MATHEMATICS (US)

Paper 0444/11
Paper 1

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus. Candidates should read the question carefully, focussing on key words and instructions and should also check their answers for sense, in the correct form and accuracy.

General comments

Candidates should pay attention to how a question is phrased, the command words used and what form the answer should take.

The questions that presented least difficulty were **Questions 1**, **14(a)**, **16(a)** and **21(a)**. Those that proved to be the most challenging were **18** (distance, speed and time), **21(b)** and **(c)** (slope and equation of a line), and **22(b)(ii)** (bearings). The questions that were most likely to be left blank were **Questions 18**, **19(b)**, **21(b)** and **(c)** and **22(b)(ii)**. It is likely that the blank responses were due to the syllabus areas being tested rather than a lack of time.

Comments on specific questions

Question 1

Most candidates were successful with this first question and gave the correct answer. The few incorrect answers that were seen included 75, 75% and 0.8 – this last may have been an unnecessary rounding. Also seen a few times was 3.4 which did not show understanding of fractions.

Question 2

This question produced a variety of incorrect answers with the percentage given as 4, 0.04, or 64 (4×16), showing a lack of understanding of this type of percentage calculation.

Question 3

This question caused some confusion as candidates tried to combine the two unlike terms such as $1py^2$ or $5p - 30$. With factorising questions like these, it is not correct to give an answer such as $5(y - 1.2py)$ as decimals must not be used inside the brackets.

Question 4

(a) This question was well answered in general. Often questions like this give the probability as a fraction but candidates need to be able to be familiar with probabilities given as decimals or percentages as well. Some gave the probability as 0.3, the same as for green balls, while others gave 50%, maybe from the wrong assumption that if there were only two colours of balls in the bag, the probability of red was half. There was no instruction as to the form of the answer so 70% and $\frac{7}{10}$ were both acceptable.

(b) In this part, candidates were more successful, perhaps realising that it did not matter what the form of the probability was as there were no blue balls so the answer was 0 or zero although some gave 0.3 again.

Question 5

(a) A very small number of candidates found dealing with the directed numbers challenging, giving answers such as 1, 6, 8 and −12 (from multiplying the temperatures).

(b) The common incorrect answers to this part included 5 or 3.

Question 6

This problem solving question was found challenging by some candidates. The volume of the cuboid had to be divided by the area of the base to find the height. This question was made slightly harder as there was not a diagram to aid candidates' understanding of the physical situation.

Question 7

Most candidates showed good understanding of scientific notation with many answering both parts correctly. There were some candidates who found this question challenging, more in **part (a)** than **part (b)**. Candidates need to remember that in scientific notation there is only one digit in front of the decimal point.

(a) The most common incorrect answer was 64×10^4.

(b) The most common incorrect answer was 6×10^4 instead of 6×10^{-4}.

Question 8

(a) Candidates answered this well following the correct order of operations.

(b) Some candidates treated this as $\sqrt{8}$ (ignoring the cube part of the root and the negative sign) with the answer $-2\sqrt{2}$. Others used the 3 and the 8 giving the answer $\frac{3}{8}$.

(c) As with the first part of the question, the majority of candidates answered this correctly.

Question 9

The frequently occurring misunderstanding was to divide 2100 by 3 (or occasionally, 7) instead of the total number of parts, 10. Some divided correctly but then did not carry on to complete the method by multiplying 210 by 3.

Question 10

(a) This part was generally answered correctly with candidates drawing the horizontal and vertical lines on the diagram to aid them.

(b) No calculation was necessary here as the midpoint can be seen from the diagram.

Question 11

(a) The answer to this part was sometimes given as t^3 as candidates divided the indices instead of subtracting.

(b) This part was more successfully answered, with the most common incorrect answer of u^{10} coming from adding 5 and 5 rather than multiplying.

Question 12

(a) The vast majority of candidates recognised that this quadrilateral was a square.

(b) This example of a problem-solving question had two stages, firstly to find the area of the square and then divide by the area covered by one roll to give the minimum numbers of rolls required. This was answered well.

Question 13

(a) Candidates answered this part well. The estimation calculation was written with each number correct to 1 significant figure as $2 \times \left(0.5 + \sqrt{4}\right)$ and the correct order of operations was followed to reach the correct answer.

(b) The explanations given by candidates were generally clear and concise.

Question 14

This question was answered correctly by a vast majority of candidates. Candidates must ensure that they answer with values from the given list and write a single value for each answer.

(a) Most gave 28 although 27 was given by small number of candidates.

(b) This part was not answered by a few candidates and an incorrect number was picked by some.

(c) This part was correctly answered by more candidates than the previous part. There were two numbers in the list that are prime but candidates only had to give one. Some gave many answers, including 28, which they had already picked out as a multiple of 7, or 27, the cube number, showing that they were not clear what prime numbers are.

Question 15

This was a straightforward fraction question with an addition where only one fraction had to be changed in order to get a common denominator. This was well attempted, with the majority showing full working. Some candidates omitted to check the form of the answer required as some left their answer as an improper fraction and so didn't gain the final mark. A common misconception showing a lack of understanding of fractions was $\frac{5}{6} + \frac{2}{3} = \frac{7}{9}$.

Question 16

(a) Very nearly all candidates answered this question correctly. Candidates should check to see how many terms are required as, occasionally, more than one term was given.

(b) This part proved to be much more challenging for many candidates. Most showed that they were finding the difference between terms and many used this to generate an expression involving $3n$, but there were many errors in finding the required expression. Candidates who attempted to use the nth term formula frequently went wrong, usually because they misremembered the formula but also because of errors in substituting values. A common incorrect expression was nth term = $n + 3$. This is an obvious place for candidates to check their work to see if their nth term expression gave the right values. Also there were some answers that were simply integer values rather than expressions in n.

Question 17

(a) This part was well answered but some of the answers showed a lack of precision in their wording as it was common to see, 'All angles are the same' when it should be that the angles in the corresponding place in each triangle are the same or two expressions such as Angle A = Angle P. Other true statements such as, 'The angles add to 180 in both triangles', 'Both triangles have acute angles' or 'One triangle is an enlargement of the other' did not get the mark as these did not explain what make the triangles similar. The use of the word 'congruent' was incorrect.

(b) Many found the length of AC correctly by using scale factors. A frequent incorrect method of dealing with similar triangles was for candidates to write 18 – 12 = 6 so 27 – 12 = 15.

Question 18

This problem solving question had three parts to the method, converting the distance from kilometres to metres to match the speed given in m/s, finding the time using distance ÷ speed and finally converting the answer in seconds to minutes and seconds as required by the question. Many candidates found at least one of these stages challenging. Many did not convert the 18 km to 18 000 metres so $\frac{18}{20}$ was often seen. Some who got as far as 900 seconds stopped there without converting to minutes.

Question 19

(a) (i) Candidates were mostly correct in this part. Some only gave the horizontal line and others added extra lines, most commonly diagonals.

(ii) In this part, the diagonal lines were often missing or just one diagonal was drawn. Candidates must ensure their lines go all the way across such diagrams so the lines are not too short.

(b) Common incorrect quadrilaterals given were square, parallelogram and trapezium. Other words or phrases such as obtuse angle, diamond, hexagon, pentagon, rectangular prism, cylinder and cube were also seen. Candidates need to know that quadrilateral refers to a four sided two dimensional shape so that the answer cannot have more than four sides or be three dimensional.

Question 20

This was one of the more straightforward mapping diagram questions. The vast majority gave the correct answer for *k.*

Question 21

(a) Many candidates wrote down the correct co-ordinates for point *P*. Only the occasional reversing of the co-ordinates was seen.

(b) These last two parts proved challenging for candidates and were most likely to have been left blank. A few used the formula with two points from (–2, –4), (0, –1) and (2, 2) for finding the slope but made numerical errors with the negative signs. Only a few attempted a rise ÷ run calculation based on a triangle drawn on the graph. Some tried to use the whole line with an answer of $\frac{8}{5}$ using (3, 4) as the top most point which is not on the line. Some showed no working and just gave an answer such as 2 or 3.

(c) Candidates were not confident with the process for finding the equation of the line. Not many equated the *m* in the equation with the slope they had found in the previous part. The remaining value, *b*, is where the line crosses the *y*-axis, in this case, –1. Some candidates reversed these values when substituting. An answer of $y = 1.5x + –1$ did not gain full credit as the signs had to be resolved into $y = 1.5x – 1$.

Question 22

(a) Most incorrect answers were from dividing by the wrong power of 10 as answers such as 3.67 and 367 were often seen but there were also numerically larger numbers than the given value, such as 36 700 which might indicate that candidates were not completely familiar with the relationship between meters and centimeters. Some answers had completely different figures such as 4000, 1835 or the correct value rounded to 37.

(b) (i) This part was very well answered with candidates gaining partial credit for accurately measuring the distance between the towns when the actual distance they calculated was incorrect.

(ii) This part was often missed out by candidates. Incorrect answers included 44° (the angle from north towards *S* anticlockwise), 7.8 cm, the distance between *S* and *T* on the scale drawing or a compass direction.

MATHEMATICS (US)

Paper 0444/21
Paper 2

Key messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae and definitions and show all working clearly. They should be encouraged to spend some time looking for the most efficient methods suitable in varying situations.

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

General comments

The level and variety of the paper was such that candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as most candidates attempted the whole paper.

Working was generally well set out. Candidates should ensure that their numbers are distinguishable, particularly between 1, 7, 4 and 9 and always cross through errors and replace rather than try and write over answers.

Candidates showed good number work in **Questions 11** and **13** and demonstrated sound algebra skills in **Questions 5**, **14** and **21**.

Candidates found challenging volume scale factor in **Question 18**, trigonometric functions in **Question 20**, functions in **Question 23** and vectors in **Question 24**.

Comments on specific questions

Question 1

The majority of candidates could find the required percentage. Some tried to find 16 as a percentage of 12 and occasionally $\frac{12}{16}$ was found but the result was not converted to a percentage. The majority of errors came from trying to divide 12 by 16 which many were attempting to find in a division sum.

Question 2

This question on factorisation was answered fairly well by candidates. A few added superfluous elements to their factorisation such as a 1 in front of y, which was condoned. Some divided by y rather than factorising and others had elements outside the bracket which were not in both terms of the expression.

Question 3

This question was well attempted, with the majority of candidates gaining at least 1 mark. The vast majority knew to square the 9 and the 3 first. It was fairly common to see an arithmetic error in 6×9 and a method error at this point was to subtract 6 from 81, giving 75×9. Many got to 27 and then forgot that this needed to be cube rooted and others left the answer as $\sqrt[3]{27}$.

Question 4

This question was well attempted by more able candidates. Many candidates gave an incorrect answer of 60 having calculated $180 \div 3$ rather than $180 \div 3^2$. Some candidates incorrectly assumed that the solid was a cube and so gave the answer 3.

Question 5

Candidates demonstrated a good knowledge of the rules of indices with the majority giving the correct simplifications, particularly in **part (b)**. The most common incorrect answers were t^3 and u^{10}.

Question 6

Many candidates understood that they needed to use trigonometry to find the side of the triangle and a good number gained a mark for applying the correct relationship, showing $\sin 30 = \frac{x}{12}$. Very few could then evaluate sin 30 and so candidates must be made aware of the trigonometric ratios which they are expected to know. Some knew the relationship between the lengths of sides for a triangle with these angles and so reached the correct answer this way.

Question 7

A minority of candidates were able to correctly calculate the required angle. Many candidates gave an answer of 130°. Candidates sometimes referred to the opposite angle of a cyclic quadrilateral, but used this incorrectly with the centre as one of the vertices of the shape; hence 50° was a common incorrect answer. Some candidates worked out $2 \times 130° = 260°$ but did not recognise that this would be the reflex angle and gave it as their answer.

Question 8

Very few candidates were able to give the correct simplification of the surd calculation. A small minority gained 1 mark for multiplying out the brackets correctly but by far the most common answer was 5 from candidates only considering $(\sqrt{3})^2 + (\sqrt{2})^2$ or combining the two roots to make $(\sqrt{5})^2$.

Question 9

Many candidates understood how to deal with the function and gained at least 1 mark, even if there were then errors in the simplification. The most common error in the method was to equate $1 - x$ with the function and solve for x.

Question 10

More able candidates demonstrated sound understanding of probability and were able to obtain the correct answer. Many candidates did not understand the significance of the phrase ‘without replacement’ in the question and an answer of $\frac{4}{25}$ was often seen. It was also common to see the answer $\frac{2}{5}$, the probability of an even number being picked from the 5 cards.

Question 11

Candidates clearly understood the definitions of different types of numbers and there were very few incorrect choices in all parts of the question.

Question 12

There were very few candidates who recognised the format of completing the square and could find the values of *a* and *b*. A small number knew that the value of *a* was 2 but then did not know how to proceed to find *b*. Some gained a mark for expanding the right-hand side of the equation correctly but then did not know how to relate this to the left-hand side and compare coefficients. The incorrect expansion of the right-hand side to $x^2 + a^2$ was often seen. Some decided to subtract *b* and then square root the left-hand side without any expansion of $(x+a)^2$ which made the necessary comparison of like terms impossible.

Question 13

Candidates demonstrated a good knowledge of dealing with fractions in this addition. A significant number of candidates did not gain the final answer mark, as they left their answer as an improper fraction, usually $\frac{3}{2}$, or converted to a mixed number but forgot to simplify the fractional part. Candidates should be encouraged to look for the most efficient ways of dealing with fractions; in this case just converting $\frac{2}{3}$ into $\frac{4}{6}$. Although correct, it was extremely common to see denominators of 12, 18 and 24 which ultimately leads to more arithmetic errors and is more time consuming.

Question 14

A sound understanding was demonstrated dealing with this expansion and simplification. The majority of candidates were able to gain at least 1 mark even if errors were made. Errors in the double bracket expansion tended to involve a missing term or a value of 3 rather than 2. The most common error in the single bracket expansion was to omit the x from $-6x$ or to ignore the negative sign and make it positive. There were some errors collecting like terms, some of which could have been rectified with careful checking. Method errors at this point involved multiplying the x^2 terms to make $2x^4$ and some looked to try and factorise the expression back into two brackets.

Question 15

It was only a small proportion of the more able candidates who had a strategy to attempt this question on inverse proportion. The vast majority simply substituted one of the given values of *x* into $x+1$, $\sqrt{x+1}$, or the reciprocal of these.

Question 16

This question proved challenging for candidates. The majority did not recognise the expression in **part (a)** as the difference of two squares. Candidates attempting to factorise often gave the answer $(p+q)(p+q)$, whilst others resorted to combining terms incorrectly, resulting in expressions in pq or p^2q^2 or similar. **Part (b)** of this question could either be attempted by using the answer to **part (a)** or by attempting to solve simultaneously. Where candidates had a correct factorisation in **part (a)** not all of them recognised how this could be used to answer **part (b)**; where they did identify the connection, the answer was generally correct. Candidates who did not have a correct factorisation in **part (a)** or who did not identify the connection between their factorisation and **part (b)** often tried to solve the equations simultaneously. Some did this successfully; others were able to get as far as $(2+q)^2 - q^2 = 7$ or $p^2 - (p-2)^2 = 7$ but did not know how to proceed. Many took a trial and error approach, often arriving at an answer of 7 using the first equation only, finding $p = 4$ and $q = 3$.

Question 17

There were some completely correct answers to the simplification in **part (a)** and a reasonable proportion gained one mark, usually for an answer of $81y^{12}$ where candidates were unaware that the power also applied to 81. Those who did deal with 81 correctly sometimes showed some manipulation of the number, either by writing it as 3^4 before raising it to the power of $\frac{3}{4}$ or they showed that the 4th root was 3 before cubing it, but the majority appeared to go straight to their calculator. It was the ability to manipulate powers which helped in

part (b) and this was carried out very successfully. Those who changed 4^p to $\left(2^2\right)^p$ were more successful than those who evaluated 2^3 to 8 who then often did not know how to proceed.

Question 18

Volume scale factors proved to be one of the most challenging topics on the paper. Candidates need to understand that a length scale has to be converted when working with a volume or area. The majority of candidates used a linear scale factor and divided 8 by 20. Conversion of units was more successful and if a method mark was awarded, it was usually for a correct multiplication by 100^3 to give an answer in cubic centimetres.

Question 19

Some of the more able candidates were equipped with a correct starting point, where they usually earned a mark for a correct denominator. It was also relatively common to award 2 marks when a correct common denominator and numerators for both fractions were shown. This was often followed with a sign error when dealing with the $-2(x+2)$ part of the numerator, leading to the incorrect answer of $\frac{x+3}{(x+2)(3x-1)}$. Those who tried to deal with the subtraction as one fraction straight away often made this error and could not gain the mark for a correct numerator and so candidates should be encouraged to show this intermediate step in the working. Care should be taken with all signs in the expression as there were many cases of a plus erroneously becoming a negative and vice versa. Candidates should also take care with brackets and be aware that $x+2(3x-1)$ is not the same as

$(x+2)(3x-1)$. Some candidates who correctly multiplied the numerators and denominators by the appropriate expressions to give fractions with a common denominator then cancelled these back again before expanding brackets. Following a completely correct method to arrive at a single fraction, it was fairly common to then see terms being cancelled incorrectly; for example cancelling an x seen as part of an expression in the numerator with an x seen as part of an expression in the denominator. Less able candidates sometimes resorted to merely adding or subtracting terms in the numerators and in the denominators.

Question 20

In **part (a)** some candidates knew that the amplitude was 4 but very few could find the period of the function. Common responses were 4 sin for the amplitude and 3*x* for the period. Very few candidates possessed the necessary skills to answer **parts (b)** and **(c)**. These parts of this question had the highest rate of blank responses on the paper.

Question 21

Almost all candidates could give the next term in the sequence in **part (a).** Finding the expression for the *n*th term was more challenging. Those who did not score were typically offering $n+3$ as the answer. Some were confusing values in the general formula; a check to see if their formula produced the required values would have been beneficial. **Part (b)** was carried out successfully by the majority. Any errors were usually made in the numerator, with 29 or 33 being the most common. Some did not appreciate that different sequences were being used to generate the numerator and denominator.

Question 22

More able candidates could usually make some progress with this question, even if they could not make the step from the working to the final answers. More candidates gained the method mark for showing the correct working to find the area of the sector than for the triangle, perhaps not realising that this needed to be subtracted to find the shaded area. Despite the question giving an expression in terms of π, it was common to see lots of multiplications involving 3.14, either from a correct statement for the area of the sector or from other circle formulae which were being used. Many candidates thought this question involved finding the lengths of the arc and the hypotenuse of the triangle; others wrote down formulae relating to circles but could not apply them to the question.

Question 23

Few candidates were familiar with the terms domain and range in **part (a)**. Some demonstrated some knowledge, but used inequalities, not appreciating that a domain and range can be distinct values, as was the case in this question. Slightly more candidates understood the effect on the function in **part (b)** with some gaining 1 mark, usually for recognising it as a translation. It was common to see the translation being given as $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$. There was a high rate of blank responses in both parts of the question.

Question 24

It was only the most able candidates who made any reasonable attempt at this question. Candidates should be encouraged to show clearer working in vectors questions, particularly showing a route, which would gain credit and focus the candidate on the direction of the vector. It was common to see the correct fractional lengths of the vectors on the diagram and in the working. However, without a clear route written down or arrows on the diagram, the direction of *KB* or *BL* or *KC* or *AL* was often incorrect in **part (a)**. Finding the proportion of *CB* that covered either *CK* or *KB* proved challenging for less able candidates. A position vector was required in **part (b)** and it was clear that a large proportion of candidates did not understand this term. It was common to see the answer as half of the answer for **part (a)**. Again, the direction of different parts of the route was often incorrect. Arithmetic errors were sometimes made when dealing with the fractions and signs when simplifying, but those who set out their working clearly were able to gain a mark for a correct route.

Question 25

Many candidates demonstrated a good understanding of equations of straight lines with many completely correct answers given, particularly in **part (a)**. Even where errors were made, there was the opportunity to gain part marks within each part of the question. Errors were often made in calculating the gradient in **part (a)**, often through dealing with the negative value incorrectly, but as long as the correct working was shown, 2 marks were still available. Non arithmetic errors in finding the gradient included calculating the difference in x divided by the difference in y; inconsistency in which co-ordinate was being subtracted; and mixing up x and y values within the calculation. Candidates should be aware that they may be given a $(0, y)$ co-ordinate and that the value of y is the intercept of the line. Many candidates substituted the value of the gradient into the general equation of a line to find the intercept which was unnecessary, and if the gradient was incorrect, led to an incorrect intercept if point $(6, 9)$ was chosen. Many did gain the mark available for giving an equation $y = mx - 3$, even if the gradient was calculated incorrectly. Less able candidates struggled to find the perpendicular bisector in **part (b)**, with many not attempting the question. A good proportion understood the relationship between a straight line and its perpendicular, and many gained both marks for either the correct answer, or following through correctly from an incorrect gradient in their equation for **part (a)**. A common error was to only apply half of the relationship between the gradients, and so give either the reciprocal or the negative value of the gradient. Again, any further working was unnecessary as the point $(0, 2)$ was given, and many gained a mark for recognising this and using it correctly within an equation.

MATHEMATICS (US)

Paper 0444/31
Paper 3

Key messages

To be successful in this paper, candidates had to demonstrate their knowledge and application of various areas of mathematics. Candidates who did well consistently showed their working out, formulas used and calculations performed to reach their answer.

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. Few candidates omitted part or whole questions. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed and emphasise that in show questions candidates must show every step in their calculations and not start with the value they are being asked to show.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Attention should also be paid to the correct presentation of a length of time rather than the time of day. Candidates need to be encouraged to make it clear that a length of time differs from the time of day through the use of notation i.e. a length of time should be in the form … hours and … mins or correct decimal form rather than written as a time of day e.g. 7:30 or 7 30.

Candidates should also be encouraged to process calculations fully 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.

The standard of presentation was generally good; however candidates should be reminded to write their digits clearly and to make clear differences in certain figures. A large number of candidates write the digits 4 and 9 identically and similarly 0 and 6 and 1, 2 and 7. Many candidates also overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite. There was evidence that most candidates were using the correct equipment.

Comments on specific questions

Question 1

(a) The best solutions to ordering a list of decimals, percentages and fractions showed comparison of each by converting to decimals (or percentages). Candidates who did this before ordering generally were successful in gaining full credit. Often candidates who did not convert to decimals only gained partial credit, with one value out of order. All candidates attempted this question.

(b) A small majority of candidates correctly identified the smallest prime number to be 2. Many candidates however thought it was 1, 3, 5 or 7.

(c) Most candidates achieved full credit by giving a full list of factors of 18. The most common error was the omission of 1, 18 or both, with some candidates also including 4 as a factor. A few less able candidates wrote a list of multiples instead of factors.

(d) Candidates were more successful at identifying a common factor of 16 and 72 as either 4 or 8. Successful candidates often wrote a complete list of factors for both 16 and 72 and then identified the common factors.

(e) Most candidates correctly simplified the fraction fully. However a significant number of candidates showed understanding of simplifying but did not cancel fully and left their answer at $\frac{7}{35}$ or $\frac{2}{10}$. A few candidates gave the answer of 0.2, which again demonstrates the importance of reading the question fully as it clearly indicates that their answer must be a fraction.

(f) Finding the value of the prize proved to be the most challenging part to this question. The best solutions showed full working out, showing division by 5 and then multiplication by 11. The most common error involved candidates finding $\frac{5}{11}$ of \$160, which led to the common incorrect answer of 72.72. This question again demonstrates the importance of not rounding prematurely in candidates working. Some candidates showed that they understood that they needed to divide by $\frac{5}{11}$ but found $\frac{5}{11}$ as a decimal and then rounded it to 0.45. This therefore led to the incorrect answer of $\frac{160}{0.45}$ = 355.55. Candidates who showed where 0.45 had come from gained a method mark but just $\frac{160}{0.45}$ gained no marks as full working was not seen.

Question 2

(a) Nearly all candidates successfully found the amount. This question proved to be one of the best answered of the whole paper.

(b) The vast majority of candidates found the correct change. Few incorrect answers were seen with the most common being not calculating the change but just the cost of the coffee and two biscuits (\$5.10). It is important for candidates to read the question having done a calculation to ensure that the question has actually been answered.

(c) (i) This part proved to be very successfully answered by nearly all candidates. Most candidates showed their multiplication sum and demonstrated that they could use their calculators correctly.

(ii) This part proved very challenging for all candidates. The best solutions showed good understanding of the context of the question and showed full working out to calculate the amount Harriet was paid for the extra 8 hours and added this to their answer from the previous part. The most common incorrect answer given was \$519.75, as candidates added 8 to 34 and calculated all 42 hours at time-and-a-half. Many candidates did not reach the correct final answer but gained partial credit for correctly finding the pay for the 8 hours (\$99) but did not add it to their previous answer. A significant proportion of candidates used the correct full method but did not gain full credit because they rounded prematurely (1.5×8.25 rounded to 12.38 or 12.4 or truncated to 12.37) which led to answers of 99.04, 99.2 or 98.96 instead of 99 for the extra 8 hours. In most cases candidates were still able to gain partial credit as they had shown their working out clearly.

(d) Most candidates understood that they were required to find the number of hours worked each day and then to add these together. Although most candidates attempted this method, only a small majority correctly found the total number of hours to be 33 due to errors in writing length of time in the correct format. The most common error saw candidates writing 7 hours and 30 mins as 7.3 or 7.30 instead of the correct decimal form of 7.5 hours. This often led to errors when adding their times together.

(e) The majority of candidates correctly identified that they needed to divide by the exchange rate although many candidates did not gain full credit due to errors in rounding. The question indicated that their answer had to be 'correct to the nearest cent' so answers of 85.2 did not gain full credit. Most candidates showed their working out which allowed them to gain a method mark if they could not do the division correctly. A few less able candidates incorrectly multiplied by the exchange rate. This led to an answer of $1 035 986.65. Candidates should consider the size of their answer and whether it is sensible in relation to the context of the question.

(f) This part on calculating compound interest challenged all but the most able candidates. Many candidates were successfully able to quote the correct formula to calculate compound interest with many then able to substitute the correct figures. Many candidates attempted to find simple instead of compound interest.

Question 3

(a) (i) Completing the bar chart involved a number of steps which most candidates did not show in their working out although many candidates did draw a bar of correct height of 6. Candidates had to correctly identify the heights of the 3 given bars and then subtract this total from 40 to find the height of the bar for senior tickets. Candidates who showed this working out gained full marks but few candidates showed any working out so gained either full marks or no marks, depending on if they drew a bar of the correct height.

(ii) All candidates attempted this question and it proved to be the most successfully answered part of this question.

(iii) Many candidates found the correct probability. Candidates should be reminded that probabilities must be given as fractions, decimals or percentages and not ratios or in words.

(b) (i) All candidates gave the correct range.

(ii) Candidates successfully found the median of the list of numbers. Candidates gained full marks by writing an ordered list and then correctly identifying the middle value. The most common incorrect answer was 31 from the middle value of the original list (unordered).

(iii) Candidates correctly found the mean. Most showed their working out and those who did not gain full credit usually made an arithmetic error in addition, but still gained partial credit if the addition had been shown in the working.

(c) Completing the dot plot was successfully completed by all candidates. Candidates were able to give the correct number of dots for each type of ticket.

(d) Explaining the meaning of continuous data was extremely challenging for candidates. Correct answers needed to demonstrate understanding that continuous data is measured and that there are no gaps. Common errors were to comment on the dot plot rather than the actual question.

Question 4

(a) Most candidates correctly found the acute angle at *C* to be 62 and then went on to recognise the isosceles triangle and then found the value of *a* to be 56.

(b) Calculating the interior angle of a regular 10-sided polygon proved to be one of the most challenging questions on the paper with many candidates not attempting the question. Successful solutions followed one of two methods: finding the exterior angle by dividing 360 by 10 and then subtracting the answer from 180, or finding the sum of all interior angles $(10 - 2) \times 180$ and then dividing by 10.

(c) A small majority of candidates correctly applied the circle theorems. Few candidates marked the angle at *F* as 90° on the diagram but most candidates who gained one or two marks used 90° in their working. The most common error was to assume that *x* and *y* were equal and therefore the answers of 32 and 32 were often seen.

(d) This part proved to be very challenging for all but the most able candidates. Many were able to identify angle *CED* as 28° but very few candidates were able to give the correct reason with the correct wording. A common error was to state that the angles were corresponding instead of alternate.

(e) (i) Finding the length was well answered by the majority of candidates who correctly identified that they needed to use Pythagoras' theorem. Good solutions showed all working, including squaring, adding and square rooting. Some candidates identified Pythagoras' theorem but subtracted instead of adding or made errors when using their calculator despite writing down the correct method.

(ii) The use of trigonometry is a challenging area of mathematics which candidates answered very well. The most common method was to use cosine to find the length of *SU*, although sine could be used with the angle of 70°.

Question 5

(a) (i) Most candidates identified the need to add the algebraic terms to find the perimeter of the rectangle. However many did not gain full credit as they did not write their solution in its simplest form. Common incomplete simplifications were $7a + 7a + 2a + 2a$ or $14a + 4a$ or $2(7a + 2a)$.

(ii) Candidates identified the correct method to find the expression for the area of the rectangle but many gained partial credit for showing $7a \times 2a$ but not simplifying to $14a^2$.

(b) Candidates gained full credit by identifying the first three terms of the sequence. Little working out was seen, especially from candidates who did not gain any marks. Common incorrect answers were 5, 10, 15; 2, 7,12; 6, 11, 16; 5, 25, 625; or 25, 625, 390 625. Candidates who used the *n*th term correctly but started with $n = 0$ gave 5, 6 and 9 as their answer.

(c) (i) Few incorrect values were seen; the only common error was an omission of a minus sign.

(ii) There was good plotting of points with very few straight lines joining points seen and even fewer thick or feathered curves drawn. Common errors were to draw the curve beyond $x = 1$ or $x = -1$, or plotting at (0.5, 12) instead of (1, 12).

(iii) Most candidates correctly drew the line $y = 8$ on their graph. It is important to remind candidates that all straight lines must be ruled.

(iv) Finding the solution to the equation was well answered by candidates. However, the majority of correct answers came from calculation rather than reading the intersection from their graph.

Question 6

(a) Candidates were able to plot two or more of the points. However a significant number of candidates did not attempt this part of the question. Candidates showed little difficulties with the scales of the axes but candidates lost marks for inaccuracies of plotting.

(b) Candidates identified the correlation as positive.

(c) Identifying the point representing the person who had a high score in speaking and a low score in the written test was very well answered by all candidates.

(d) Many candidates were able to draw an acceptable line of best fit. The most common incorrect line simply joined the corners of the grid. Less able candidates often joined all the points with straight lines.

(e) Most candidates gave a score for the written test within the acceptable range. Many candidates correctly used their line of best fit to gain a follow through mark.

Question 7

(a) Good answers contained all three parts to describe a rotation, including degrees and direction and centre of rotation. The most common error was to omit the centre of rotation or give the wrong direction. Less able candidates could correctly identify the transformation as rotation but often did not give the centre or angle or direction. A number of candidates described more than one transformation.

(b) Good solutions in this part contained the correct transformation, enlargement, and the correct scale factor and centre. The most common error was to omit the centre of enlargement or give the wrong scale factor. Again a significant number of candidates described more than one transformation.

(c) Many candidates were able to translate the shape correctly. Many less able candidates did not attempt this part or translated in the wrong direction, often one left and three up. Some candidates translated the square and not the 'flag stick' and therefore not the whole shape.

(d) Many candidates were able to correctly reflect the shape in the line $y = 1$. Common errors were to reflect in the x-axis or a different line in the form $y = k$.

Question 8

(a) This question is a 'show that' question so candidates must show all their working and not use the given answer in their working. Good solutions usually showed calculation of the area of the circle first and then multiplied by the height to find the volume. The most common error was to use 113… but not clearly show where this had come from. Candidates had to show $\pi \times 6^2$ for it to be classed as full working. Those who did show the correct method sometimes did not gain full credit as they did not show the unrounded result which rounds to 1923. This question proved to be very challenging to many candidates.

(b) Calculating the shaded area proved challenging for all but the most able candidates and a large proportion of candidates did not attempt it. A large variety of successful methods were seen. The most common method used was to find the area of the semi-circle, find the area of the half square and then subtract them. However an alternative method involved finding areas of the whole circle, the whole square, subtract and then halve their answer.

Question 9

(a) Most candidates were able to correctly simplify the expression. Some common incorrect answers were $6a + 2b$, $6a - 4b$ or $10a + 4b$.

(b) Candidates successfully substituted the given values and found the correct answer. A common error when substituting $x = 3$ into $4x^2$ was working out 12^2 not 4×3^2. Also the 3×-2 often became 3×2 or $3 + -2$. This led to answers such as 138, 42 or 37, although if the correct full substitution was shown the candidate gained partial credit.

(c) (i) Candidates solved the equation correctly. The most common error was $x = \frac{20}{4} = 5$.

(ii) Solving the two step equation was also successfully done by the candidates. Errors can come from the first step where candidates subtracted 5 from 16 instead of adding, hence leading to the incorrect answer of $\frac{11}{3} = 3.66…$

(iii) Good solutions showed each step of the working, usually by expanding the bracket first, subtracting 5 and then dividing by 10. The alternate method of dividing by 5 first was also seen completed correctly. Some used a substitution to show that 2.2 was the correct value of x.

(d) Solving for r proved to be the most challenging part of this question. Candidates who recognised the correct first step usually then went on to gain full credit. The most common errors were to subtract 5 from p or attempt to divide by 3 with errors (usually $\frac{p}{3} = r - 5$).

Question 10

(a) Successful solutions showed all construction arcs and used a ruler, pencil and pair of compasses. Common errors involved drawing the line *BD* for the angle bisector and not using a compass or showing construction arcs to draw the perpendicular bisector of *AB*.

(b) Candidates were successful in measuring the angle *DXC*. Good use of a protractor was demonstrated by candidates and candidates were able to gain the mark as a follow through if their drawing in **part (a)** was incorrect.

MATHEMATICS (US)

Paper 0444/41
Paper 4

Key messages

Candidates sitting this paper need to ensure that they have a good understanding and knowledge of all of the topics on the extended syllabus.

Candidates should not cross out their working and just give an answer on the answer line. The method needs to be seen clearly to enable method marks to be awarded.

Unless directed otherwise, candidates should give answers correct to at least 3 significant figure accuracy. This often requires candidates to retain numbers in their working that are more accurate than 3 significant figures otherwise premature approximation is likely.

General comments

Many candidates demonstrated that they had a clear understanding across the wide range of topics assessed. The majority of candidates attempted most questions on the paper.

The presentation of some candidates' work made it very difficult to follow their thought processes. By setting their work out in a clearer order, some candidates may make fewer slips and mistakes. Some candidates wrote over their answers which made it difficult to know which number is actually written and whether a sign is a plus or minus sign.

For questions involving algebra, candidates are advised to complete each step on separate lines, rather than trying to do more than one step on the same line. Marks in algebra are generally awarded for individual steps clearly seen.

Candidates should ensure that they know how to convert between different units when working with lengths, areas and volumes.

Candidates need to read the questions carefully. In particular, when worded questions have been completed candidates should read the question again to ensure that they have a sensible answer and one that precisely answers what is asked.

Comments on specific questions

Question 1

(a) (i) The translation of shape *T* was done very well. The most common errors seen were translations that were correct in only one of the two directions or translations by $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$. Some candidates were muddled between counting half squares or whole squares because they had not looked at the grid carefully enough.

(ii) The rotation of shape *T* was again done very well. The most common error seen was a rotation through 180° but with an incorrect centre, usually (5, 2).

(iii) Most candidates were able to state rotation and give 180°. The centre of rotation caused the most problems with (4, 6) or (5, 6) the most common errors. Some candidates chose to describe the transformation as an enlargement but had problems with the centre and also often did not give a negative enlargement. Candidates who described the transformation using more than one transformation, for example a rotation and translation, did not score as a single transformation was specifically asked for.

(b) (i) Candidates who first drew the line $y = x$ were generally successful in drawing the reflected shape correctly. Candidates who did not draw $y = x$ often drew shapes that were distorted and not similar to *T*. A common error was to draw, and then reflect in, the line $y = -x$.

(ii)(a) Many correct answers were seen. Common incorrect answers included 90° clockwise or 180°.

(ii)(b) A significant number of candidates did not offer a response to this part. Of those who gave a response, only a small minority answered it correctly. Common incorrect responses included other equations of lines parallel to the *y*-axis or the *x*-axis.

Question 2

(a) Most candidates completed the table correctly.

(b) The quality of the curve drawing was very high with curves seen passing through the correct points. Candidates read the scales carefully and plotted the non-integer values of *y* generally very accurately. The most common errors seen were the mis-plotting of either (−3.5, −4.1) at (−3.5, 4.1) or (−3, 2) at (−3, −2) which gave the curve the wrong general shape. Only a few candidates used a ruler or had curves that were not smooth.

(c) Many candidates correctly gave the value of *x* where the curve crossed the *x*-axis with acceptable accuracy.

(d) Although there were a small number of correct lines and answers given, this part proved challenging with many candidates omitting to attempt this part. Various strategies were seen for finding the solution, many algebraic, some drawing the curve $y = x^3 + 3x^2 + 2x + 2$ and some using their calculator. However, the question required a suitable straight line to be drawn and evidence of the line $y = -2x$ being drawn or stated.

(e) Whilst some candidates were successful in giving a correct value for *k*, there were as many who did not attempt to answer this part. Common errors seen included giving the answer 2 or 6, or non-integer answers.

Question 3

(a) Most candidates recognised that Pythagoras' theorem could be used and many were successful in using it to obtain at least one of 80 and 130. Candidates who used longer alternative methods involving trigonometry often made errors with premature approximating. Other common errors included adding the internal lengths *AD* and *BD* as part of the perimeter or using Pythagoras' theorem incorrectly, for example, calculating $DC = \sqrt{150^2 + 170^2}$.

(b) Candidates needed to use the cosine rule in this part and many were successful. Of those using the cosine rule, a common error was to see $120^2 = 100^2 + 150^2 - 2 \times 100 \times 150 \cos ABD$ written correctly, followed by $14400 = 2500 \cos ABD$. Others incorrectly assumed that angle $DAB = 90°$.

(c) (i) Most candidates used a correct trigonometrical ratio and went on to write 28.07….and then 28.1°. Candidates should be aware that angles are required to be given to 1 decimal place accuracy and that 28° alone is not accurate enough. A few candidates were successful in using longer alternative methods, such as the cosine rule.

(ii) Candidates who considered this question by marking their 28.1° angle on the diagram often correctly evaluated $360° - 28.1°$. Common errors included attempting reverse bearing type calculations such as $180° + 28.1°$. Also, because *C* was stated as due north of *B*, many other candidates gave answers such as *D* is north-west of *B.*

(d) Candidates were generally successful in working out the areas of triangles *ADE* and *BCD*. Triangle *ABD* was more challenging and required a method akin to $\frac{1}{2} \times 100 \times 150 \times \sin ABD$. A common error was to again assume that angle $DAB = 90°$ and simply to calculate $\frac{1}{2} \times 100 \times 120$, or to assume that the perpendicular height of triangle *ABD* bisected side *AB*.

Question 4

(a) (i) To score full credit in this question, candidates needed to assign their numerical answers to the correct statistical word. Whilst the majority of responses showed the range came from $27 - 20$, only those who evaluated this as 7 were awarded the mark. The mode was successfully found by most candidates. The method for the median was frequently seen either by a list of 14 correctly ordered scores or by 22 and 23 selected. Candidates generally calculated the mean accurately, providing an answer correct to at least three significant figures.

(ii) Most candidates answered this correctly. Common errors included $\frac{1}{14}$ and $\frac{3}{13}$. Candidates who gave 0.21 as their most accurate answer did not score.

(b) This question proved challenging, with few candidates able to work out what to do with the scores when given to them algebraically. Some were successful in starting with the expression $(n-1)(x+1)$ but were unable to proceed any further. Others incorrectly assumed that the ratio of the means and scores would be equivalent and tried to set up an equation to solve.

(c) (i) The mean from the grouped frequency table was generally worked out carefully and accurately. Although the odd slip was made, usually when selecting the mid-interval values, most candidates showed clear working and they were consequently frequently awarded the method marks. The most common conceptual error seen was the multiplication of the number of days by the class width rather than by the mid-interval values.

(ii) Many candidates gained full credit on this question. Others gained partial credit for correctly drawing the 3rd and 4th bars but not dividing the frequencies for the 1st and 5th groups by the class width of 10. Some candidates didn't use a ruler and their bars did not follow the grid lines accurately enough.

Question 5

(a) Almost all candidates recognised that they needed to split the area into regions and most correctly worked out the area of the rectangle as 3×1.2. The area of the semi circles however was not always completed correctly. The most common errors included using 1.2 as the radius or using the wrong formula for the area of a circle. Premature rounding of the 1.13 to 1.1 and then evaluating $1.1 + 3.6 = 4.7$, caused candidates not to gain the final accuracy mark.

(b) Whilst some candidates were successful with this part, the majority of candidates were unable to deal with the variety of units involved. Most candidates multiplied their area by 20 or 0.2 but incorrect conversions such as 20 cm = 0.02 metres and 100 cm^3 = 1 litre were commonly seen. Other candidates did not use their previously found area and tried to restart the question, more often than not making errors or only considering the rectangular section of the pond.

(c) There were many different methods that could be used to answer this question but most involved two unit conversions. Some candidates were successful with their chosen approach. As with the previous part, many candidates could not convert from litres to cm^3 or m^3 correctly. In addition, many candidates were not sure whether they should be multiplying, dividing, adding or subtracting the various numbers. The easiest way to complete this part, used by a minority, was to consider the ratios $\frac{x+20}{1007} = \frac{20}{946}$ and solve directly for x, avoiding any unit conversions. This question had a high number of candidates who offered no response.

Question 6

(a) (i) Whilst many candidates were successful in first evaluating s as 1991.475, a variety of errors were seen. Some candidates misread the given values, for example, some omitted the minus sign or decimal point from the -2.2. Others evaluated $(at)^2$ rather than at^2. Having obtained a value for s, only a minority of candidates both rounded their value correctly to 4 significant figures and gave it in standard form. Common errors included rounding incorrectly, rounding to 4 decimal places rather than 4 significant figures, having an incorrect power of 10 or writing an incorrect answer on the answer line, in standard form with 4 significant figures, but with no evidence as to where it had come from.

(ii) Whilst there were clear rearrangements seen by some candidates, many candidates scored zero or one mark on this question. Common misconceptions seen included not multiplying each term by 2, dividing by ut rather than subtracting ut and square rooting both sides rather than dividing by t^2.

(b) (i) A large number of candidates were able to produce algebraically accurate workings to reach the required result. Candidates generally showed clear products for the areas of the two rectangles and often formed a correct equation relating their difference to 62. The most common errors included slips with minus signs, particularly when brackets were removed or multiplied out or omitted in error.

(ii) A large number of candidates were able to factorise the expression correctly. The most common errors were sign errors within either or both of the brackets.

(iii) Very few candidates were able to make the connection between **part (b)(ii)** and this part. Most candidates attempted to solve the quadratic afresh by either completing the square or using the quadratic formula. Having then obtained the answer 7, it was evident that few candidates had read the question carefully as many made no further progress. Of those who did substitute 7 back into the rectangle lengths, only a minority obtained the correct difference in perimeters. The common errors included arithmetic slips, finding areas rather than perimeters or only getting as far as working out the lengths.

Question 7

(a) The crucial part of this question is to divide by the original cost, \$2.50. In fact, most candidates started this question correctly by calculating $\frac{2.65}{2.5}$. Whilst many candidates went on from here to arrive at the correct answer of 6%, it was common for candidates to go no further than giving final answers of 1.06, 106, or 0.06. Other candidates merely subtracted the two costs to get 0.15, which was not far enough to score.

(b) Some candidates worked out the correct value of the investment. Other candidates worked out the correct interest as \$105 but did not go on to find the total value of the investment, \$605. The other most common errors were to omit to divide the 1.5 by 100 or to use compound rather than simple interest.

(c) Whilst some candidates completed this question correctly, many candidates used the formula for simple rather than compound interest. Of those using the compound interest formula, some used 1.5 instead of 0.015.

(d) Of those candidates who set up an equation of the form $500 \times x^{14} = 586.80$, most usually went on to find the 14th root. The main errors seen arose from trying to add or subtract 1 before rooting the answer or from premature approximation. Candidates who did not score had generally started incorrectly, sometimes with simple interest or were just guessing interest rates and evaluating.

Question 8

(a) Many candidates did not recognise that this question required using the quadratic formula even though the answers were required to 2 decimal places. Consequently some candidates tried to complete the square, with rare success, and others tried to factorise with no success. Of those using the formula, a variety of errors were seen such as short square root signs, short fraction lines and slips with negative signs. Candidates who did not show clear substitution, or who showed $\frac{-3 \pm \sqrt{41}}{4}$ with no prior steps, or who used a calculator, could only score partial credit.

(b) (i) This was a more unusual equation which tested candidates understanding of algebra. Few candidates realised that the method for solving this equation required firstly collecting like terms before squaring both sides. Some candidates successfully used the substitution $y = \sqrt{x}$ and solved first for y and then for x which was a very perceptive approach to the problem. The most common error was for candidates to attempt to square both sides as their first step. This approach either gave a more complicated equation but more often than not the middle terms were ignored and they incorrectly arrived at $x + 1 = 1 - 4x$ or $x = 0$.

(ii) Only a minority of candidates recognised that the power had to be zero, and for these candidates the question was simple. Other candidates tried a variety of approaches to solve for x including using logs. A handful of these candidates were successful but logs are not on the syllabus and will never be necessary in solving equations of this form.

Question 9

(a) For candidates familiar with functions, this question was straightforward, evidenced by the high success rate. The main errors seen were those who found hg(2) rather than gh(2) or who found g(2)×h(2), as well as arithmetic slips.

(b) Again, this part was well answered with many scoring full marks and others scoring 1 mark for writing $x = 7y - 2$ by changing the x and y or for a correct first step in rearranging, usually, $y + 2 = 7x$. The most common misconception was seen by those who did not understand inverse function notation and stated $\mathrm{f}^{-1}(x) = \frac{1}{\mathrm{f}(x)} = \frac{1}{7x-2}$.

(c) Many candidates started off their response to this correctly by writing $\left(x^2+1\right)^2 + 1$. Candidates generally then attempted to expand the bracket and collect like terms. A very common error was to forget to add the $+1$ back on after expanding. Errors in the expansion were also common with the middle term(s) frequently missing.

(d) Candidates familiar with functions were often able to set up the equation $3^{7x-2} = 81$ and solve correctly. For those candidates not recognising that 81 = 3^4, the equation was more difficult to solve with candidates guessing and substituting values for x or sometimes using logs. Logs are not on the syllabus and will never be necessary in solving equations of this form. Candidates who reached $7x - 2 = 4$ generally reached $x = \frac{6}{7}$, with only a few candidates making slips in this final stage.

Question 10

(a) The majority of candidates gave the correct answer. The most common errors seen were $\sqrt{1000} = 31.62\ldots$ and $\frac{1000}{3} = 333.3\ldots$.

(b) This part was answered well with the correct answer often given. Many candidates were able to score at least the first method mark even if they were unable to correctly rearrange the formula to make x^3 the subject. Common errors included miscopying the given formula as $V = \frac{4}{3}\pi r^2$, or having the correct formula but square-rooting, rather than cube-rooting, in the final step.

(c) This part was more challenging with only a minority of candidates recognising that the perpendicular height, h, needed to be found first, using Pythagoras' theorem. It was very common to see candidates simply using the slant height in the given formula for the volume of a cone. Of those attempting to use Pythagoras' theorem, few were able to correctly work out the perpendicular height as $2x$ because either the squares of the given lengths were added rather than subtracted or because they were unable to square $x\sqrt{5}$ correctly. Nevertheless, some candidates completed this question correctly and produced clear solutions to support all stages of their working.

(d) Most candidates recognised that the product of the three given lengths needed to be used but most overlooked the fact that, because the constant cross-sectional area was a triangle, they also needed to divide by 2. Whether or not candidates had used the correct cross-section, many found it difficult to deal with the $\frac{1}{2}$ appearing in two lengths and the cross-section so that attempts to divide through by one or more of them frequently led to an incorrect equation. Again, some candidates completed this question correctly with clear algebraic manipulation shown.

Question 11

A number of candidates scored full marks on this question and they produced neat and clear solutions to support their working, which was required to be shown. The candidates who were most successful set their working out carefully and kept each part of the journey separate. Some candidates drew timelines to help assimilate the information given.

The question asked for the average speed of the whole of Brad's journey. In order to be able to work this out, candidates needed to realise that they had to find both the total distance travelled and the total time taken for the whole journey.

To find the total distance travelled, candidates needed to find the distance travelled in each of the three parts and add them together. Candidates generally demonstrated good knowledge of distance $=$ speed $\times$ time. Most worked out the taxi ride as 16.5 km and the bus ride as 104 km. The main errors came from premature approximation when converting minutes into hours or because candidates used minutes rather than hours, giving 990 and/or 6240 as their distances. The distance taken by the plane, 6200 km, was more challenging and required finding an arc length. Errors in this came from using the wrong equation for the circumference of a circle or not finding the correct fraction of the circumference or misreading 55.5 as 55. However, many candidates were successful in accurately finding the three distances and a good proportion then added the three distances together to arrive at a total distance travelled of 6320 km.

The journey begins at 16 30 one day and ends at 14 36 the next day. Taking into account the 6 hour time difference the total journey time is 16 hours and 6 minutes. The overall average speed therefore is $\frac{6320}{16.1} = 393$ km/h. A common error was for candidates to work out the times travelling each section of the journey, namely 55 mins, 7 hours 10 mins and 1 hour 36 mins and to work out the total time Brad was actually moving to be 9 hours 41 mins. Candidates who showed working and calculated $\frac{6320}{9\frac{41}{60}}$ were awarded 9 marks.

The most common misconception seen was for candidates to work out the average flight speed as $\frac{6200}{7\frac{1}{6}} = 865$ km/h, then to find the mean of the three speeds, $\frac{18+865+65}{3} = 316$ km/h.