(ii)** $y = \frac{3}{2}x + 2$; **(iii)** $\begin{pmatrix} 12 \\ 18 \end{pmatrix}$; **(iv)** 21.6; **(b)(i)(a)** 3**b** – 4**a**; **(i)(b)** $\frac{1}{5}(6\mathbf{b} - 8\mathbf{a})$;

(i)(c) 6**a** + 3**b**; **(ii)** OR is parallel to OT; **(iii)** $\frac{9}{4}$

Question 8

(a) (i) A majority of candidates earned the mark for a correct substitution and evaluation of s. Arithmetic slips and substitution of the wrong values were the main cause of error.

(ii) Candidates found this a challenging question. Some were able to substitute correctly and obtain the correct quadratic equation and then went on to earn at least two of the three marks. Leaving the answer in surd form was the usual reason for the loss of the final mark. For the remaining candidates, some could obtain the correct quadratic equation but could make no progress in solving it and the others either could not obtain the correct quadratic or made no attempt at all.

(iii) A minority of candidates gained at least two marks here. For these candidates, most attempted subtraction of the 'ut' term as their first step and were often successful. Starting with multiplication by 2 was not always successful, forgetting to multiply the 'ut' term by 2 being a common error. Dividing by ½ rather than multiply by 2 often led to an error, i.e. leaving the fraction in the denominator of their final answer. Dealing with the t^2 term was carried out correctly by some candidates while others thought that square root was needed to deal with the term.

(b) (i) (a) A majority of candidates were able to substitute correctly and evaluate their expression. Some wrote C(m) as C(20), treating this as 20C, and went on to divide their answer by 20.

(i) (b) Those candidates who were successful in part **(a)** were also successful in this part. d their final answer by 200.

(i) (c) Most of those candidates who were successful in the previous parts were also successful part. Some divided their final answer by 2000.

(ii) Candidates didn't generally notice that as m increased $\frac{200}{m}$ decreased to values that were negligible in comparison with the other values. Many candidates made no attempt.

Answers: **(a)(i)** 215; **(ii)** 2.62; **(iii)** $\frac{2(s-ut)}{t^2}$; **(b)(i)(a)** 120; **(b)** 201; **(c)** 1100.1; **(ii)** $100+\frac{m}{2}$

Question 9

(a) Many of the candidates were able to demonstrate their algebraic skills to good effect and earn all three marks. Some didn't recognise the difference of two squares and factors such as $(x-3)^2$ or $x(x-9)$ were sometimes seen. Less able candidates simply cancelled the x^2 terms leading to an answer of $\frac{x}{3}$.

(b) More able candidates again demonstrated their algebraic expertise and earned all seven marks with efficient solutions that were clearly set out and easy to follow. Some candidates were clearly aware of the correct method of solution, but algebraic slips in expanding brackets such as $2x(x+1)$ and $15(x+1)-20x$ produced the wrong quadratic equation. Eliminating the denominators led to some errors, typically $15-20=2x(x+1)$. After obtaining an incorrect quadratic equation some candidates earned marks for a correct method for solving their quadratic.

Answers: **(a)** $\frac{x}{x+3}$; **(b)** $\frac{3}{2}$ and -5

Question 10

(a) Almost all candidates earned several marks for completing some parts of the table correctly, usually the numerical values. If errors occurred they tended to be with the number of triangles. The algebraic parts of the table proved more challenging. Many were able to recognise the linear rule, the common errors were usually $n+3$, $3n$ or $3n+1$. Some recognised the numbers of triangles as square numbers but gave n^2 as their formula. Most candidates with a correct formula opted for $(n+1)^2$ with just a few opting for n^2+2n+1.

(b) Many correct answers were seen to this part. Some candidates reduced the equation to $(n+1)(n+2)=240$ and were able to spot the correct value of n. Some tried to multiply the brackets by $\frac{3}{2}$, which produced an equation which they found difficult to solve.

(c) (i) A small majority were able to show the given equation. More able candidates usually experienced no difficulty but less able candidates struggled to make progress. A common error involved the correct use of the formula but then not equating their expression to 9.

(ii) This proved to be the most demanding part of the question. Those that understood the question was about the **total** number of lines had few problems setting up and solving the equations and usually gained full marks. Some candidates made the equations more difficult by choosing higher values of n, $n=3$ was common although values such as $n=9$ and $n=10$ were seen. The most common error was to use $n=2$ with the number of lines as 18 rather than the total of 27. These candidates usually gained some credit for the correct multiplication and subtraction of their incorrect equations. Many candidates made no attempt at all.

Answers: **(a)** 15, 18, $3n+3$; 6, 10; 25, 36, $(n+1)^2$; **(b)** 14; **(c)(ii)** $p=3$, $q=\frac{11}{2}$