MATHEMATICS D

Paper 4024/11
Paper 1

Key messages

In this paper candidates need to be familiar with the whole syllabus. As it is a non-calculator paper, candidates need to be competent in basic numeracy skills, particularly in multiplication and division of whole numbers as well as decimals, and be able to convert from one form to another. Candidates need to learn necessary formulae and facts. All working should be shown and answers clearly written in the appropriate answer space.

General comments

The majority of candidates had sufficient time to complete the paper and the scripts covered the whole range of marks. The paper gave all candidates an opportunity to demonstrate their strengths.

While many candidates showed clear working, some of the presentation of the answers was difficult to follow and figures such as 1, 4 and 7 and 3, 5 and 8 were sometimes very similar.

Candidates dealt with basic algebra well in the questions on factorising, simplifying and solving simultaneous equations. Some candidates would benefit from improving their skills in the more demanding aspects of manipulating algebra. In particular, candidates had difficulty in managing the expressions when dealing with direct proportion (**Question 7**) and finding the inverse function (**Question 19b**). In **Question 12c**, few were able to apply the rules of indices.

Although candidates generally showed good skills in basic numeracy, some improvement is needed in number topics such as standard form and dealing with problems relating to factors and multiples.

The questions that candidates found most difficult were the speed-time graph (**Question 23**), matrices (**Question 24**) and vectors (**Question 25**).

It is important to read the questions on the paper carefully, especially when instructions are given to write numbers to 1 significant figure, for example, or to give answers in their simplest form.

Comments on specific questions

Question 1

(a) This question was very well answered. A few candidates made an arithmetic error when trying to convert their fraction to a decimal, a step that was not required.

(b) Many candidates reached the correct answer. A few gave the answer as a fraction which was acceptable. A common error was to multiply the digits correctly but then make a place value error and give the answer as 3.9 instead of 0.39.

Question 2

A minority of candidates scored the mark for this part. Many candidates' answers related to the points being scattered rather than referring to there being no correlation. Comments referring to a line not being able to be drawn, often stating the points needed to be colinear, were common incorrect responses.

Question 3

(a) Many candidates recognised the net would form a pyramid. There were a variety of incorrect answers, the most common being a triangular prism.

(b) Many candidates did not know the meaning of the word ‘vertices’. They often counted the number of lines showing on the diagram as 8 for the triangular sides or 12 if they included the square base. A common incorrect answer was 4.

Question 4

(a) The majority of candidates were able to factorise the difference of two squares. Some incorrect answers of $(1 - 6p)^2$ were seen and a few attempted to reverse the terms placing the variable as the first term.

(b) This part was very well answered by the majority of candidates. Those who did not score full marks often managed to score one mark for a correct partial factorisation.

Question 5

(a) Most candidates understood they needed to add 2 hours 40 minutes to the start time of 22 45. There were many correct answers. The most common error was an answer of 1 25 with no indication of “am” or the zero needed for 24-hour clock notation. It was also common for candidates to give answers such as 24 25, 00 25, 25 25 or 24 85.

(b) Many candidates answered this correctly. The majority were able to convert hours and minutes into minutes. Those who reached the correct fraction $\frac{24}{160}$ were able to cancel it to its simplest form. A common error was to divide $\frac{160}{24}$.

Question 6

Candidates made a good effort to convert the numbers into equivalent decimals, or fractions with a common denominator, or to a percentage. Some errors were made in this process. The fraction $\frac{1}{30}$ caused the most problems, often leading to partially correct answers.

Question 7

Most candidates used the correct relationship between the variables for direct proportion and a large majority found the expression for the constant of proportionality. Many went on to derive the correct answer while others got themselves into a muddle, often because they omitted to write the relationship $y = \frac{t}{4}x$. This would have helped to structure the solution in readiness for the second stage. Some were confused by having a letter to substitute rather than a pair of numbers. A few chose to ignore the letter, only working with the values 2 and 4.

Question 8

Less than half of the candidates scored full marks. These were able to correctly write the given values to 1 significant figure and carry out the calculation. A common wrong answer was 180 coming from rounding to 1 rather than 0.9. Others rounded to 6 and 2 rather than 60 and 20. Some candidates did not estimate any of the numbers and instead tried to calculate an accurate answer.

Question 9

A large majority of candidates found the correct solutions for these simultaneous equations. Both the elimination method and the substitution method were used with equal success.

Question 10

(a) This part was well answered by most candidates. A common incorrect answer of 25 per cent was given mainly by those who divided by 200 rather than by 250 but also by some who cancelled $\frac{50}{250}$ down to $\frac{1}{4}$.

(b) The majority of candidates struggled to understand this question relating to simple interest, the style of which was different to the usual type of question on this topic. The correct answer of 50 was occasionally given, however many different responses were seen.

Question 11

(a) There were many correct answers for this part. Incorrect answers were the result of errors made in expanding the brackets. The term –15*k* was usually correct but the multiplication of -3×-2 gave rise to –6, or 2 or –2 by those who did not multiply both terms in the bracket by –3. A few attempted to solve an equation.

(b) Many candidates obtained the correct solutions to this equation following a common factor approach. Candidates should be discouraged from attempting to use the quadratic formula on this type of equation; there were many incorrect attempts at this, usually as a result of sign errors being made. Some candidates re-arranged the equation to $5x^2 = 3x$ and cancelled x from each side, thereby losing one of the possible solutions.

Question 12

(a) Many candidates answered this part correctly. Those who added the indices often left the answer as 3^2 and so did not score the mark for this incomplete evaluation. Some re-wrote 3^{-2} as $\frac{1}{9}$ and 3^4 as $3 \times 3 \times 3 \times 3$. This method often led to the correct answer but some arithmetic mistakes were seen. A few gave the answer incorrectly as 9^2, from multiplying the 3's as well as adding the indices.

(b) This part was nearly always correct. Candidates clearly knew $3^0 = 1$.

(c) Candidates found this part on simplifying with fractional indices very challenging and only a small minority scored the mark. Answers often included $\sqrt{\ }$ or $\sqrt[4]{\ }$ notation with incorrect terms. The answer $(4y^2)^{\frac{3}{4}}$ was seen a number of times. Many varied errors were made.

Question 13

(a) Almost all candidates were able to write the number in standard form correctly. A few gave the power of 10 as 4 instead of –4.

(b) Many candidates were able to evaluate the numerical calculation. Those who chose to write the numbers in full were usually successful, but some numbers did not have the correct number of zeros. Those who worked with powers of 10 displayed a good understanding of the question. A common incorrect approach was to subtract 9 from 8 and give an answer of 1 or –1 multiplied by 10^1, 10^9 or 10^{17}.

Question 14

(a) Most candidates were able to find the correct highest common factor, with some writing their answer as $2 \times 3 \times 5$. A few gave a factor that was not the highest.

(b) Although there were many correct answers, candidates found this question more challenging. Errors usually involved missing out one or more of the prime factors, for example, giving 5 rather than 5^2. Some gave the answer as 3, the only factor common to all three numbers.

(c) This part was found to be the most challenging with a minority giving 6 as the correct answer. Some found this efficiently by inspecting the indices and deducing the extra factors needed. Others chose a longer route by evaluating $p = 600$, choosing 3600 as the next multiple of p that is a square number and deriving 6 from this. Many did not know how to approach this question and gave no response, and incorrect answers of 3 were quite common.

Question 15

(a) Many candidates shaded the correct triangle. It was common for more than one triangle to be shaded, not following the instruction given in the question. Candidates found this question on line symmetry more challenging because the reflection line was not vertical, and most chose to shade a triangle on the left-hand side in an attempt for this to be the case.

(b) (i) Many candidates were able to find the missing angle in the isosceles triangle. Common errors included calculating 180 – 88 without dividing by 2, or halving 88.

(ii) There were many correct answers for this part. As in **(b)(i)**, a common error was to give the answer 92 from 180 – 88 and a significant number gave no response.

Question 16

(a) A variety of sets were shaded in the Venn diagram. However, many candidates had a clear understanding of what a 'complement' meant and shaded in the correct region. Candidates who shaded more than one region as part of their working process needed to indicate clearly which one they intended to be their final answer.

(b) (i) There were many correct answers for this part. Errors usually included extra letters.

(ii) Most candidates were able to state the number of elements in the required set. Some candidates listed members.

Question 17

(a) A minority of candidates were able to identify the correct region described by the inequalities. A variety of incorrect letters were selected with some listing more than one.

(b) Most candidates were able to give two of the three correct inequalities to define the required region and gain partial credit. A common error was to omit $x > 0$ and to write the inequality signs in the reverse direction.

Question 18

(a) (i) Many candidates were able find the correct median from the cumulative frequency diagram. A very common error was made by candidates who used 140 as the total frequency rather than the 120 stated in the question. This was the result of looking at the maximum value on the y-axis instead of the graph.

(ii) Candidates found this part more challenging and even those who used the correct total were less successful in finding the interquartile range. Some identified the upper and lower quartiles as the 90^{th} and 30^{th} values but subtracted these and read off at the 60^{th} value to find the answer.

(b) This part was not answered well by many candidates. Candidates tended to subtract 0.8 from both the median and interquartile range or alternatively added 0.8. Many candidates did not understand the concept of range and how it would remain the same.

Question 19

(a) Most candidates answered this part correctly.

(b) Many candidates were able to carry out the first step in the method for finding the inverse function, but only a minority managed to reach a fully correct answer. Most got as far as eliminating the fraction to reach $xy = 5 - x$ or $xy = 5 - y$. Instead of isolating the common variable, many followed this with $x = \frac{5-x}{y}$ or $y = \frac{5-y}{x}$ with both leading to $\frac{5-x}{x}$ as a common incorrect answer.

Question 20

(a) Only a minority of candidates were able to use the relative frequency, 0.2, to find the missing value for *p*, but many gained the follow through mark for both their responses summing to 108. Common errors were to divide the total frequency of 300 by 4, find $\frac{4}{0.2}$ or $\frac{108}{2}$.

(b) Many candidates were able to find the expected value. Incorrect answers were varied with many not showing any working.

Question 21

In all parts of this question, candidates should be encouraged to use the diagram, putting in the answers as they find them.

(a) Many were able to find the correct angle having recognised the triangle was isosceles. Incorrect answers of 180° – 53° = 127° were quite common.

(b) There were many correct answers given by those who knew the opposite angles in the cyclic quadrilateral added to 180°. Some who knew the rule applied it to the incorrect angle so 180° – 127° = 53° and 180° – 106° = 74° were common incorrect answers.

(c) Most candidates found the correct angle recognising the alternate angles in the diagram.

(d) This part was answered well by most candidates who recognised the triangle in the semi-circle was right-angled.

Question 22

Nearly all candidates attempted to use a ruler and a pair of compasses in their constructions.

(a) (i) Most candidates constructed an accurate perpendicular bisector with both pairs of construction arcs visible. Occasionally a perpendicular bisector was seen with only one pair of arcs.

(ii) This part was less well answered with many candidates not understanding the question required the bisector of angle *A*. Bisectors of other angles and lines were seen instead.

(b) Candidates who were successful in **part (a)** tended to gain full marks in **part (b)**.

Question 23

(a) Most candidates understood that they needed to find the gradient of the line to find the deceleration and many correct answers were seen. When errors occurred, they were usually the result of finding the vertical height of the first sloping line rather than that of the second part of the graph.

(b) Very few correct answers were given in this part, with most candidates having difficulty identifying an appropriate method.

(c) Many candidates knew the distance travelled was represented by the area under the graph but finding the correct area proved challenging for some. Those who used the trapezium were generally successful. The most common incorrect approach was to find speed x time, $40 \times 24 = 480$.

Question 24

(a) This was well answered by most candidates, with only arithmetic slips the cause of partial marks awarded.

(b) Many candidates answered this part correctly. Most obtained $\begin{pmatrix} 0 & -1 \\ 2 & 3 \end{pmatrix}$ but arithmetic slips were made when finding the determinant. This was sometimes calculated as –2 rather than 2 from a sign error in multiplication. Others had the determinant as 5, resulting from $3 \times 0 = 3$ within the calculation.

(c) This part proved to be demanding for most candidates who did not realise they could use the inverse from the previous part of the question to find matrix X. Successful candidates tended to form a pair of simultaneous equations using matrix A, leading to the correct answer. Errors in this approach were usually in setting up matrix X as $\begin{pmatrix} x \\ x \end{pmatrix}$ or $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ instead of $\begin{pmatrix} x \\ y \end{pmatrix}$.

Question 25

In this vector question, many candidates did not follow the instruction to simplify their answers at each stage. A common error was to use notation such as $\overrightarrow{AC}$ rather than 3**a** throughout.

(a) (i) Many correct answers were given for this part. A common error was 3**a** or 3**a** + **a** not simplified. Notation such as **a** + $\frac{3}{4}$ was frequently seen in this part and the next.

(ii) Those who had the correct answer in **(a)(i)** usually had this part correct also, and many scored a follow through mark when the previous answer was 3**a**.

(b) (i) Many candidates were able to give a correct vector route e.g. $\overrightarrow{AC} + \overrightarrow{CP}$ but then could not proceed to give the correct final answer. This was often a result of previous errors or because they used vectors going in the opposite direction.

(ii) Few correct answers were seen. Only those candidates who had scored full marks in the previous parts usually scored in this part.

(iii) Only a minority of candidates scored the final mark dependant on **(b)(i)** being correct or a multiple of vector **b**. Even those who had the potential to gain this mark often did not know the shape was a trapezium. Many opted for rhombus, kite or parallelogram.

MATHEMATICS D

Paper 4024/12
Paper 1

Key messages

In order to do well in this paper, candidates need to:

- be familiar with the content of the entire syllabus
- be competent at basic arithmetic
- set out their work in clear, logical steps
- be able to select a suitable strategy to solve a mathematical problem.

General comments

The majority of candidates were well prepared for this paper and most attempted all of the questions. Candidates across the ability range were able to demonstrate their understanding of the syllabus content, with some questions accessible to all and others offering challenge to the most able.

Work was usually well presented and diagrams were drawn accurately. In questions with several stages of working, it is beneficial if candidates set their work out in clear steps with annotations where appropriate. In **Question 22**, for example, candidates could indicate that a calculation is the total volume of water or volume of the container and in **Question 18(a)** candidates should show *AB* or *BC* next to the appropriate calculation.

Candidates often make errors in calculations involving decimals, particularly when they are attempting to adjust powers of 10 to eliminate the decimal. In calculations involving negative numbers, slips often occur with signs, particularly when multiplying or dividing. They would benefit from checking their arithmetic and correcting errors identified. Candidates should write their final answer clearly on the answer line and cross out and replace any incorrect work rather than overwriting it.

Many candidates would benefit from a greater understanding of standard form, vectors and histograms. They would also benefit from having more experience in answering questions where they need to identify the mathematics required as this would improve their performance in problem-solving questions.

Comments on specific questions

Question 1

(a) Most candidates were able to correctly subtract the fractions. Some used a common denominator of 32 and left the answer as $\frac{28}{32}$ which was acceptable as the question did not require the answer to be in its simplest form.

(b) Most candidates were able to correctly divide the fractions. Some gave the unsimplified answer of $\frac{15}{18}$ which was acceptable. Common incorrect answers were $\frac{10}{27}$ as result of multiplying the fractions or $\frac{6}{5}$ as a result of inverting the first fraction instead of the second.

Question 2

Many candidates were able to correctly order the values. The most common errors were to place $\frac{7}{200}$ as the smallest value or 4 per cent as the largest. Some candidates converted all values to decimals before ordering, but the place value was not always correct.

Question 3

(a) Most candidates were able to identify 37 as the prime number.

(b) There was some confusion in identifying the square number. Although many knew that 36 was a square number, it was common to see the answer $\sqrt{36}$ rather than 36.

(c) Many candidates were unfamiliar with irrational numbers. Although some correctly identified $\sqrt{35}$ as irrational, it was common to see one of the fractions selected for the answer. It was also common to see more than one answer here; some candidates knew that a square root may be involved in an irrational number, so listed both $\sqrt{35}$ and $\sqrt{36}$.

Question 4

Most candidates were able to solve the equation correctly. Common errors were to reach $10x = 1$, but then give the answer $x = 10$, or to make a sign error when rearranging the equation and reach $6x = 13$.

Question 5

(a) Many candidates identified this expression as the difference of two squares and often were able to factorise it correctly. Common incorrect answers in the correct form were $(49 - 7t)(49 + 7t)$, $(7 - 9t)(7 + 9t)$ and $(3t - 7)(3t + 7)$. Another common error was to identify the squares in the terms but give the answer $(7 - 3x)^2$.

(b) Many candidates are well prepared for this type of factorisation and many correct answers were seen. The main issue arose from candidates who formed the partial factorisation $3y(5x-2)+5x-2$ and did not realise that this was equivalent to $3y(5x-2)+1(5x-2)$ so were unable to complete the factorisation. Some candidates made errors with signs when factorising and those who used the table method for factorising were not always able to follow this with a correct product.

Question 6

(a) Candidates who did a correct calculation with time did not always give their answer in the correct format of either 8.27 pm, using the 12-hour clock, or 20 27, using the 24-hour clock. Answers of 08 27 or 08 27 pm were common, neither of which were creditworthy. Some candidates attempted a subtraction of 10.15 – 1.48 leading to an answer of 8.67. Others who attempted to count back by 1 hour and then by 48 minutes did not always reach the correct time.

(b) Candidates found this question challenging. Those who understood the concept of upper bounds did not always read the question carefully and assumed that the value was rounded to the nearest centimetre rather than the nearest 5 cm so gave the answer 95.5. Another common incorrect answer was 100, resulting from adding on 5 cm rather than 2.5 cm.

Question 7

(a) Many candidates were able to identify the symmetry of the diagram and draw an acceptable line. Incorrect answers usually involved a line joining the ends of the two chords or sometimes a line perpendicular to the one required.

(b) Candidates found the concept of rotational symmetry more challenging than line symmetry. Most candidates shaded one triangle, but it was often positioned one triangle away from the correct answer.

Question 8

Many candidates are well prepared for this type of question and rounded the three values correctly to one significant figure. Many candidates have difficulty performing calculations involving decimals and, having shown $\frac{40 \times 3}{0.6}$, made place value errors leading to answers of 20 rather than 200. Another common error was to round 0.6013 to 1 rather than 0.6 leading to the answer 120.

Question 9

(a) Many candidates were able to link the scale factor correctly with 14 to reach the answer of 35. Common errors were to misread the scale factor as 5 cm to 1 km rather than 5 cm to 2 km leading to the answer of 70. Some attempted to convert 14 km to centimetres, either correctly or incorrectly, rather than using the scale factor.

(b) Candidates had more difficulty with this part and few were able to link the square of the scale factor correctly with the given area of 50 cm^2. Some candidates who understood that the area factor had to be used squared 50 as well as $\frac{2}{5}$ leading to the answer 400. The most common incorrect answer was 20 resulting from using the scale factor in place of the area factor. Some candidates just attempted to convert 50 cm^2 to km^2.

Question 10

Many candidates were able to set up an equation for inverse proportion and substitute the given values to find an expression for k in terms of t which they often used with $x = 3$ to reach the correct expression for y. Some found the use of $y = t$ confusing and did not know whether to use y or t with $x = 3$. A small number of candidates did not read the question carefully and took x to be inversely proportional to x^2 or directly proportional to x.

Question 11

(a) Although there were a number of correct answers it was clear that many candidates found this question challenging. Common errors were to leave the answer as an ordinary number, to attempt to convert the 4500 into standard form but to leave 1000^2, or to convert 4500 into 4.5×10^3 then add the powers to get 4.5×1000^5. There were some who gave the correct value of 4 500 000 000 but were unable to write it in standard form giving answers such as 4.5×10^7 or 4.5×10^{-9}.

(b) Candidates who dealt with the division of the powers of ten separately often reached 0.6×10^{-5}, and either left their answer in this form or converted it to standard form incorrectly, often 6×10^{-4}. It was common to see candidates adding the powers of 10 to reach the answer 0.6×10^{-11}. Some candidates were unable to divide 2.4 by 4 and sometimes multiplyed to get 9.6.

Question 12

Some candidates knew the formula for the sum of the interior angles of a polygon and correctly evaluated $(12 - 2) \times 180$. Others misread the question and went on to divide this by 12, giving the answer 150, the interior angle of a regular 12-sided polygon. Common errors were to use 360 or 90 in the calculation in place of 180, to use (12 – 1) or to find 12×180 or 12×360.

Question 13

(a) Candidates who recognised that any value to the power of 0 is equal to 1 gave the correct answer. There were many incorrect answers, commonly $2x$, $2x^2$ and 0.

(b) Some candidates understood that both the 3 and the x^3 had to be squared and gave the correct answer of $9x^6$. Common errors were to add the powers for x, leading to $9x^5$, or to square the x^3 term only, leading to $3x^6$.

(c) A more successful approach to this question was to either deal with the negative power or deal with the fractional power first. Those dealing with the negative power were often able to reach $\left(\frac{x^3}{8}\right)^{\frac{1}{3}}$ but sometimes concluded with $\frac{x}{8}$ rather than $\frac{x}{2}$. Some candidates thought that the negative power should also be inverted, so wrote $\left(\frac{x^3}{8}\right)^3$. Candidates who dealt with the fractional power first often found the cube root of either 8 or x^3, but not both, although some did reach $\left(\frac{2}{x}\right)^{-1}$. Candidates who dealt with each term individually were usually unsuccessful.

Question 14

(a) Candidates who calculated the 20th percentile as 24 usually read the graph correctly at this cumulative frequency. However, many did not read the question carefully and read the graph at a cumulative frequency of 20 leading to an incorrect answer of around 36.56. The scale on the temperature axis was found to be challenging and many candidates were unable to read it correctly.

(b) Candidates were more successful in this part and most were able to read the cumulative frequencies for the two given temperatures and subtract them correctly. Some careless errors were seen in this part, such as incorrect results from subtracting from 100 or adding the values instead of subtracting. A small number of candidates misinterpreted the question and found the temperature midway between 36.8 and 37 as 36.9 and read the cumulative frequency for this temperature.

Question 15

(a) Many candidates gave the answer 8, the frequency density, rather than using this to calculate the frequency of 16 which was the correct value for p.

(b) Most candidates were able to draw the bar for $1 < t \leqslant 2$ correctly as the frequency density for this group is the same as the frequency. Fewer were able to draw the bar for $6 < t \leqslant 8$ correctly and a height of 4 was more common than the correct height of 2. Some omitted the first bar and others drew bars with the wrong width, $0 < t \leqslant 2$ for the first or, less frequently, $6 < t \leqslant 9$ for the second.

Question 16

(a) This part proved to be very challenging. A common incorrect answer was 60°, a result of assuming that the angles at the centre were equal. Some candidates calculated most of the angles in the shape, often with arithmetic errors, and others assumed that the bisectors met the sides at 90°. The most straightforward approach was to use the property that the exterior angle of a triangle is equal to the sum of the opposite angles, but few candidates were able to recall this fact.

(b) Some candidates were able to identify the correct triangle, but others attempted shading the regions for each condition without clearly identifying the area where both conditions applied. Many candidates shaded more than one triangle, commonly *OAR* and *OQA* or *ORB* and *OQC*.

Question 17

(a) Many candidates were able to draw the second sets of branches on the tree diagram and most identified that the probability of white for the first bead was $\frac{2}{3}$. As the beads were not replaced in the bag, the denominators for the second set of branches are 2 not 3, but many candidates repeated the first probabilities on the second set of branches. Those who appreciated that there was no replacement were often able to get the probabilities of $\frac{1}{2}$ correct for WW and WB, however the probabilities for BW and BB were found to be more challenging. In some cases, candidates drew only one second set of branches or did not line up their branches correctly with the first set.

(b) Candidates who had considered the information given in the question carefully were able to give the answer 0 in this part without needing to do any calculation; as there was only one black bead in the bag, it is impossible to take two. Many followed through from their tree diagram by selecting the correct two probabilities and multiplying them which led to the correct answer if their tree had been correct, but too often led to an incorrect answer such as $\frac{1}{6}$. Some candidates added probabilities rather than multiplying them.

Question 18

(a) Candidates found this question very challenging and only a small proportion were able to identify that they needed to use Pythagoras' theorem to find the length of the lines. In order to gain full credit in this question, candidates had to show correct use of Pythagoras' theorem to find the length of *AB*, to find the length of *BC* as 10 either by inspection of the coordinates or by Pythagoras' theorem, and then state that the two lengths were equal with no errors in their working. Some started by equating the two expressions which was not acceptable for full credit and others made sign errors in their calculations. Many candidates did not know how to find the lengths of the lines and common approaches were to draw some axes with the triangle shown or to calculate gradients or midpoints of lines.

(b) Very few candidates found the correct area in this part. Those who used the area of a triangle formula often used both base and height as 10, so an area of 50 was common. Few candidates identified the height of the triangle as 8. Many candidates attempted to use the array method to calculate the area which sometimes resulted in a correct answer although sign errors, incorrect multiplication by 0 and omission of $\frac{1}{2}$ were common.

Question 19

(a) Most candidates were able to construct the triangle accurately and construction arcs were usually shown.

(b) Many candidates were able to draw the triangle accurately. The most common error was to measure the obtuse angle incorrectly and draw angle *ABD* as 84° rather than 96°.

Question 20

(a) Some candidates were able to identify that angle *ABD* was in the same segment as angle *ACD* and gave the correct answer of 34°. Common incorrect answers were 69° from incorrect application of angles in the same segment, 21° from 90 – 69, 17° from 34 ÷ 2 and 45° from 90 ÷ 2.

(b) Many candidates identified that this angle could be found using the property that the angle at the centre is twice the angle at the circumference. Many answers were incorrect because candidates used their incorrect answer from **part (a)** here rather than the 34° given on the diagram.

(c) Some candidates identified that they could use the fact that angles in opposite segments are supplementary to find this angle and correctly subtracted 34 and 69 from 180. A common incorrect answer was 103, resulting from the assumption that the opposite angles were equal.

Question 21

(a) Many candidates were able to position *A* correctly. The most common errors were to draw $\overrightarrow{OA}$ as **p** or 3**p**.

(b) This part was more challenging with few candidates positioning *B* correctly. It was common to see vectors such as **p** + 2**q** or –2**q** used.

(c) Many candidates found it difficult to use the gridlines to help identify the required vector and most were unable to reach the correct answer. Some used a combination of vectors such as

$\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC}$ to reach an answer which was rarely successful. Answers involving 2**q** were common but often in expressions such as 3**p** – 2**q** or **p** + 2**q**.

Question 22

This question was found to be very challenging. Many candidates knew that the volume of 400 drops was found by multiplying 400 by 0.08 and started with this correct step. Common errors here were to place the decimal point in the answer incorrectly or to incorrectly calculate 4 x 8. The next step to equate this volume with the volume of the box with height *h* (the change in water level) caused problems. Candidates often tried to find the volume of the whole box by giving the height a value (usually 5 or 4) and then to subtract 32 from this volume. Those who equated the correct two volumes were generally successful in reaching the correct change in water level although some went on to subtract a small change in water level found by using $0.08 = 5 \times 4h$.

Question 23

(a) Some candidates were able to use the given vector to justify the gradient of $\frac{1}{2}$. Some omitted a stage in their working showing $\frac{6-0}{12-0} = \frac{1}{2}$ without showing the required step of $\frac{6}{12}$. Some incorrect statements were seen such as $\begin{pmatrix} 12 \\ 6 \end{pmatrix} = \frac{1}{2}$ or $\frac{12}{6} = \frac{6}{12} = \frac{1}{2}$.

(b) (i) Some candidates were able to compare the vectors for $\overrightarrow{AP}$ and $\overrightarrow{OB}$ to reach $p = 4$. Some complex calculations were seen in this part and answers such as 1, 2 and $\frac{1}{2}$ were common.

(ii) Very few candidates were able to give the correct answer in this part. Many attempted calculations involving Pythagoras' theorem to find the lengths of the lines which were usually unsuccessful. Some candidates gave answers involving vectors, such as $\begin{pmatrix} 4 \\ 2 \end{pmatrix} \div \begin{pmatrix} 12 \\ 6 \end{pmatrix}$.

(c) (i) Few candidates recognised that they could use the fact that the product of the gradients of perpendicular lines is –1, leading directly to the answer –2. Common incorrect answers were 2, $\frac{1}{2}$ and $-\frac{1}{2}$.

(ii) Only a small proportion of candidates realised that the answer in this part was their answer to the previous part multiplied by 3 and so few correct answers were seen.

Question 24

(a) Candidates made good attempts at this question and many gave a matrix with at least two correct values. Incorrect values usually resulted from errors in dealing with negative numbers or multiplication by 0. A small number of candidates multiplied the matrices rather than subtracting them.

(b) Many candidates understood how to find the inverse of a matrix, however they found it challenging to deal with a fractional determinant. Some showed a correct answer but then went on to incorrectly simplify to reach their final answer. The most common partially correct answers were $\frac{1}{2}\begin{pmatrix} 1 & -1 \\ 0 & \frac{1}{2} \end{pmatrix}$ or $\begin{pmatrix} 1 & -1 \\ 0 & \frac{1}{2} \end{pmatrix}$.

(c) Many candidates found this part challenging as they could not use rules of matrix multiplication to identify that **X** was a 2 by 1 matrix. It was common to assume that **X** was a 2 by 2 matrix and reach the answer $\begin{pmatrix} 2 & 2 \\ -1 & -1 \end{pmatrix}$. Other approaches were to attempt to multiply or divide the two given matrices.

Question 25

(a) Candidates who identified that the gradient of the graph between $t = 0$ and $t = 10$ was required usually found the correct value. This was sometimes given as the acceleration of –3.2 rather than the deceleration of 3.2. Common errors were answers of 32 from 40 – 8 or 4 from 40 ÷ 10.

(b) Many candidates understood that an area was required in this part, but few found the area of the whole trapezium. Answers of 80, the area of the bottom rectangle, or 160, the area of the triangle, were common. Some treated the shape as a triangle and evaluated $\frac{1}{2} \times 40 \times 10$.

(c) Some candidates set up a correct equation to find the speed using $0.4 = \frac{v - 8}{60 - 10}$. This often resulted in the correct answer, although some errors in rearrangement were seen. Some used $50 \times 0.4 = 20$, but did not add on 8, the speed at $t = 10$. Many candidates gave the answer 24 from 60×0.4 or 32 from $60 \times 0.4 + 8$.

MATHEMATICS D

Paper 4024/21
Paper 2

Key messages

Candidates should use a suitable degree of accuracy in their working. Final answers should be rounded correct to three significant figures where appropriate or to the degree of accuracy specified in the question.

It is important that candidates carefully read what is required in a question rather than assuming what is asked.

Candidates need to be careful when asked to explain a given statement that they do not repeat what has been stated in the question. They are advised to set their work out logically and clearly, showing all stages of working leading to the required result.

General comments

Values of $\frac{22}{7}$ or 3.14 were sometimes used for π which led to inaccurate final answers. Note the rubric at the beginning of the question paper states that candidates should use either the calculator value for π or the value 3.142.

On occasion, candidates gave an inaccurate final answer due to inappropriate rounding of intermediate results. Typically, intermediate values should be rounded to at least one more significant figure than given in the question. It is important that candidates retain sufficient figures in their working and only round their final answer to three significant figures.

Comments on specific questions

Question 1

(a) This question was answered well by the vast majority of candidates. A small proportion divided by 406 rather than by 350.

(b) The minority of candidates recognised this as a bounds question. A common error seen was to add 15 to 6×1.2. The question required candidates to find the upper bound of 15 and the upper bound of 1.2 before applying the calculation. A comment that the maximum mass of 23.25 kg was possible, therefore Neema could not be certain the mass was below 23 kg, was then required.

(c) Again, this part was well answered. The most common error seen was to write 72.17 as the final answer, without going on to round to the required degree of accuracy.

(d) Another well answered question, with most candidates gaining full marks. A small proportion rounded intermediate answers, resulting in a final answer which was not within tolerance (see General comments).

(e) Most candidates correctly found the cost per night at the hotel. A common error was to subtract 6.5 per cent of 996.84 to find the total amount before tax, rather than using a reverse percentage method. In this case, candidates were still able to gain credit for using a correct method with their wrong answer to find the cost of a dinner.

Question 2

(a) (i) Most candidates drew a histogram with a correct linear scale for the frequency density axis. When frequency densities were calculated they were usually correct and used to draw correct bars. A common error seen was to use the frequencies as the height of each bar, rather than calculating frequency densities.

(ii) Most candidates were successful in finding this percentage.

(b) (i) A common error here was to state the median as the halfway point of the range 0 to 6 (ie 3 books borrowed), rather than considering the frequency with which each of these numbers appeared.

(ii) Candidates tended to be more successful at this part than the previous one. The misconception in **(b)(i)** continued here for some candidates, who went on to sum the frequencies, dividing their total by 7.

(iii) Roughly half the candidates were successful here. A common error was to include 4 books borrowed in the calculation, rather than 'more than 4' as directed in the question.

(iv) Most candidates found this part very challenging. The most common error was not appreciating that the two visitors cannot be the same person, and therefore this is a probability 'without replacement'. Another error seen was in not considering that these two visitors could be chosen in two different orders, therefore the probability for one order then needs multiplying by two.

Question 3

(a) A small proportion of candidates correctly identified both the scale factor of 2 and the centre of enlargement as (7, 1). Some candidates stated the scale factor as –2.

(b) Correct rotations of 90° clockwise were often seen. Some candidates wrote down a centre other than (1, 0). Candidates are reminded that they may find tracing paper helpful in questions involving rotations.

(c) (i) This transformation was less successfully completed than the previous one, perhaps due to the matrix multiplication which was often not seen.

(ii) Only a handful of fully correct answers were present here. Many candidates stated the transformation was a rotation with a fewer recognising the line of reflection as $y = -x$. Better responses referred back to the answer from **(c)(i)** or used the original matrix given in the question.

Question 4

(a) The most common error here was to use 8 for the radius rather than 4. However, there was a large number of clearly worked, correct solutions to this part using an appropriate degree of accuracy throughout the question.

(b) The curved surface of the cylinder was often found correctly. However, a large number of candidates did not realise that the slant height needed to be calculated using Pythagoras' theorem in order to calculate the surface area and used the value of 15 (the vertical height) instead. A small number of candidates incorrectly used the value of 2580 given in the question to try to find the slant height.

(c) Candidates found this part challenging. Many responses did not make reference to the prompt in the question that the posts were 'geometrically similar' and attempted to perform the calculation by substituting values into the surface area formula with no success.

Question 5

(a) (i) Better responses approached this question by completing the square. A fair proportion of scripts attempted to expand the right side of the given equation, generally with success.

(ii) Many candidates understood the instruction 'hence' as directing them to find the values of x using the completing the square form of the quadratic formula found in part **(a)(i)**.

(b) Factorising and then simplifying the fraction was done well by many candidates. Those who did not correctly factorise both numerator and denominator were awarded credit for at least one of these done correctly. There were some scripts where neither was attempted, but these were in the minority.

(c) There were many candidates who eliminated the fractions and solved the equation correctly. Some candidates did not recognise the need for common denominators when adding the two algebraic fractions. Other candidates, having attempted to add the two fractions, were not able to eliminate the denominator.

Question 6

(a) The answer to this part was almost always correct.

(b) This question was difficult for a number of candidates. Some recognised the sequence was quadratic and found the correct expression using a method of differences. Better responses used the original counter patterns to deduce that the numbers are height x width, where height is always width + 2. Hence, for Pattern n the number of counters is $n(n + 2)$.

(c) (i) There were varied, equally successful, approaches here; some using algebra and some trial and improvement. Better responses equated the expression from **Question 6(b)** to 1358 and solved. This produced a quadratic equation with one positive solution, 35.9. Many candidates then stated the largest possible Pattern was 35.

(ii) More successful approaches here used the number of counters found in **Question 6(c)(i)** subtracted from 1358; this number was recognised as forming a 7×9 rectangle, or Pattern 7.

Question 7

(a) Candidates found this question challenging. A minority of responses presented a fully correct rigorous argument. A common error was an assumption of parallel lines to prove equal angles. Some candidates successfully proved congruence rather than similarity.

(b) (i) A common error here was to find the ratio the wrong way round, suggesting that the corresponding side to SX was QX rather than PX. There were a small number of candidates who added and subtracted scale factors.

(ii) Better responses recognised that both triangles had the same height (with P as the apex) and therefore ratio of areas = ratio of bases = 6.3:4.5 which then needs simplifying. A method seen by some candidates involved attempts to calculate the areas of both triangles. However, not enough information was provided to and therefore this strategy was not successful.

Question 8

(a) Most candidates answered this part correctly, although occasionally $x + 4$ rather than $x - 4$ was seen.

(b) There were some good responses here, the explanations were equally clear either in terms of algebra or in terms of words.

(c) Many candidates found this part challenging. Better responses referenced information from a number of sources; the diagram, the stem which stated that the area of the rectangle was 80 cm², and the expression for CQ in **Question 8(b)**. Some candidates provided a circuitous response, starting with the given expression for y which they had been asked to derive, rather than developing an argument involving setting up an algebraic expression for shaded area = 80 – area of triangle PQC. A good number did use this approach, some introducing errors by not including brackets correctly around $\frac{80}{x} - 4$ and $x - 4$.

(d) The answer to this part was almost always correct.

(e) There were many good attempts at plotting the smooth curve, although some candidates found the scale rather difficult to plot accurately. Some candidates did not appreciate that the graph should have a minimum point below $y = 68$. Most sketches involved a correct smooth curve rather than line segments drawn with a ruler.

(f) A common incorrect answer seen here was 68 by those candidates who did not recognise that the curve should have a minimum below this value. Those candidates who sketched a curve passing smoothly through $x = 8$ and $x = 10$, rather than a series of straight line segments through the points, were more successful reaching the answer.

Question 9

(a) They key here was to recognise that the cosine rule was required, which it was by a large proportion of candidates. Better responses showed all working involved in reaching the answer, giving numerical answers to a greater degree of accuracy than that already stated in the question.

(b) Knowledge of angles and bearings, and reference to the answer given in **Question 9(a)**, were needed here. Candidates often found the bearing of *C* from *A* rather than the other way round.

(c) A large number of candidates correctly divided their distance by 4.6 to find the time taken, showing good knowledge of the relationship between speed, distance and time. A minority of candidates appreciated that trigonometry was required to find the distance travelled from *A* to the point closest to farm *C*. Common wrong values used were 520, 680 or 950/2.

(d) Working vertically rather than horizontally proved challenging for a large number of candidates. Better responses used trigonometry to find the vertical height of the helicopter above *B* then used the height found to calculate the angle of elevation of the helicopter above *C*.

Question 10

(a) A large number of candidates realised Pythagoras' theorem was required here. Candidates who drew a right-angled triangle on the grid tended to be more successful than those who did not. In some responses, sign errors were introduced.

(b) Better responses developed the equation by explicitly showing the calculations required to find gradient and the *y*-intercept, then rearranging to obtain the quoted equation. A common error was to state the *y*-intercept as $\frac{1}{3}$ without explaining how this was reached, for example using similar triangles. Candidates are advised that attempts to read the *y*-intercept directly from the graph are not appropriate here as the scale cannot be read to the accuracy required.

(c) Better responses identified that the line *M* passed through $P(-4, -3)$ and went on to substitute this point into $y = 3x + c$. Candidates are reminded that in questions such as this, if they have not successfully derived an equation in one part, they can still go on to use the given equation to attempt later parts.

MATHEMATICS D

Paper 4024/22
Paper 2

Key messages

On a calculator paper, candidates need to avoid using premature approximation of values as this usually results in inaccurate final answers. When giving numerical answers from the use of π, candidates are advised to follow the instructions given on the front of the paper to 'use either your calculator value or 3.142' instead of using $\frac{22}{7}$ or 3.14. Questions which ask candidates to show, for example, that the length of a side is a particular numerical value require the candidates to give a more accurate value for the length and show that this value rounds to the given value.

General comments

Candidates are demonstrating a good understanding of many of the topics on the syllabus. The questions that the candidates found most challenging were **1(c)**, **4(d)(iii)**, **5(a)(ii)** and **10(a)**. The questions on which candidates were more successful were **1(b)**, **3(a)(i)**, **4(a)**, **4(b)** and **6**. Working is being shown by the majority of candidates enabling part marks to be awarded when appropriate.

Comments on specific questions

Question 1

(a) Just over half of the candidates were able to work out the correct amount paid to the employees in one week. The common mistakes were usually involving the use of $7\frac{3}{4}$ hours, with many converting this to 8 hours 15 minutes or incorrectly converting to $\frac{21}{4}$ from $\frac{7\times 3}{4}$. Others chose to deal with the hours and minutes separately and often made mistakes in the process. Another misunderstanding seen was that candidates assumed that the amount for a week involved 7 days and not 5 days each week. The working shown was not always clearly presented, making it difficult to see if a correct method was being used.

(b) Candidates had more success with this part of the question. Common incorrect answers were 16.3 from $\frac{3598}{22102}$, 35.98 from $\frac{3598}{100}$ and 7.53 from $\frac{3598}{25700+22102}$.

(c) It was rare to see the correct answer to this part. It was common to see candidates finding 8 per cent, 15 per cent, 23 per cent, 7 per cent, 92 per cent or 85 per cent of \$465.75. Occasionally candidates divided by either 1.08 or 1.15, with some then multiplying by the other value.

(d) About two fifths of the candidates were able to calculate the correct amount of money left, some then rounded this value to 602 or 601.8. A few chose to work out the compound interest using year on year calculations, but those who used this method often lost the accuracy needed for the answer. The wrong formula for compound interest was seen on some scripts, as well as the use of simple interest on others.

Question 2

(a) Just under half the candidates were able to state the correct equation of the line of reflection. Some incorrectly stated $x = -1$ while others gave an answer which was a number or an expression and not an equation.

(b) The number of candidates who were able to state all three things required for the description of the transformation were in the minority. Some gave one or two parts correct, with the scale factor usually being incorrect. There were candidates who did not give a single transformation but instead gave an enlargement by a positive scale factor and then included the necessity for a rotation as well.

(c) About a third of the candidates were able to draw *D* in the correct place on the grid. It was rare to see candidates make a mistake with just one of the vertices and much more common to see *D* incorrectly placed on the grid with the most common misplacement being as a result of the correct *x* and *y* coordinates reversed.

Question 3

(a) (i) A large number of candidates were able to use the scale correctly to draw the remaining six points in their correct positions. Occasionally candidates made a mistake with one or two points and some incorrectly had the scale of the *x*-axis as 1 small square representing 1 second, resulting in only two points correctly plotted. The need to complete the scatter diagram was not always recognised by the candidates.

(ii) About half the candidates understood the requirements of this question and gave the correct answer. A common wrong answer was 10, where candidates counted the number of values that were less than 55 for the 400 m and added this to the number of values less than 125 for the 800m.

(iii) Many candidates knew that the diagram showed positive correlation. Incorrect answers included increasing, negative, random and acceleration.

(iv) About half the candidates were able to draw an acceptable ruled line of best fit on the scatter diagram. The most common error was to assume that the line had to go through (45, 110). Freehand lines, curves and zigzag patterns obtained from joining point to point were also seen.

(v) Candidates with ruled straight lines were normally able to use their line to estimate how long the runner would take to run 800m.

(b) (i) Only a minority of candidates were able to explain the equation using the information in the table. Many candidates had an idea why it was correct but their explanation lacked clarity. Some candidates used the value 38 in their response but did not explain where this value came from. Some were able to show how they could obtain 12 from 50 – 10 – 15 – 13 but failed to equate this to $p + q$.

(ii) It was rare to see candidates correctly form the equation. Some candidates appreciated the need to work out the estimated mean but not all were able to form the equation correctly and then complete the proof without error. Some candidates used the incorrect method of trial and error to find values of *p* and *q* that when substituted into the $142.5p + 162.5q$ gave a value of 1870.

(iii) Candidates who appreciated they needed to solve the simultaneous equations given in the previous two parts usually proceeded to the correct solutions, either via substitution or elimination. Some candidates obtained the correct solutions with no relevant supporting working, while others gave values that added to 12 but did not satisfy the other equation.

Question 4

(a) Candidates usually completed the table correctly.

(b) Correct graphs were seen from the majority of candidates. Very occasionally the points were joined with line segments or one or two points were incorrectly plotted.

(c) About half the candidates were able to draw a tangent at the correct point and use this to estimate the gradient of the curve. Others knew how to draw the tangent but did not use the correct method for the gradient or made errors in their calculation.

(d) (i) Many candidates were unable to draw the given line on the graph. Candidates who attempted to draw the line by finding the points where the line cut the two axes were unable to draw an accurate line as one of the points was not on the given grid. Occasionally, inaccuracies were seen in the drawing of the line as the points chosen were in close proximity to each other.

(ii) Even fewer candidates were able to find the three points of intersection, as many of their lines did not cross the cubic curve three times. Some candidates did not read the requirement of the question and gave three pairs of coordinates as their answer, rather than just stating the required x-coordinates.

(iii) A very small minority realised that the accurate values of A and B can only be found by eliminating y from the two equations. Those who did so usually found the correct values required, however some gave the value of A as 25. Many attempted to use their three values to the previous part to obtain a cubic, without realising that due to the accuracy of their answers the cubic obtained also had a quadratic term. Other candidates substituted two of their values into the given equation and solved simultaneous equations, without realising that the values obtained would vary depending on which two values they chose.

Question 5

(a) (i) The more able candidates made a good attempt at this question, with many or all the elements correctly positioned in the diagram. Some candidates did not place the elements that were not part of sets A, B or C on the diagram. The most common error was not listing 1 as a square number. Some candidates listed the elements of each set at the top of the page and did not place them on the diagram.

(ii) A minority of candidates obtained the correct answer for this part of the question with many candidates listing elements rather than the number of elements in the set.

(iii) About half the candidates were able either to use their Venn diagram to write down the possible values of p, or use the descriptions of the sets to do so.

(b) (i) Only a small proportion of candidates were able to obtain the correct probability, with very few seeing the connection between this part of the question and the Venn diagram. Common mistakes were not to include 1 as a square number, give the probability of an odd number, or write the number of cards showing an odd square number.

(ii) Similarly, very few had the correct probability here. Mistakes included adding probabilities, using two fractions with denominators of 16, or doubling the required probability.

Question 6

(a) Correct rearrangements were seen by many candidates, with others making a correct first step in the rearrangement.

(b) Many candidates were able to write the correct single fraction however some candidates then went on to do further work, often involving the expansion of the denominator and then attempting to factorise again, which obtained errors. Other candidates made algebraic errors when expanding and simplifying the numerator.

(c) Candidates had most success with this part of the question, with many correct answers seen. Common incorrect solutions were $\frac{3}{10}$ or $(\pm)\frac{10}{3}$.

(d) Over half of the candidates were able to solve this equation, showing the necessary working. Mistakes were seen in the expansion of brackets, usually $5x + 3$ or $4x^2 - 2$. Candidates usually rearranged their expression to a quadratic with all the terms on the same side of the equation.

Many then attempted to use the quadratic formula, however mistakes were often seen. Those who recognised that the quadratic factorised usually completed the question accurately.

Question 7

(a) Many candidates appreciated the need to use the sine rule to find angle *SPR*. However not all went on to correctly find the required bearing. Some candidates failed to obtain marks due to premature approximation with either the sine of the angle or the angle itself. Other errors included candidates attempting to use the cosine rule, failing to use any trigonometry or finding the bearing of *Q* from *P*.

(b) (i) Nearly half the candidates correctly used the cosine rule and then gave a value for *QR* which was more accurate than to the nearest metre. The most common mistake was not giving a value of *QR* to more than 3 significant figures. Some candidates made mistakes when quoting the cosine rule while others, having substituted the values correctly, then applied it incorrectly. About a fifth of the candidates made no attempt at this part of the question.

(ii) Many correct attempts were seen to calculate the time taken with answers given correctly to the accuracy required. Common errors included no conversion from an answer in hours to an answer in minutes and seconds, incorrect conversions from kilometres to metres, and obtaining an answer in minutes of 2.20 and writing this as 2 minutes 20 seconds.

Question 8

(a) Many candidates used the given formula to calculate the volume of one of the cones, while others appreciated the need to subtract the volume of the two cones to obtain the required volume. Some candidates incorrectly assumed that the volume could be obtained using a radius of 16 cm and a height of 15 cm. Some candidates who knew the correct method did not obtain full marks as they either gave their answer in terms of pi or used inaccurate values of pi, normally $\frac{22}{7}$.

(b) Correct methods, as well as accuracy, were seen on many scripts. Candidates generally used the most direct use of Pythagoras as their chosen method however alternative methods were also seen. Those who used alternative methods did not always obtain an accurate value for *c*. A quarter of candidates were unable to make any attempt at this part of the question.

(c) Many candidates did not realise the need to calculate the slant height of the large cone in order to work out the curved surface area of the cone. This resulted in many not being able to obtain an accurate value for the surface area. There were other candidates who correctly calculated the curved surface area of the bowl but made mistakes regarding the total surface area, either forgetting to add the area of the base, by adding or subtracting areas of other circles, or using the wrong formula for the area of a circle.

Question 9

(a) (i) Many candidates were able to obtain a correct expression, however some had expressions that did not involve an *x*.

(ii) Those who were able to obtain a correct expression for the previous part were usually able obtain a correct expression here as well.

(b) Those who had correct expressions in the previous parts were usually able to correctly substitute these into the given equation involving areas of rectangles. Many were able to complete this accurately but some made algebraic errors in the process. About a quarter of the candidates did not attempt this part of the question.

(c) The majority of the candidates attempted to solve the equation using the correct quadratic formula. The common errors occurred from not dealing with $-(-22)$ or $(-22)^2$ correctly or giving both solutions to 3 significant figures rather than 2 decimal places.

(d) The more able candidates were able to use the required root to obtain the correct value for the unshaded area. Other candidates were able to use their value to calculate a relevant area in the given rectangle while others thought an algebraic expression for the unshaded area was required. About a quarter of the candidates made no attempt at this part of the question.

Question 10

(a) Very few candidates were able to show that the two triangles are congruent, with the correct reasons and congruency statement. Many were able to state which sides and angles were equal but often without a supporting reason. Several candidates tried to prove that the triangles were similar by considering only the angles.

(b) (i) Several candidates gave a correct angle here and those who did not were usually able to identify at least one correct, relevant angle in the given diagram.

(ii) This question proved difficult for the majority of candidates with many choosing not to attempt it. Those who were not able to calculate the area correctly usually attempted to find the sector area at some stage in their calculation. Some candidates interpreted *OD* as the diameter of the circle.