MATHEMATICS D

Paper 4024/12
Paper 12

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
- produce clear, accurate graphs and diagrams
- 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.

Candidates often presented their working clearly and many demonstrated good basic algebraic and arithmetic skills. Diagrams were often clear and accurate, with correct geometrical instruments used. In some cases, a correct method was seen leading to an incorrect answer: arithmetic slips occurred particularly when negative numbers were involved. Candidates would benefit from spending some time checking their working for errors in arithmetic. They should write their final answer clearly on the answer line and cross out any incorrect work rather than overwriting it.

In questions involving problem solving, such as **Questions 7**, **21** and **23**, candidates would benefit from spending some time considering their approach before starting to answer the question. In these questions, work was often difficult to follow and it would benefit from some annotation to clarify the method being used. In some questions, candidates would benefit from starting with a sketch or annotating the diagram provided.

Many candidates were unfamiliar with the topics of completing the square and congruent triangles. Candidates should be able to show that two triangles are congruent, including giving a geometrical reason for each pairing and quoting the correct congruence condition for the pairings used.

Comments on specific questions

Question 1

(a) Most candidates were able to correctly divide the fractions. The most common errors were to invert the first fraction rather than the second fraction or to make an arithmetic slip when multiplying.

(b) Most candidates answered this part correctly. A small number did not evaluate their answer completely, gave the answer as $\sqrt{3}$ rather than 3 or were unable to find $\sqrt[3]{125}$.

Question 2

Most candidates understood that they were required to construct the bisector of angle *B* and most showed correct arcs as part of their construction. The question asked for the locus of points inside the quadrilateral, so those candidates who did not extend their line to reach *AD* did not gain full credit.

Question 3

(a) Some candidates did not know that to find the range they needed to subtract the lowest value from the highest. Common errors were to subtract the first and last numbers in the list to give an answer of 70 or to give the answer as an interval such as $-45 \leqslant x \leqslant 40$ or –40 to 40. Some candidates attempted the correct subtraction, but arithmetic errors led to the common incorrect answers of 95 or –5.

(b) Most candidates showed a correct method to find the mean, however arithmetic errors in dealing with the negative numbers were common. An approach that was often successful was to deal with the positive and negative numbers separately, leading to a calculation of (–140 + 90) ÷ 10 which was usually evaluated correctly. A small number of candidates ignored the negative signs completely which led to a mean of 23.

Question 4

To gain full credit in this question candidates needed to show the three values rounded correctly to one significant figure as well as the correct final answer of 1000. In many cases candidates wrote the numerator as 72 – 32, rounding the values to two significant figures. Some were unable to square 0.2, with 0.4 rather than 0.04 often seen, and some rounded 0.198 to 1 rather than 0.2. Division by a decimal was found to be a challenge and 40 ÷ 0.04 often led to an answer of 100. Only a very small number of candidates did not round and attempted to evaluate the exact answer.

Question 5

This question was well answered with many candidates reaching the correct answer. In some cases candidates showed a correct method but made an arithmetic error in their division of 16 000 by 50, with 32 or 3200 common incorrect answers. Some candidates divided 4000 by 50 and did not multiply the result by 4.

Question 6

(a) The most common approach in this question was to calculate 15 per cent of 760 and add the result to 760 which often led to the correct answer. Candidates found calculating 85 per cent of 760 to be more challenging and arithmetic errors were frequently seen in this method. Some gave the answer as $114, the amount of tax paid, rather than the earnings after tax. A small number used an incorrect method, usually $\frac{760}{15} \times 100$.

(b) Most candidates correctly calculated the amount of interest as $144, but some gave this as the answer and others subtracted it from the investment to give an answer of $1056. Only a small number of candidates took 1200 as the interest or attempted to use compound interest rather than simple interest.

Question 7

The most successful approach in this question was to use a common denominator to find equivalent fractions. These were often added to give $\frac{27}{20}$ and then an attempt to divide by 2 was seen, which sometimes led to the answer $\frac{13.5}{20}$ or $\frac{27}{10}$. It was common to see the two fractions correctly converted to decimals, 0.6 and 0.75, but candidates often just gave a value between these two rather than finding the midpoint, 0.675. Of the candidates who found 0.675, many could not convert this to a fraction, although an answer of $\frac{675}{1000}$ was given full credit as the simplest form was not required.

A common incorrect answer was $\frac{7}{10}$, where candidates had just found a fraction lying between the two given values. Another common incorrect answer was $\frac{3}{4.5}$, the result of finding the midpoint of the two denominators. Working in this question was often very difficult to follow with calculations and fractions spread across the page in a disorderly manner.

Question 8

Many candidates understood that 5 parts was 2 litres and so 3 parts would be $\frac{3}{5}\times 2=\frac{6}{5}$ litre. The conversion to millilitres was not always correct and the decimal point was often incorrectly placed: this was due either to not using 1000 ml = 1 litre or incorrectly converting $\frac{6}{5}$ to a decimal.

The common misconception was to assume that there were 2 litres of drink rather than 2 litres of fruit juice, giving the calculation $\frac{3}{8}\times 2$ and an answer of 750 ml.

Question 9

(a) Most candidates answered this correctly, producing a correct graph with accurate, ruled lines. The most common error was to end the horizontal line at (40, 15) rather than (60, 15), a result of assuming that the total time for the journey was 40 seconds, rather than 40 seconds at constant speed.

(b) Most candidates answered this part correctly. Some showed a correct fraction but simplified it incorrectly or converted it into an incorrect decimal. A small number calculated time ÷ speed rather than speed ÷ time.

Question 10

(a) Some candidates were able to use correct set notation to describe the shaded region, although many found this part very challenging. Some poor set notation was used and common incorrect answers were $P\cup R\cap Q'$, with the brackets missing, or $(P\cup R)Q'$, with the intersection symbol missing.

(b) Only a minority of candidates were able to give a correct answer in this part, with most answers being either a number in the range $9 < x < 10$ or, less commonly, an irrational number. Those candidates who answered correctly usually chose a square root of a number between 81 and 99, although some gave the answer 3π. Some candidates realised that irrational numbers involve a square root, so gave an answer of the square root of a number in the range, such as $\sqrt{9.5}$.

It was clear that some candidates did not know what an irrational number is and answers were often improper fractions or attempts at decimals with many decimal places.

Question 11

Many candidates reached the correct solutions by multiplying the second equation by 2 and then adding to eliminate *y*.

A significant number used a substitution method, which involved working with fractions. This often led to errors, particularly when attempting to substitute $y=\frac{-5-9x}{4}$ into the second equation. Some did rearrange the second equation to $y=3x-3$, which they were usually able to substitute to reach the correct solutions. Some candidates inaccurately converted the *x* value of $\frac{1}{3}$ into 0.3 or 0.33 and others wrote $x=\frac{7}{21}=3$. Some candidates, despite having made errors in the method, were able to give two values that satisfied one of the two equations.

Question 12

(a) Many candidates were able to interpret the standard form numbers and order them correctly. The most common errors were to position 4.2×10^{-4} as smaller than 3.5×10^{-4}, to order from largest to smallest or to order the values without considering the power of 10.

(b) (i) Many candidates were able to adjust the powers of 10 and subtract the values, giving a correct answer in standard form. The most common incorrect answers were 1×10^{1} or 1×10^{19}, resulting from a simple subtraction of 5 from 6.

(ii) Candidates found multiplication of the two values less problematic than the subtraction in the previous part. Some did not realise that 30×10^{19} was not in standard form, and some converted incorrectly to 3×10^{18}.

Question 13

(a) Candidates found this question challenging. Some made sign errors leading to $x^2 + 6x - 9$, for example, others wrote the brackets out as $(x+3)(x-3)$ and some expanded them correctly but then factorised them again for their answer. A small number of candidates equated the given expression to 0 and attempted to solve the resulting equation.

(b) Candidates were more successful in this part and many were able to deal with the negative signs and reach a correct answer. The most common error was to write $6(y-3)+5x(3-y)$ leading to a final answer of $(6+5x)(3-y)$. Most candidates showed a correct partial factorisation of the expression.

Question 14

(a) It was clear that many candidates were unfamiliar with the method of completing the square, so did not know how to start to write the expression in the correct form. Some candidates identified that the first bracket would be $\left(x - \frac{7}{2}\right)^2$ but were unable to find a correct value for *b*. The most common incorrect answer was $(x-7)^2 + 5$, a result of putting the numbers in the starting expression into the required format.

(b) Even candidates who had been able to complete the square correctly had difficulty identifying the minimum value of the expression. Some selected the wrong part of their expression, 3.5 was a common answer, and others gave the answer in coordinate form without identifying that –7.25 was the minimum value. Many candidates attempted to use the quadratic formula to find solutions.

Question 15

(a) This part was often answered correctly. Those candidates who did not give the correct product usually showed a partially correct factor tree or a ladder which involved arithmetic errors.

(b) Some candidates were able to identify one of the values of *N* correctly, but it was rare to see both correct. Most answers involved either 210 or 294 together with 252, where candidates had not considered that the highest common factor of 168 and 252 was 84 rather than 42. Some candidates did not understand that the required answers had to be multiples of 42 and attempts to find factors of any numbers in the range 200 to 300 were seen. In some cases, answers were outside the given range.

Question 16

(a) The majority of candidates identified the transformation as a translation but had more difficulty with giving the correct vector. Most vectors involved 3 and 4, but the signs were often incorrect and the 3 and 4 were sometimes reversed. A small number of candidates gave a coordinate pair, rather than a vector, which was not accepted.

(b) Some candidates drew correct rays through (0, 3) and constructed a correct enlargement using the negative scale factor. Some ignored the negative sign in the scale factor and drew an enlargement with scale factor 2 rather than –2. It was common to see small triangles where candidates had taken the negative scale factor to mean a scale factor of $\frac{1}{2}$.

Question 17

(a) Many candidates were able to complete the four fractions correctly on the tree diagram. A small number transposed the $\frac{2}{5}$ and $\frac{4}{5}$ on the second set of branches or used a denominator of 6 rather than 5 on these branches.

(b) Many candidates found the two correct products from the tree diagram and added them to reach a correct answer. Common errors in this part were to find just one product, to add or multiply the two required fractions from the second branches or to confuse when to add and when to multiply. Some candidates made arithmetic errors, particularly $2 \times 1 = 3$.

Question 18

(a) Most candidates correctly substituted $p = -2$ and reached the correct result, giving it either as a decimal or a fraction. Some omitted the negative sign in their answer or made an error in converting their correct fraction to a decimal.

(b) Many candidates were able to rearrange the formula correctly, showing clear steps in their working. Common errors included multiplying out $r(3 - p)$ as $3r - p$ or $3r - 3p$, making sign errors when changing sides of the formula, moving only part of a numerator or denominator and dividing one side of the formula by a term (usually r) but not doing the same to the other side. Some candidates substituted their answer from part **(a)** into the formula before attempting to rearrange.

Question 19

(a) Most candidates understood how to use inverse proportion and usually reached the correct answer. A common error was to evaluate the constant of proportionality correctly as 160 but then to forget to square the 10 in the next calculation, leading to an answer of 16 rather than 1.6. A small number of candidates used direct proportion rather than inverse proportion or took y to be inversely proportional to x rather than to the square of x.

(b) Candidates found this part very challenging and few identified that y would be multiplied by 4 when x was halved. Some understood that 4 was involved but wrote that y was increased by 4 times which was not sufficiently precise. Many stated just that y would increase, or it would double, and a number noted that it would also decrease or would not change.

Question 20

Candidates whose first step was to simplify the terms in the bracket had the most success with this question because they could then take the reciprocal and square root of a simpler expression. Those who attempted to take the reciprocal and then square root before simplifying often made errors in one or more of the terms, as they had difficulty dealing with fractional powers. A common error was to start by inverting the fraction, but to replace the power of $-\frac{1}{2}$ with 2 rather than $\frac{1}{2}$. Some candidates correctly dealt with the indices in the x and y terms but did not take the square root of 9.

Question 21

Those candidates who started by setting up a correct equation for the surface area often reached the correct answer, although some gave the value of *y* as their answer rather than the height of the cuboid as required. Some candidates attempted to set up an equation for the surface area but without a diagram omitted the areas of some faces. Some did not use the given relationship between height and length so had an equation involving *h* and *y* which they could not solve. Some candidates set up an equation for volume and others could not combine terms correctly and reached a linear equation.

Question 22

(a) Most candidates completed the table correctly. Some made errors in the number of lines in the patterns, often using 10 in place of 12 for pattern 3.

(b) Many correct answers were given, usually in the form $5n - 3$, although some were the unsimplified expression $3 + 5(n - 1)$. Common errors were answers of $3n - 5$ or $n + 5$, although some candidates attempted to form a quadratic expression.

(c) Some candidates equated their expression from part **(b)** with 92, solved to find the required pattern number and often went on to find the correct number of dots. Some gave the pattern number, 19, as their answer. Some candidates who had been unable to find the *n*th term in part **(b)** carried on the patterns and reached the correct answer. The most common misconception was to substitute 92 into their expression as the value of *n* rather than use it as the number of lines.

Question 23

Some candidates were able to analyse the pattern, identify an efficient approach to find the required area and reach the correct answer. Many candidates did not use an efficient method and calculated many partial areas which were not identified clearly and they had difficulty in combining the correct areas to reach their answer. Many candidates found the smaller shaded area correctly using $\frac{60}{360} \times \pi \times 3^2$. Finding the larger shaded area was more challenging and many candidates gained some credit for finding the area of the large or small circle. Some candidates substituted values of 3.14 or $\frac{22}{7}$ for π leading to very complex calculations, which are not required on a non-calculator paper, and others took the radius of the large circle to be 9 rather than 6. Some incorrect formulas were seen, either the arc length formula or using $2\pi r^2$ for the area of a circle.

Question 24

(a) Few candidates understood the requirements for a correct congruence proof. To gain full credit, candidates needed to give three correct pairs of sides/angles with correct geometrical reasons for each and state the correct congruence condition for the pairs they had used. Many candidates were able to identify two correct pairs of sides. A correct reason for $OA = OC$ (equal radii) was often given, but candidates found it more challenging to give a reason for $AP = CQ$ (midpoints of equal chords) or $OP = OQ$ (equal chords are equidistant from the centre). Candidates who gave the angle pair $\angle APO = \angle CQO$ sometimes gave the correct reason as perpendicular to chords. Even when three correct pairs with reasons had been seen, few candidates gave a congruence condition. Those who gave a congruence condition often used SAS in place of RHS. Some candidates were clearly confused between similarity and congruence and gave three pairs of angles and many gave a lengthy description of the shape in the diagram without any pairings of equal sides or angles.

(b) Candidates who marked the 140° on the diagram correctly often went on to reach the correct answer. It was common however, for candidates to take the reflex angle as 140°, leading to angle *COQ* = 35° and angle *QCO* = 55°. Some candidates marked angle *ABC* as 70° and angle *OBQ* as 35° on the diagram but did not give the correct answer for angle *QCO*, perhaps because they did not understand the three-letter notation for the angle. A small number took *AOQ* to be a straight line leading to angle *COQ* = 40°. Some candidates showed some unknown angles as 45° or 60° on the diagram and worked with those.

Question 25

(a) Many correct answers were seen in this part. Some candidates had one or two elements incorrect due to arithmetic errors, often a result of incorrect multiplication by 0. The most common misconception was to multiply the corresponding elements together leading to the answer $\begin{pmatrix} 4 & 0 \\ 0 & -3 \end{pmatrix}$.

(b) (i) Many candidates were able to set up a correct equation and solve it to give $k = -2$. The most common error was an answer of $-\frac{2}{3}$, resulting from $3k - 2 = -4$ rather than $3k + 2 = -4$.

(ii) Candidates found this part more challenging. Many did not realise that the determinant had been given so they recalculated it, often incorrectly. Some candidates used the given determinant but used $\frac{1}{4}$ or –4 in place of $-\frac{1}{4}$ in their inverse matrix. Candidates should take care with negative signs when manipulating matrices, as some had a correct inverse matrix, but made errors with signs when trying to simplify it. It should be noted, however, that an answer of $-\frac{1}{4}\begin{pmatrix} -2 & 1 \\ -2 & 3 \end{pmatrix}$ is acceptable and there is no need to simplify it further.

MATHEMATICS D

Paper 4024/22
Paper 22

Key messages

Presentation of work made some candidates' responses difficult to mark, particularly when they wrote over a first attempt. At times it was difficult to distinguish a candidate's writing, for example, *y* and 4 looking identical. Premature approximation, or answers truncated rather than rounded, could not be awarded accuracy marks.

General comments

Candidates were able to make a reasonable attempt at all questions on the paper in the given time. It was encouraging to see that all candidates were able to attempt some of the questions on the paper. There was an improvement in the quality of candidate responses to angles questions where reasons were required, with many candidates now attempting to give reasons throughout their working. Contexts involving time proved challenging for many candidates, along with the scale in **6(a)** which involved a change of units.

Comments on specific questions

Question 1

(a) Most candidates understood the table of charges and correctly calculated the total cost of the family visit to the zoo. Occasional arithmetic slips were seen in addition to some missing the fact that the 3-year old child, being under 5, was free.

(b) (i) Many candidates correctly obtained \$3.90 as a percentage of \$26. A significant number gave 85 as their response and some stated the reduction of \$3.90 as their answer. Some misread the cost for an adult as \$22; candidates are advised to read the question carefully.

(ii) Most candidates knew how to find the percentage reduction, but unfortunately some errors were made in calculating the total cost in May. The subsequent method was often correct, although a few found the difference as a percentage of the May total and not that of April. A few used the difference as \$3.90, the decrease in one adult price. Many responses could not be awarded full marks due to incorrect rounding, giving the truncated value 9.39 as the most accurate answer.

(c) (i) Calculating the time difference proved challenging for many candidates. Incorrect answers seen included 5 hours 25 minutes, 6 hours 35 minutes and 6 hours 25 minutes.

(ii) Better responses recognised that if the Ferugio family arrived at 10.50 am and left at 4.25 pm, attendance at the first and last shows was not possible. The most common wrong answer was 210 from 6×35, not taking into account the arrival and departure times. Some candidates did not use the 35 minutes but instead worked out the length of time from the start of one show to the start of the next and carried out various calculations with these values.

Question 2

(a) A significant number of candidates did not offer a response to this question. Errors seen included points incorrectly or inaccurately plotted, coordinates transposed and misreading of the scale.

(b) Many candidates appreciated that the scatter diagram showed negative correlation, with many qualifying it with weak or strong. A common error was to mention inversely proportional, while others made comments about temperature.

(c) Candidates who understood the term 'line of best fit' usually drew a satisfactory ruled line through the points. There were some lines that did not cover the range of the points and others were drawn with a positive gradient, many of these attempting to go through the origin. Some candidates chose to draw an S shape, by joining the points, while others joined the points in order and created a loop.

(d) Most candidates who had drawn a ruled line of best fit read correctly from their line, although some misinterpreted the scale.

Question 3

(a) Candidates found this question challenging. The expectation here was that candidates would use an open circle above –3 and a closed circle above 2 and join the two with a single line. Many of the candidates who had the correct notation chose to draw a line from each of the circles of varying lengths, with it being unclear where the candidate intended these lines to stop. They appeared to be treating this as two separate inequalities rather than a region between two values. Some tried to identify the region by shading.

(b) A significant number of candidates scored full marks for this part and most scored at least one mark. Common errors included reversing the inequality signs, interchanging the x and y and confusing $y = ½x$ with $y = 2x$. Most candidates went directly to the inequalities rather than using the equations first. It was often difficult in this question to distinguish when candidates had written a number 4 and when they had written the letter y.

(c) Many candidates scored full marks when solving this double inequality. The best responses then listed the integer values as their answer. Some responses showed arithmetic errors on one side of the inequality. Other responses reversed one of the inequalities, usually the one involving negative values. The two most common errors was either for the candidate to expand $4(m – 2)$ and then add 8 to one side of the inequality and divide the other side by 4 or to bring the –12 and 10 to the same side of the inequality at some point during their working.

Question 4

(a) (i) Better responses stated clearly the geometrical reason why angles are supplementary and that two angles that are adjacent means the two angles are next to each other. A common error was to give an incorrect reason for angle *AEB*, referring to parallel lines or stating that the angles were alternate. Some responses omitted to give the reason 'angles on a straight line'. Reasons which were seen but not satisfactory included 'adjacent' and 'supplementary'. Many responses quoted incorrect reasons, such as opposite angles in a quadrilateral (or trapezium) are equal or add to 180 and final answers of 110 and 70 were common. It was good to note that the use of terminology such as F angles was rarely seen.

(ii) Success in this part was dependent on the recognition that the two triangles were similar and that triangle *ADC* is isosceles. Better responses recognised both these facts and in many cases methods such as ratios of corresponding sides, sine rule, cosine rule and the use of Pythagoras' Theorem were seen. Use of ratios was the most common method employed and usually led to the correct answer, although in some cases incorrect ratios were used.

(b) Candidates found this question challenging. Many assumed that the sum of the interior angles of a pentagon was 360°. A few candidates used values which were not multiples of 180, particularly 450°. Some candidates equated the sum of the angles involving a to the sum of the other angles.

(c) A variety of methods were used as a starting point in this question. Most opted to use the efficient method of simple trigonometry and calculated either angle *PQM* or angle *QPM*. Some did not realise that triangle *QRM* was congruent and repeated the process a second time. Having found a correct value for the angle *PQR*, most candidates opted to use the formula for the sum of the angles in a polygon rather than work with the exterior angle. More efficient methods used the cosine ratio, a significant number of responses involved the calculation of *PM* before using the sine or tangent ratio. Others used *PM* to find *PR* before using the cosine rule. In most cases, the less efficient methods resulted in a loss of accuracy for angle *PQR* because of premature rounding in the intermediate values.

Question 5

(a) (i) A minority of candidates worked with the most efficient common denominator of 12b. Many of the candidates attempted to get a common denominator of (4b)(6b). An error seen at this stage involved simplification of the denominator, usually to 24b. Some responses did not give the final answer as a single fraction as required, leaving the numerator as $9a – 2a$ or $a(9 – 2)$.

(ii) Candidates who noticed the numerator of the first fraction was the difference of two squares were usually able to factorise correctly and complete to a single fraction in its simplest form. Occasionally candidates did not cancel the fraction by dividing the numerator and denominator by 2. It was not uncommon to see individual components of the numerator being incorrectly cancelled with individual components of the denominator, often resulting in a final answer of $\frac{b-3}{3}$.

(b) Many candidates attempted to correctly expand the right-hand side of the equation. Errors seen expanding $–5(x + 4)$ were usually $–5x + 20$ or $–5x + 4$. Most were able to correctly gather the terms involving x and the numbers onto separate sides of the equation in order to complete the solution. Occasionally arithmetic errors were seen with the collection of the constant terms. There were a minority who did not understand the order of operations on the right-hand side of the equation with some writing the first step as $x \times 4 – 5(x + 4)$ or $–4\ (x + 4)$.

(c) Generally, this part of the question was well done with candidates correctly forming a quadratic equation, showing their method for solving and going on to give the dimensions of the card. Common errors when forming the equation were to forget to subtract the unshaded area, to have the unshaded area as y or $2y$, to add the unshaded area or to write $2y \times y + 3$ and obtain a two-term quadratic. The method of solving the quadratic was not always shown but is necessary when the candidate has been asked to 'Show all your working'. Some candidates attempted to use the quadratic formula to solve their equation, however the fraction did not always include both parts of the correct numerator. Occasionally candidates gave the two solutions of their quadratic equation as the dimensions of the card, even when one of them was negative. Other candidates who solved their equation were able to use their positive solution to calculate the dimensions of their card.

Question 6

(a) Better responses converted the two distances into the same unit in order to obtain the scale in the correct form. Some responses show an incorrect conversation of 4 km into centimetres. Others, having converted to 400 000 cm, did not state the ratio in the correct form. Many responses started with the ratio 4:5, or implied this with an answer obtain from use of 1.25.

(b) Many candidates knew how to find a bearing and measure it accurately. Common errors were to measure in an anticlockwise direction or to give the bearing of *B* from *A*.

(c) There were a high proportion of diagrams where *C* was positioned correctly. A smaller number succeeded with one or other of the bearings, the 120° from *A* being most often correct. Some responses did not include an attempt at the bearings while others showed a lack of understanding of how to measure a bearing correctly.

(d) Most candidates who correctly positioned *C* were able to find the actual distance. Many other candidates demonstrated the ability to accurately measure the distance between two points.

(e) (i) Knowledge of how to use the sine rule was demonstrated by many candidates. Not all of these candidates showed the explicit sine rule, and went straight to an answer which was often not correct to one decimal place. Premature approximation was often noticed when candidates showed intermediate working, resulting in an inaccurate final answer. Some candidates assumed the triangle was isosceles while others treated it as a right-angled triangle.

(ii) Understanding of finding the speed by dividing a distance by a time was seen in many responses. A common misunderstanding was evident in attempts to convert 12 minutes 20 seconds into a time in hours; responses including times of 12.2 or 12 to calculate the speed were often seen. Some responses involved calculations in seconds, with some showing no attempt to convert to hours and others making an incorrect attempt. A few responses were based on the wrong distance, the most common values being 4 km and 4.8 km. Premature approximation often resulted in an inaccurate value for the speed.

Question 7

(a) Nearly all candidates evaluated the *y*-coordinate correctly.

(b) The majority of the candidates were able to plot the points and join them with a smooth curve. Some errors were seen with plotting, usually involving the last three points plotted lower than needed. Better responses used a curve and included the first or last section of the curve.

(c) A good understanding of finding the equation of a straight line was demonstrated by many candidates. Arithmetic errors were sometimes present when calculating the gradient or when rearranging the equation to find the value of *c*. Accuracy was sometimes lost when candidates drew the line and attempted to use two points on it to determine the gradient, rather than use the values given in the table.

(d) Only a minority of candidates scored both marks for this part of the question. Many attempts to draw the line were seen passing through (1, 3) but with the incorrect gradient. Occasionally there were slight inaccuracies with the gradient of the line which led to a value for *k* outside the range permitted. Some attempts to solve the problem algebraically were seen, rarely with success, rather than drawing the line as indicated in the question.

Question 8

(a) Most candidates understood how to find the required probability. A common wrong answer was $\frac{46}{75}$, from including an extra interval.

(b) This was well answered with few errors made in stating the frequencies or the midpoints. Attempts to reach the answer by multiplying by the class width or dividing by the number of intervals were rarely seen. Occasionally arithmetic slips were made.

(c) There were generally three types of graph drawn for this cumulative frequency graph. There were responses in which the points were plotted correctly scoring full marks. There were some responses in which the correct cumulative frequency values were plotted at either the midpoint or the lower bound of each interval. In some cases, either a bar chart or a frequency polygon were drawn.

(d) Many of the candidates knew the median was the middle value, however several thought that the total frequency was 80 and so read their graph at 40.

(e) Candidates found this part challenging. A common error seen was due to reading from the graph at 15 and not 60. Some responses used the total frequency as 80, resulting in readings of 16 or 64.

(f) Those who had drawn the correct cumulative frequency curve usually scored in this part, although on occasion a non-integer value was given. An incorrect value of 18 was often seen from reading from a displaced graph. Candidates are encouraged to consider if their answer is reasonable in the context of the question.

Question 9

(a) Many candidates recognised the need to use the cosine rule and were able to calculate the length of *AB* correctly. Better responses observed the rules of accuracy, common yet inaccurate values seen were either 6.8 or 6.83. Writing cos 27 as 0.89 and using this truncated value also led to inaccurate answers. A small number of candidates drew a perpendicular from *B* to *AC* and used a combination of trigonometry and Pythagoras' Theorem, with better responses working to appropriate levels of accuracy throughout. The incorrect use of the sine rule or use of an incorrect cosine rule were common errors.

(b) Although many candidates seem familiar with the formula for the volume of a prism, the interpretation of the area of the cross section caused some difficulty. Some correctly worked out the area of the triangle, but there were candidates who truncated their final answer. A common error involved the omission of 0.5 in the formula for the area of the triangle.

(c) Candidates found this part challenging. Many candidates equated the volume of the prism to the volume of the carton, not realising that the cuboid carton would only be half full. Those who realised that they only needed to work out the height of the triangle usually did so correctly.

Question 10

(a) (i) Most candidates answered this correctly. A common incorrect answer was $\begin{pmatrix} -7 \\ -11 \end{pmatrix}$.

(ii) The majority of the candidates knew how to find the magnitude of a vector and many of these went on to give a comparison of lengths. Common errors seen included comparing the values within the vectors or adding each vector component to compare the total.

(b) (i) This part was generally well answered, although some candidates made a slip with the signs in the expression. Some responses stated the answer in terms of $\overrightarrow{OA}$ and $\overrightarrow{OB}$ instead of **a** and **b**.

(ii) Many candidates obtained a correct vector route and went on to reach the vector required. Candidates who chose to go via *P* tended to fare better than those who chose to go via *B*.

(iii) Better responses demonstrated a good command of vector algebra and included a correct vector for $\overrightarrow{AR}$, however not all went on to complete the proof. Some responses included the vector $\overrightarrow{OR}$ and did not go on to find $\overrightarrow{AR}$. Some working included a step interpreting $QR = 2OQ$ to mean that $\overrightarrow{OR} = 2\overrightarrow{OQ}$. Arithmetic errors were often seen, as was reversing the vector direction. Several candidates chose not to attempt this question.

Question 11

(a) Most candidates seemed familiar with the function notation and were able to correctly substitute.

(b) Few responses led to correctly finding inverse function. The most common slip was to start this question by rearranging it to $4y = 7x - 1$. There were a few responses that showed correct rearrangement but then did not express the inverse in terms of *x*.

(c) A large number of candidates who successfully equated $3(t - 2) = 6$ were able to obtain $t = 4$. A common incorrect answer was 12 from $3(6 - 2)$.

(d) About a third of the candidates were able to obtain the correct values for *p* and *q*. Many candidates were able to obtain a correct expression but made slips when rearranging it into the correct form. Other candidates rearranged it into the correct form but did not state the values of *p* and *q*. Answers of 21 and –36 were also seen where candidates multiplied by 4 at some stage in their working.