

MATHEMATICS D (CALCULATOR VERSION)

Paper 4024/11

Paper 11

Key Message

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

General comments

There were some good scripts seen and most questions had been attempted successfully by some candidates. However it was apparent that many candidates had difficulties knowing how to approach a significant number of the topics. There were a few candidates who stopped working well before the end but this was most likely due to the difficult nature of the questions rather than a lack of time to complete the paper.

Candidates should show all necessary working in their solutions. Presentation was often good, but attention needs to be given to presentation of some figures. 1, 4 and 7 were sometimes difficult to distinguish, as were some 6's and 8's and candidates sometimes misread their own figures. Care should be taken in transferring the answer obtained in the working space onto the answer line.

Erasing pencil working makes it impossible to award method marks for a wrong answer and the debris left behind can obscure the answer on the answer line. If an answer is changed, it should be crossed out and replaced rather than overwritten.

Comments on specific questions

Question 1

- (a) The rules for the order of operations in arithmetic were understood by many candidates. There were two common errors. The first was to calculate $(3 + 5)(3 - 1.4)$ and the second was to calculate $3 + 5 + 1.6$.
- (b) This part was generally well answered with the common error being the placement of the decimal point.

Answers: (a) 11 (b) 0.014

Question 2

- (a) This part was answered well. Errors included leaving the answer as $1 - \frac{2}{15}$ (or $1 - \frac{-2}{15}$) or writing this subtraction as an incorrect decimal e.g. 0.7.
- (b) This part was generally well answered with the common error being to not cancel the fraction to its lowest terms.

Answers: (a) $\frac{13}{15}$ (b) $\frac{4}{7}$

Question 3

- (a) Most candidates changed the numbers to decimals and others converted them to fractions with 900 as the denominator. $\frac{2}{3}$ was often correctly found as 0.666... in the working and this was then occasionally rounded to either 0.67 or 0.66 before being placed on the answer line, making it identical to one of the other decimals. $\frac{7}{9}$ was sometimes written as 0.63. At times the values were written in order starting with the largest.
- (b) Many candidates used the correct method for finding a percentage decrease. The common errors were to find 80%, rather than 20%, and to use 4, rather than 5, as the denominator.

Answers: (a) 66%, $\frac{2}{3}$, 0.67, $\frac{7}{9}$ (b) 20

Question 4

- (a) Many candidates were not confident converting decimal parts of an hour to minutes. The common errors were to write 2.4 h as 2 h 4 min thus reaching an answer of 2 h 59 min or to write it as 2 h 40 min and reaching an answer of 2 h 95 min which was then converted to 3 h 35 min. Occasionally those who worked in minutes reached 199 min then divided to give a decimal answer.
- (b) The topic of upper and lower bounds did not seem to be fully understood. Common incorrect answers included 1500, 1540, 1499 and 2000. The correct upper bound of 1.55 kg was then sometimes not converted to grams.

Answers: (a) 3 hours 19 minutes (b) 1550

Question 5

The first step of multiplying by their denominator was frequently correct but errors were then made in reaching the final answer, including not changing the variable, thus giving the answer as $\frac{3}{5y-2}$. Care should be taken to write the answer as $\frac{3}{5x-2}$ or $3/(5x-2)$ rather than $3/5x-2$. Sometimes the first step of $5xy = 2x + 3$ was converted back to $\frac{2x+3}{5x}$. One misunderstanding was to think that $f^{-1}(x)$ is the reciprocal of $f(x)$, thus giving $\frac{5x}{2x+3}$ as the answer.

Answer: $\frac{3}{5x-2}$

Question 6

Candidates often did not recognise this as a question in estimating and attempted both long multiplication and division. Those who gave approximations to the 3 values were usually able to score the mark for the square root being approximately equal to 4. The expected approximations for 304.3 (of 300 or 304) and for 0.1975 (of 0.2) were not always used. 0 was a common value chosen for 0.1975. Positioning the decimal point in the answer caused some problems with 608 being a common incorrect answer. A common error in the calculation $\frac{1216}{0.2}$ was to give an answer of 680.

Answer: 6000, 6080 or 6100

Question 7

Many candidates were able to deal with the multiples of the vectors. Those who recognised that there were 2 equations to solve were often able to score at least one mark. There were a number of arithmetic errors made, particularly in dealing with the signs.

Answer: $x = -5$, $y = 4$

Question 8

- (a) The method was generally understood but slips were made in the subtraction and answers were often not converted correctly to standard form (with answers such as 21.8×10^5). Errors included dividing rather than subtracting the 2 amounts.
- (b) There was some confusion over which amounts to use – often the answer to **part (a)** or 2.3×10^6 was divided by 4. Again, non standard form answers such as 0.3×10^5 were given.

Answers: (a) 2.18×10^6 (b) 3×10^4

Question 9

Many candidates were able to solve the 2 inequalities but the answers for a and b were often reversed on the answer line. At times the attempt to solve the inequalities resulted in a solution of -3 and -9 from $13 - 7 < -2x < 18$. If the inequality sign was changed in the solution, the signs were then sometimes incorrectly changed too, resulting in answers of 5.5 and 3 . A few answers of 13 and 18 were given with no attempt to solve the inequalities.

Answer: $a = -5.5$, $b = -3$

Question 10

This question was generally answered well with those not gaining full marks often scoring one for a partial factorisation. A few candidates continued to try to solve an equation.

Answer: $(x - 5)(2y - 3)$

Question 11

There was a general misunderstanding of the question by some candidates who assumed they only had to give one answer for each part.

- (a) A common incorrect answer was parallelogram.
- (b) A common incorrect answer was square.
- (c) Those candidates who gave correct but incomplete answers to all 3 parts were able to score a mark in this part. A common incorrect answer was to include parallelogram.

Answers: (a) rectangle, rhombus (b) parallelogram, rectangle, rhombus (c) rectangle, square

Question 12

- (a) This part was answered well. A common incorrect answer was -10.3 .
- (b) There was a wide variety of answers given, ranging from -7 to 293 . Those who recognised the direct proportion relationship between temperature and angle were often able to reach the correct answer.
- (c) This part was generally well answered.

Answers: (a) -13 (b) 35 (c) -5

Question 13

- (a) Answers containing the figures 25 were common but the wrong power of ten was often used. 2.5 was the most common incorrect answer.
- (b) Using direct proportion or the unitary method usually produced the correct answer. There was some confusion over units.
- (c) Area scale factor is a difficult mathematical skill. The common error was to use a linear scale factor, calculating 8 divided by 2 and multiplied by 5, giving an answer of 20.

Answers: (a) 250 000 (b) 14 (c) 50

Question 14

- (a) There were many correct answers but 7, 3 and 6 were common incorrect answers.
- (b) Many candidates knew that finding the mean involved Σfx and they were able to show the correct method to find this, even though arithmetic errors were occasionally made. Those who continued to divide by 50 were usually successful although cancelling did cause a few problems. The mean is 3.8 and so should not be then rounded to 4. Others divided by 6, giving an answer which clearly did not fit the original data and this was rarely recognised by candidates. Occasionally the sum of the scores divided by 6 or $50/6$ was thought to give the mean.

Answers: (a) 5 (b) 3.8

Question 15

- (a) Completing Venn diagrams continues to cause difficulties for many candidates. The most common answer was to incorrectly draw 3 intersecting loops. Many unnecessarily put numbers in the sets, including 1 as a prime number.
- (b) The answer was often given as 2, which is not greater than 5, or multiples of 4 such as 4 or 24. If a list of possible answers is given they must all be correct in order to score the mark. Occasionally an odd number was given as the answer.

Answers: (b) 10 or 14 or 22 or 26 etc.

Question 16

- (a) Candidates generally knew the correct formula for the area of a trapezium but sometimes selected the wrong values from the diagram.
- (b) The method of finding the areas of the separate faces and adding was understood but one face, often 20×5 , was frequently missed out of the calculation. The volume of the solid was sometimes found.

Answers: (a) 12 (b) 344

Question 17

- (a) The most common answer was (0,-2) rather than (0,-3) and there were also answers with the y (rather than the x) coordinate equal to 0. Some candidates found the 2 points on the axes then gave (1.5,-3) as their answer.
- (b) Finding the inequality $y > \frac{1}{4}x$ caused problems. One mark was sometimes awarded for $2x - y > 3$ or for an attempt to use $y = \frac{1}{4}x$.

Answers: (a) (0, -3) (b) $y > \frac{1}{4}x$, $2x - y > 3$

Question 18

- (a) The common incorrect answers were $3a^8$ or $9a^6$.
- (b) A good proportion of answers were correct. Common incorrect answers were 8 , $\frac{1}{2}$, $\pm\frac{1}{16}$ or $\frac{1}{4}$.
- (c) The correct answer was often seen. Common incorrect answers were 9 , 3 and $\sqrt[3]{1}$.
- (d) Few candidates were able to deal with fractional indices. The most common answer was to solve $12\frac{1}{2} \div 3\frac{3}{2}$ giving an answer of $2\frac{7}{9}$. A few were able to change $12\frac{1}{2}$ to $2 \times 3\frac{1}{2}$ but then tried to divide the powers rather than subtract them.

Answers: (a) $9a^8$ (b) 16 (c) 1 (d) $\frac{2}{3}$

Question 19

- (a) There were many attempts to use the interior angle formula but most tried to use $160 = (n-2) \times 180$. Those few who found the exterior angle first were more successful although there was some careless cancelling of $360/20$.
- (b)(i) This part was usually well answered.
- (ii) There were quite a number of correct answers with common incorrect answers of 160 (the interior angle of the polygon) or 170 or 20 .

Answers: (a) 18 (b)(i) 10 (ii) 150

Question 20

- (a) This part was answered very well. A few, often able, candidates missed this part out.
- (b) This part was answered very well with just occasional incorrect additions of 6 .
- (c) The correct answer was not as common as $n + 6$. Some candidates used $a + (n - 1)d$, not always successfully. Less able candidates often gave a numerical answer.
- (d) Those who included $6n$ in their answer for **part (c)** often gave a correct explanation. A number of candidates recognised that 100 was not a multiple of 6 or that the equation $6n + 6 = 100$ did not have an integer answer. A common error was to simply state that the numbers increased by 6 each time without giving the starting value. There was some confusion over the use of the words 'multiple' and 'factor'.

Answers: (b) $24, 30$ (c) $6n + 6$

Question 21

- (a) Those that read the question carefully and used inverse proportion were usually successful but many used direct proportion, giving an answer of 66 or $66\frac{2}{3}$.
- (b) Only those who recognised inverse proportion could score the mark. Some gave the formula $T = \frac{120}{A}$ rather than the expression $\frac{120}{A}$. Others gave $\frac{k}{A}$ with $k = 120$ seen in **part (a)**. Candidates giving $\frac{120}{T}$ did not answer the question.
- (c) Only the more able candidates were successful. Common incorrect answers were $3\frac{1}{2}$ and $\frac{4}{9}$. There were a number of no responses.

Answers: (a) 24 (b) $\frac{120}{A}$ (c) $\frac{3}{10}$

Question 22

- (a) This part was often correct but some candidates were unable to distinguish between the determinant and the inverse. Common incorrect answers were $\frac{1}{7}$ or 3.
- (b) There were a number of correct answers seen even if **part (a)** was incorrect. Some follow-through marks were scored.
- (c) Many candidates tried to use $\mathbf{AX} = \begin{pmatrix} 11 \\ -5 \end{pmatrix}$ but rarely wrote \mathbf{X} as a 2×1 matrix. Calculations often involved $\mathbf{X} = \begin{pmatrix} 11 \\ -5 \end{pmatrix} - \mathbf{A}$ or $\mathbf{X} = \begin{pmatrix} 11 \\ -5 \end{pmatrix} / \mathbf{A}$. Only a few used the inverse \mathbf{A}^{-1} and those who did often tried to find $\begin{pmatrix} 11 \\ -5 \end{pmatrix} \mathbf{A}^{-1}$.

Answers: (a) 7 (b) $\frac{1}{7} \begin{pmatrix} 1 & -2 \\ 1 & 5 \end{pmatrix}$ (c) $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$

Question 23

- (a) There were a reasonable number of correct answers. Incorrect answers included 1.5, 10 (from $60/6$) or the area of a triangle.
- (b) Many candidates recognised that the answer involved the intersection of the 2 lines and the correct answer was fairly common. Errors included writing answers such as 3.6 and there was some confusion over the units with answers such as 36 seconds being given.
- (c) It was common to measure the distance from P rather than Q , giving an answer of 24.
- (d) Of those who attempted this question, a number were able to draw the correct straight line. Incorrect answers included drawing a straight line from 2 pm to 6 pm or from top left to bottom right.

Answers: (a) 15 (b) between 33 and 39 inclusive (c) 36 (d) straight line from (3, 0) to (5, 60)

Question 24

Vector geometry continues to remain a mathematical concept that many candidates struggle with. There were a number of scripts with no response throughout this question.

- (a) Correct answers, sometimes unsimplified, were obtained by the more able candidates with common errors of $\frac{1}{2}\mathbf{q} - \mathbf{p}$ and $\mathbf{p} + \frac{1}{2}\mathbf{q}$.
- (b) More able candidates were able to score the mark here, occasionally as a follow-through from **part (a)**. The answer must be in terms of \mathbf{p} and \mathbf{q} and not e.g. **AD**.
- (c) This proved to be a challenging part for many candidates. Often the answer was not given in its simplified form.
- (d)(i) Only the more able candidates were able to attempt this part. There was often little recognition that the answer involved their answer to **part (c)** and that it must be in terms of \mathbf{p} and \mathbf{q} .
- (ii) Only the more able candidates were able to make a valid attempt at this part and very few correct answers were seen.

Answers: (a) $\mathbf{p} - \frac{1}{2}\mathbf{q}$ (b) $\frac{1}{3}\mathbf{p} - \frac{1}{6}\mathbf{q}$ (c) $\frac{1}{3}\mathbf{p} + \frac{5}{6}\mathbf{q}$ (d)(i) $\mathbf{p} + \frac{k}{2}\mathbf{q}$ (ii) 5

Question 25

- (a) There were quite a number of correct answers within the range. The common error was to measure the wrong way on the protractor and give an answer of 43° and there were some examples of inaccurate measuring. There was some evidence that not all candidates had a protractor.
- (b) Candidates were more successful at drawing the perpendicular bisector than the line parallel to AD . A number of candidates drew circles of radius 4 cm at A and D but did not draw the straight line between them.
- (c) The shaded region was often drawn incorrectly between the straight line and the arcs of the circles.
- (d) Common errors were to mark P on the perpendicular bisector, the intersection of their 2 loci or on CD .

Answers: (a) 136° to 138°

Question 26

- (a) Many candidates knew the size of the angle was 90° and showed some recognition of the reason why but needed to use the words 'tangent' and 'radius' (or 'diameter') in their explanation.
- (b) Some candidates, usually the more able ones, realised that their solution had to involve Pythagoras' theorem in triangle OTB and made a recognisable attempt at it. Forming the correct Pythagorean equation involving $(x + 10)^2$ proved to be more challenging. Those who did use the correct equation then had problems expanding $(x + 10)^2$, often writing $x^2 + 100$. Few were able to successfully solve the equation to reach $x = 75$. There were a number of no responses in this part.

Answers: (a) 90° ...tangent- radius property (b) 75

MATHEMATICS D (CALCULATOR VERSION)

Paper 4024/12

Paper 12

Key Message

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

General comments

The question paper assessed candidates of all abilities. Presentation of the work was usually good. However, some scripts were quite disorganised and marks were lost through carelessly planned work and misreading of figures.

Questions that were most accessible were 1, 2, 3(a), 12, 15(a), 16(b), 19, 22 and 26(a).
Questions that proved particularly challenging were 8(b), 9, 18(b), 27(b)(ii), and 28(b)(ii).

At times, candidates appeared not to read the questions carefully. They should be encouraged to pay careful attention to the wording, the numbers given, the units used and the units required in the answer. In particular, they must understand what is meant by “lowest terms”.

It was noticeable that a significant number of candidates need to improve their ability to estimate, approximate and use appropriate degrees of accuracy, and to understand the integer class of number. Some candidates were very competent at performing standard techniques, and yet seemed to find it difficult to recognise the appropriate mathematical procedure required for a given situation.

Candidates need to improve their skills in manipulating fractions and in basic arithmetic. Work, that was otherwise good, was spoilt by calculations such as $57 - 32 = 35$; $-30/5 = 6$; $90 \times 20 = 180$ and $16 \times 0 = 16$. Candidates need to be aware of the advantage in simplifying fractions involving products by cancelling a number in the numerator with one in the denominator at the beginning rather than doing this, or even using long division, at a later stage. Thus $\frac{30 \times 360}{45}$ is equal to $\frac{2 \times 360}{3}$ (at a first stage, by cancelling 5s and 3s), which in turn is 2×120 , rather than by evaluating $\frac{10800}{45}$.

There were a small number of scripts that contained answers only, with no supporting workings. This practice tends to disadvantage candidates as it is not possible to award marks for appropriate methods or intermediate results.

Candidates should be made aware that only their final answer to each question should be written in the answer space. Alternative offerings and working should not be written there. When an answer is to be changed, it is far better to delete and replace the original one rather than attempt to write over it. Care should always be taken to ensure that answers obtained in the working are accurately transferred to the Answer Space.

Comments on specific questions

Question 1

(a) This was well answered on the whole. Some attempts showed that some candidates need to get an understanding of the necessity of expressing the two fractions with a common denominator. A few candidates gave the answer $1\frac{-1}{36}$.

(b) This was also well answered. The common incorrect answer was 1.8 from $(0.7 - 0.1) \times 0.3$.

Answer: (a) $\frac{35}{36}$ (b) 0.4

Question 2

(a) Most candidates made a good attempt at this question. Some gave \$20, \$15, or \$45 as their answer.

(b) Most candidates attempted to convert the times to a common unit, though not always successfully.

Answer: (a) 18 (b) $1\frac{3}{4}$ hours, 6 500 seconds, 110 minutes

Question 3

(a) Most candidates answered this question correctly.

(b) Many candidates knew what to do in this question, but often made an error in the conversion from litres to millilitres, not realising that 1 litre = 1000 ml. Incorrect answers such as 50, 500, or 5000 were often seen.

Answer: (a) 6 (b) 5

Question 4

(a) This part was usually answered correctly, though some left their answer as $\frac{0}{2}$, or else gave "indeterminate" as their answer, or converted $\frac{0}{2}$ to 0.5.

(b) Those candidates competent with algebra and familiar with inverse functions gave a correct answer, although a few gave an answer that was not expressed in terms of x . Others made errors like $2y = x + 3$ implies $x = \frac{2y}{3}$.

Answer: (a) 0 (b) $2x - 3$

Question 5

(a) Many candidates seemed to be familiar with standard form. The most common incorrect answer was 4.2×10^5 . Others used 42 instead of 4.2.

(b) Many candidates made a reasonable attempt at this question. A common incorrect answer was 21×10^6 . A few converted the numbers to their full form, then used long multiplication, and finally converted the result back to standard form.

Answer: (a) 4.2×10^{-5} (b) 2.1×10^7

Question 6

Many candidates demonstrated that they were familiar with inequalities and integers but others showed that they have still to acquire this familiarity.

- (a) This was often answered correctly. Common errors were to solve an associated equation, and then merely to write “6” in the Answer Space, or to go from $-3x < -18$ to $x < 6$. Some solved the inequality correctly, but omitted to write the “>” symbol between the x in the Answer Space and their 6.
- (b) This was also often answered correctly. Some candidates need to learn the meaning of an “integer”. Common incorrect answers were -6 , or $-5\frac{2}{3}$, or 6. Some gave a list of values.

Answer: (a) $x > 6$ (b) - 5

Question 7

Many candidates knew the properties of indices and answered both parts correctly.

- (a) To answer this question correctly, candidates need to know that $4^0 = 1$ and $4^{-2} = \frac{1}{4^2} = \frac{1}{16}$. It was clear from many answers that these results are not known by some candidates.
- (b) This part was generally answered better. The usual errors were to write 2 or 6 instead of 8; to write 2, 5 or 8 instead of 6.

Answer: (a) $\frac{15}{16}$ (b) $8x^6$

Question 8

- (a) Many candidates evaluated 2^5 correctly as 32 and went on to answer this part correctly.
- (b) Candidates struggled more with this part. Most candidates tried to use a “difference” method. Successful candidates compared the given sequence with the one at the beginning of the question and noted that in the given sequence the first term was 1 more, the second term 2 more, the third term 3 more and the fourth term 4 more. Hence the n th term was n more.

Answer: (a) 25 (b) $57 - 2^n + n$

Question 9

- (a) Few candidates used the fact that the sum of an interior angle and an exterior angle is 180° to set up an equation such as $x + px = 180$. Most candidates used, to no effect, the formula for the sum of the interior angles, or the fact that the sum of the exterior angles is 360° . Answers frequently were expressed in terms of n , a letter that was not used in the question.
- (b) Only a few of those who answered part (a) correctly divided this answer into 360 to obtain the correct answer. Many of the responses were numerical.

Answer: (a) $\frac{180}{p+1}$ (b) $2p + 2$

Question 10

Many candidates did not seem to be familiar with set notation. For those who were familiar, the set A was usually drawn correctly more often than the set C. It was common for the set A to be drawn intersecting, or identical to set B, and for C to be completely outside set B or to intersect the set A. At times the letters were placed on the diagram with no drawing for the two sets. The most common error was to draw three overlapping loops, often ambiguously shaded.

Question 11

This question showed that many candidates need to improve their understanding of the concepts of writing numbers correct to two significant figures and how to use these values to find approximations to calculations. Some candidates corrected the numbers to two decimal places. Others wrote down the first two digits of each number. Those candidates who responded correctly to the instruction "By writing each number correct to two significant figures" usually went on to obtain the correct answer very economically. A small number of candidates used long multiplication, with no correction at all, sometimes subtracting 0.2034 from 110.94 as a first step. Answers of 6.0 suggested that candidates were confusing one significant figure with one decimal place.

Answer: 6

Question 12

Nearly all candidates started by calculating 150% of 8 cm as 12 cm. Only a minority went on to add 8 cm to obtain the correct answer. A few candidates used $8 \times \frac{100}{150}$.

Answer: 20

Question 13

This question was, on the whole, well attempted. Slips in arithmetical calculations were not uncommon. A few candidates used direct proportion, or inverse proportion with the square of x .

- (a) This was often correctly answered.
- (b) This was often correctly answered. A common error was to give $q = 5$, from reading the value in the table.
- (c) This was also often correctly answered. Some candidates gave the response $\frac{k}{n}$, or an irrelevant number.

Answer: (a) 15 (b) 12 (c) $\frac{60}{n}$

Question 14

- (a) This was usually answered correctly, with 47° , 23.5° , 133° , 84° and 90° being common incorrect answers.
- (b) Many candidates realised that they needed to use the "opposite angles in a cyclic quadrilateral are supplementary" theorem, and obtained the correct answer. The common error was to apply this theorem to the quadrilateral $OBCD$, which is not cyclic.
- (c) Many candidates used the property of angles in the isosceles triangle OBD to find angle OBD . Some simply subtracted their angle BOD from 180° and did not divide the result by 2.

Answer: (a) 94° (b) 133° (c) 43°

Question 15

- (a) The majority of candidates drew the correct line. A few omitted this part.
- (b) Most candidates started with the correct $\frac{168}{360}$, but some could not express this fraction correctly in its lowest terms. A final answer of $\frac{21}{45}$ was frequently given. Some attempted to find the *number* of people who liked C best.
- (c) Many candidates answered this question correctly. Some started correctly, and obtained $\frac{360 \times 30}{45}$, but could not simplify this expression correctly. Others tried to find the number of people who liked each of the songs and usually made an error in so doing. 108, from 30% of 360, was seen occasionally.

Answer: (b) $\frac{7}{15}$ (c) 240

Question 16

Many candidates need to understand the difference between bar charts and histograms.

- (a) This part was answered correctly by some, but the common incorrect answer was 2. A few gave 6, from 3×2 , having misread the length of the base; others gave 1, from $2 = k \times 2$.
- (b) Nearly all candidates drew the rectangle with base 4 to 5 correctly. The rectangle with base 5 to 8 was usually drawn, incorrectly, with a height of 3.

Answer: (a) 4

Question 17

Many candidates seem to lack understanding of the topic of upper bounds and the principles involved.

- (a) Some candidates answered this part correctly. Common incorrect answers were 57, 57.05, 58, 62.
- (b) Answers to this part were very variable. Few candidates seemed to realise that the correct method was to multiply their **part (a)** answer by 4 and divide the result by 10. Many started with a different value to their **part (a)** answer, sometimes multiplying by 2 instead of by 4, sometimes adding 0.5 or 0.05 to their answer, and sometimes dividing by a number other than 10. A few multiplied by 10 or by 100.

Answer: (a) 57.5 (b) 23

Question 18

- (a) There were many correct answers to this part. A few candidates seemed to have little understanding of the 24-hour clock and gave an answer, such as 30 18, where the number of hours is greater than 24. A few others used 7.5 hours and gave the number of minutes as 98. Occasionally the answer was given as a period of time instead of a time of day. Common incorrect answers were 5 18; 8 18; 7 18.
- (b) Answers to this part showed that very few candidates understood that an average speed is calculated from dividing the total distance travelled in the journey by the time taken for the whole journey. Many candidates found the average of 30 and 20. Some interpreted 150 km as a speed. Some assumed that the whole journey took 5 hours. Very few calculated the distance travelled during the rest of the journey as 50 km, from $20 \times (7\frac{1}{2} - 5)$, and thus that the total distance travelled is 200 km.

Answer: (a) 06 18 (b) $26\frac{2}{3}$

Question 19

Most candidates showed that they were familiar with solving simultaneous equations. The usual errors were not to multiply both sides of an equation when trying to obtain equal coefficients, to mishandle negative signs, or to obtain $y = 6$ from $5y = -30$.

Answer: $x = 9, y = -6$

Question 20

- (a) The minority of candidates who realised that angle BCA is equal to angle YZX usually obtained the correct answer.
- (b) Some candidates used the properties of the corresponding sides of similar triangles correctly. A few got as far as $\frac{15}{4}$, but then could not simplify this fraction correctly. Common incorrect answers were 2.4 from using the ratio of the non-corresponding sides BC and XY , or 4.
- (c) Few candidates used the property that the ratio of the areas of similar triangles is equal to the ratio of the squares of corresponding sides and were able to write down the correct answer. More candidates used the formula $\frac{1}{2}ab \sin C$ to find the areas, with varying success. Occasionally the answer $\frac{9}{25}$ was offered.

Answer: (a) $180 - x - y$ (b) $3\frac{3}{4}$ (c) $\frac{9}{16}$

Question 21

Attempts at this question showed that some candidates need to get a better understanding of the properties of a speed-time graph, and to appreciate that the “D-S-T triangle” is not a valid method when there is an acceleration or deceleration.

- (a) Some candidates realised that the gradient of a line was required. The incorrect answers 50, or $\frac{1}{5}$, or 0.5, or 24 (from the speed when $t = 10$), occurred quite frequently.
- (b) More able candidates realised that the area under the graph was required. Attempts to partition and calculate this area varied. Some were correct. Others omitted one of the components, or incorrectly calculated the area of one of them, sometimes by a careless error in a length, e.g. a height being 90 instead of 50, or in an evaluation, such as $90 \times 20 = 180$. A common incorrect answer was 5000 (from 50×100).

Answer: (a) 5 (b) 3 400

Question 22

- (a) Many candidates gave a completely correct answer to this part. Others made errors in finding at least one element.
- (b) Some candidates are clearly confident in finding the inverse of a matrix. Others had a fair idea, but made an error in finding the determinant (usually as 6, instead of 2) or made an error in writing the adjoint matrix.

Answer: (a)(i) $\begin{pmatrix} 11 & -6 \\ -1 & -2 \end{pmatrix}$ (b) $\begin{pmatrix} \frac{1}{2} & 1 \\ \frac{1}{2} & 2 \end{pmatrix}$

Question 23

- (a) Those who recognised that the question involved a “difference of squares” usually obtained the correct answer. Common incorrect answers were $(9x - 1)(9x + 1)$, $3x(3x - 1)$, $3(x + 1)(x - 1)$, $(3x - 1)^2$.
- (b) Those candidates who attempted this question by first factorising the given expression in y usually went on to solve the equation correctly. Some candidates tried to use the quadratic formula, rarely with success. Errors were usually made in quoting the correct formula or in evaluating the number inside the square root. Others tried to treat the equation as a linear one.

Answer: (a) $(3x - 1)(3x + 1)$ (b) -15 and $\frac{1}{2}$

Question 24

Attempts at this question showed that many candidates are very familiar with averages, whereas others need to gain a better understanding, and be able to discriminate between the different types of average.

- (a) The common incorrect answers were 3, or 6.
- (b) The most common incorrect answer was 6.
- (c) Attempts at this part varied. Many attempted to calculate $\sum fx$, often successfully, sometimes with an error such as $16 \times 0 = 16$ (even when 0×5 was evaluated as 0), sometimes with an elementary addition error. Having found $\sum fx$, most divided by 40, although others divided by 7.

The fraction $\frac{64}{40}$ was not always simplified correctly. The common incorrect method was to obtain 40 as $\sum fx$ and then to divide by 7 or by 2.

Answer: (a) 0 (b) 1 (c) 1.6

Question 25

- (a) Most candidates made an attempt to write down inequalities based on the equations $x + y = 12\frac{1}{2}$ and $x = 2$. Some were completely correct, others chose a wrong inequality symbol, or else used a symbol that included an equals.
- (b) Some answers showed that some candidates assumed that the sets P and Q contained numbers and not the coordinates of points. Other answers suggested that some candidates concentrated on the printed axes numbers and did not consider integers between those shown.
- (i) This was sometimes correct. The common incorrect coordinates answers were (8, 4), or (8, 2).
- (ii) This was also sometimes correct. The common incorrect answer was 2, with 1, 5, 6, 8, 48, 7, 10 and $7y$ being given occasionally.

Answer: (a) $x > 2$, $x + y < 12\frac{1}{2}$ (b)(i) (9, 3) (ii) 4

Question 26

- (a) This was often answered correctly. Some candidates seemed unaware that, to answer this type of question accurately, it is essential to use a pair of compasses. Occasionally D was positioned below the line AC , or the lengths of AD and CD were interchanged or misread.
- (b)(i) Some candidates constructed one, or both lines correctly. Others made no attempt, or else made an incorrect construction, such as drawing a circle, centre A , with radius 2.5 cm.
- (ii) Some candidates bisected angle B , as required. Others made no attempt, or else drew incorrect lines such as a perpendicular bisector of a line, or the bisector of another angle.
- (c) Only those candidates who were very proficient at constructions answered this part correctly.

Answer: (c) 5.4 to 5.7

Question 27

- (a) (i) Answers were either correct or usually 90° or 180° . Some seemed to ignore the word anticlockwise given in the question and gave 90° clockwise.
- (ii) This was answered correctly by the more able candidates. Others confused x - and y - coordinates. Common incorrect answers were (3, 1) or (2, 1).
- (b) (i) Many candidates gave the correct answer. Others gave 3, or 1, or 2:1, or omitted this part.
- (ii) There were very few correct answers to this part. Common incorrect answers were x -axis, or y -axis, (both of which are not *equations*); $x = 1$; $x = 0$; $y = mx + c$. Many omitted this part.

Answer: (a)(i) 270° (ii) (2, 0) (b)(i) 2 (ii) $x = -1$

Question 28

Answers to this question showed that many candidates need to gain a basic understanding of vectors. Others seemed to misunderstand the diagram and the statements clearly made in the question, and used a result like $\vec{FA} = \frac{1}{4}\mathbf{p}$.

- (a) (i) This was answered well by those who understood vectors. Common incorrect answers were $\mathbf{p} - \mathbf{q}$, or an expression involving fractions with the two vectors, or an expression using the letters F , A and E .
- (ii) This was answered well by those who understood vectors. Common incorrect answers were $4\mathbf{p} + 2\mathbf{q}$, or an expression involving fractions with the two vectors.
- (b) (i) Most of the more able candidates added $k \times$ their **part (a)(ii)** to a multiple of \mathbf{p} . Sometimes the correct multiple was given, but often it was (-3) or $(\frac{3}{4})$. A fairly common error was to take CD to be kBC .
- (ii) There were very few correct answers to this part. Many candidates omitted it. Some equated their **part (b)(i)** to their **part (a)(i)**, others chose the correct method of equating their **part (b)(i)** to a *multiple* of their **part (a)(i)**, but unfortunately chose, as the multiple, the same letter k as was used elsewhere in the question. Very occasionally k was given incorrectly as one vector divided by another.

Answer: (a)(i) $-\mathbf{p} + \mathbf{q}$ (ii) $-4\mathbf{p} + 2\mathbf{q}$ (b)(i) $(3 - 4k)\mathbf{p} + 2k\mathbf{q}$ (ii) 1.5

MATHEMATICS D (CALCULATOR VERSION)

Paper 4024/21

Paper 21

Key message

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

General comments

The paper provided adequate opportunity for the more able to demonstrate their ability whilst still being accessible to those of lower ability. Candidates appeared to have enough time to complete their solutions and most were able to deal with the arithmetical questions such as **Question 6**. Some understanding of algebra and trigonometry was demonstrated although the geometry of **Questions 7** and **11** proved more challenging.

This was the first year that candidates produced their answers on the booklet form of the question paper and they responded well to this. Their working seemed more focused than in some years now that these answers are presented in the area provided.

Some candidates are still losing marks because of insufficient accuracy in their answers or in their working. Unless the question asks otherwise, answers should be given to 3 significant figures, which will usually mean using four figures in the working and any money answers should include cents when appropriate (see **Question 6(b)**).

Comments on specific questions

Section A

Question 1

In general, all but the less able candidates were able to use trigonometry in their attempts to solve this question. A number of candidates lost marks through insufficient accuracy in answers or working. Candidates should make sure their calculators are set to Degree mode when they start the examination.

- (a) Simple use of tangent was the most direct method here and often applied successfully. Some preferred slightly longer methods, using the Sine Rule or finding PC first, generally with the same measure of success. Some used an incorrect trig ratio but their answers, used correctly in subsequent parts, could still score some marks.
- (b) The direct method was again to use tangent to find AB first but some found PC then considered $\triangle APC$. Those using the Sine Rule in this triangle were usually successful if sufficient accuracy was used but it was inappropriate to use a simple trig ratio since this triangle is not right angled.
- (c) This part was generally well answered with PC often found by Pythagoras' theorem and the relevant sides added. Some mistakenly found the perimeter of $\triangle ABC$ but since equivalent methods were needed to find this, some credit was given for applying correct techniques. Some less able candidates did not understand 'perimeter' and a few found the area instead.

Answers: (a) 3.64 (b) 8.24 – 8.28 (c) 24.2, 24.3

Question 2

Candidates' ability to deal with the algebra involved in this question was wide ranging and all but the less able candidates could use some standard algebraic techniques.

- (a) Those using the direct method of equating each factor to zero were often successful although some lost the negative sign and some gave insufficient accuracy in their decimal answers. Those multiplying out and trying to use the quadratic formula were often less successful.
- (b) Many candidates were familiar with the technique of equating coefficients to eliminate one of the unknowns and they made a correct start. Difficulty was experienced in dealing with the signs so that only the more able candidates could complete the solution correctly.
- (c) Again, many knew the technique required and made a good start, often following it through to completion. The main difficulty was expanding the numerator when the negative signs were involved. Candidates must remember that brackets are essential in the expression for the denominator.
- (d) Usually the idea of factorisation was appreciated and more able candidates were successful in their factorisation and cancelling. Candidates need to realise that simplifying usually requires some cancelling, although sometimes one of the factors was incorrect and cancelling was inappropriate.

Answers: (a) $0 \frac{-7}{3}$ (b) $x = 1 \quad y = \frac{-1}{2}$ (c) $\frac{6p+23}{(p-2)(2p+3)}$ (d) $\frac{q+1}{2q-1}$

Question 3

- (a) This was generally well answered. The value of 60° was usually given but there needed to be reference to alternate angles or Z angles to score the mark.
- (b) The understanding of bearings seemed to vary. A few candidates tried to measure the angles but the bearings needed to be calculated. Those understanding bearings often got all three parts correct. It was possible to score follow through marks after an initial error for answers in **parts (ii)** and **(iii)**.
- (c) (i) Examiners were looking for reference to the two triangles being equiangular or words that imply that. Often candidates were mentioning the sides, parallel lines or transformations such as enlargement without introducing the angles.
(ii) Only the more able candidates scored in this part. Others found it difficult to deal with the length of RQ which spans both triangles so that when the ratio 2:3 was used with 85, an incorrect answer of 56.7 was often given. Some incorrectly tried to use trigonometry to find a solution and less able candidates often left this part blank or simply tried to add or subtract the given figures.

Answers: (a) 60° alternate angles (b)(i) 130° (ii) 310° (iii) 250° (c)(i) triangles equiangular (ii) 51

Question 4

Candidates generally had a good understanding of probability.

- (a) (i) This part was well answered.
(ii) Again, this part was well answered but some misread the 9 as a 6 and gave an answer of $\frac{4}{5}$.
- (b) (i) The table was usually completed correctly.
(ii) Many were able to use the table to give the correct answers for **parts (a)** and **(b)**.
- (c) Only a few correct answers were seen for this part and candidates must understand that the individual probabilities need to be multiplied together in order to get this answer.

Answers: (a)(i) $\frac{1}{5}$ (ii) 1 (b)(ii) 0 (iii) $\frac{6}{25}$ (c) $\frac{1}{25}$

Question 5

Candidates generally found this question quite challenging. It was quite often left blank.

- (a) Some candidates correctly referred to $\triangle OAD$ being equilateral but it was not enough to simply say that AD was the same as OA . Others were able to use Cosine or Sine Rules to justify their answer.
- (b)(i) Some were able to get expressions for arc length. However confusion over the radius and difficulty in getting the answer in the correct form meant this mark was often not scored.
- (ii) Candidates needed to appreciate that arc AED was a semi-circle (which is stated in the question) but many instead used $\frac{1}{6}$ of a circle or used an incorrect radius.
- (c)(i) More candidates were able to score in this part, with correct expressions for the area of the sector often seen. Confusion over the radius limited success and the radius was often mistakenly taken as 6 cm.
- (ii) More able candidates recognised that the unshaded area $OAED$ was made up of a semi-circle and a triangle and attempted to evaluate these with varying degrees of success. The most common misconception was that the whole of $OAED$ was a 60° sector of a circle.

Answers: (b)(i) 4 (ii) $\frac{3}{4}$ (c)(i) 75.4 (ii) 45.7

Question 6

Many candidates were able to apply their arithmetical skills to score some marks in this question.

- (a)(i) Most cancelled the ratio down, generally successfully, although some stopped too soon and others went too far.
- (ii) More able candidates attempted to use a ratio in their working but care was needed to use $\frac{3}{8}$ and not $\frac{3}{5}$.
- (iii) A common misunderstanding was to find $12\frac{1}{2}\%$ of \$22 500. Candidates need to think carefully about which value represents 100% - the 2007 figure in this instance.
- (b)(i) Many were able to work out the amount paid using Plan A and to give an answer but some lost the mark by not including the cents in their answer.
- (ii) There were some good solutions seen here. Care was needed to include the \$395 deposit and to remember there were 24 monthly repayments in Plan B, not 12 as in Plan A.
- (iii) This part was quite well answered with most dividing by 2395. Candidates should take care that sufficient accuracy is used in their answer and that the reduction in the values is used.

Answers: (a)(i) 3 : 5 (ii) 9 600 (iii) 20 000 (b)(i) 252.48 (ii) 110.80 (iii) 33.4

Section B

Question 7

- (a)(i) Some candidates were able to identify sides or angles which were equal but few were able to concisely identify the three facts necessary for this congruency. The $\triangle PQR$ was often assumed to be equilateral and figures given in **part (ii)** were sometimes used, so PQ , QR and RP were often quoted as equal. However this is not known at this stage and full marks could not be awarded if this was used in the congruency proof.

- (ii) (a) More able candidates were able to write the ratio down straight away as the square of corresponding sides whereas others tried to find the actual areas of the two triangles, sometimes with success.
- (ii) (b) This mark was very rarely scored with most attempts trying unsuccessfully to find the actual area of $\triangle APR$. Candidates needed to develop the answer from **part (a)**.
- (b) (i) Some correctly recognised this as an angle in a semi-circle and others used $ABCP$ as a cyclic quadrilateral. Others gave less convincing reasons.
- (ii) Some had an understanding that the answer was something to do with angles at the circumference from an arc or chord but few were able to express it to score marks here. It was essential to recognise that the angles were from equal chords and not the same chord. The statement that PB bisects the angle APC , whilst true, was not a correct reason.
- (iii) This part was quite well answered with many correct answers for **part (a)** seen often followed by a correct **part (b)**.
- (iv) Candidates should use the diagram given to mark values of angles that can be deduced and whilst the correct answer for angle PDC was not seen very often marks, were often awarded for correct angles seen on the diagram.

Answers: (ii)(a) $\frac{16}{25}$ (b) $\frac{3}{25}$ (b)(iii)(a) 45 (b) 135 (iv) 98

Question 8

- (a) The graph was generally well plotted with the $y = 0.5$ points apparently causing the most problem.
- (b) Some candidates successfully drew the tangent but finding the value of the gradient proved more difficult.
- (c) (i) There were some good lines drawn for this part which were usually ruled. Candidates should attempt to find coordinates to plot their lines and this may have prevented some lines which were clearly misplaced.
- (ii) Most candidates who had drawn a line which intersected their graph were able to attempt to answer this part and care was needed in reading the horizontal scale. A few read the intersection with their tangent rather than the graph.
- (iii) Few candidates understood the connection between the equations of the line and curve and most attempts at this part involved substituting the value from **part (ii)** into the given quadratic expression but this does not identify B and C .
- (d) (i) A few were able to find expressions for $f(a)$ and $f(-a)$ and show what was required. Others chose to use a numerical value for a to demonstrate the result, but this mark was not often scored.
- (ii) A few more able candidates were able to plot this graph although most chose not to attempt this part.

Answers: (b) 5.5 – 7.5 (c)(ii) 1.3 (iii) $B = 4, C = 5$

Question 9

- (a) Generally candidates knew that the Sine Rule was needed for this part and applied it correctly. The fact that angle ABC was obtuse was either overlooked or misunderstood by many candidates so that full marks were often not scored.
- (b)(i) This part was the least well answered, and sometimes left blank, although some recognised that the Cosine Rule was required. Only the more able candidates succeeded in reducing their expression to the required quadratic. Less able candidates introduced squared terms by inappropriately attempting to apply Pythagoras' theorem to this triangle.
- (ii) The quadratic formula was generally quoted correctly and some marks scored. Candidates need to take care how they write the fraction line in the formula and how they deal with negative signs. When the answers were required to 3 decimal places it was necessary to use the square root to at least five figure accuracy. Those candidates taking care in these areas scored well.
- (iii) This mark was not scored very often as many candidates seemed not to realise that the previous part was in centimetres.

Answers: (a) 122° (b)(ii) 4.276 and -9.276 (iii) 93

Question 10

- (a) There were some good histograms seen but care was needed in the width and height of the last column. Candidates should always use the scale that is given in the question and, in this case, it may then have prevented frequency being used in the vertical scale rather than frequency density.
- (b)(i) Most candidates were able to complete this table.
- (ii) Many plotted the cumulative frequency curve to score marks in this part. Care was needed because the scale on each axis was different, so points such as 35 and 65 were sometimes misplaced on the vertical scale and also some started their curve at 30 rather than 35 on the horizontal scale.
- (c)(i) This was well answered with candidates usually reading their graph at a cumulative frequency of 70.
- (ii) This was not quite so well answered, and candidates need to show on their graph where they are obtaining their figures from. Since the lower quartile appeared as one of the values in the table it was only necessary to read off the upper quartile at a frequency of 105 to find the interquartile range. A mistaken concept used by some candidates was to find the difference in frequencies between the upper and lower quartiles ($105 - 35 = 70$) and then read off at 70 which gave the same answer as **part (i)**.
- (d) This part proved more challenging although some found the top weight of the small eggs by reading the graph at a frequency of 30. The lowest weight of the twelve large eggs appeared in the table but only the more able candidates used this to give the final answer.

Answers: (b)(i) 35, 65, 100, 128 (c)(i) 50.5 (ii) 10.5 (d) 16.5

Question 11

- (a)(i) Very few marks were scored in these parts. Candidates could have used the grid provided more effectively.
- (ii)(a) A very limited number got this part correct and not many realised it should be a 2 by 2 matrix.
- (ii)(b) Again very few correct responses were seen.
- (b)(i) Some gave the correct length but again candidates could have used the grid provided at the bottom of the page more effectively, in which case the length of PQ should have been apparent.

- (ii) Some realised they needed to use Pythagoras' theorem to find this length and a right angled triangle drawn on the grid could have ensured more candidates used the correct dimensions.
- (iii) Perpendicular bisectors of PP' and QQ' were needed to answer **part (a)** but very few showed them with sufficient clarity or accuracy to score here. **Part (b)** was often not answered but if the diagram had been drawn more carefully on the grid more should have been able to answer this part. Answers such as 90° or 270° suggested some thought the rotations mentioned in the previous **part (a)** were somehow involved.

Answers: (a)(i)(a) $(-2, 3)$ (b) $(-3, 2)$ (c) $(-3, 2)$ (ii)(a) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ (b) M_y (b)(i) 5 (ii) 5 (iii)(a) $(0, 2)$
(b) 307°

MATHEMATICS D (CALCULATOR VERSION)

Paper 4024/22

Paper 22

Key message

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

General Comments

There were some well presented scripts. The working spaces and answer spaces in the booklet were generally used effectively.

Much of the algebra and trigonometry, such as in **Questions 1** and **2**, gave candidates at all levels opportunities to gain marks.

Plotting and drawing in graphical questions was generally successful.

The construction of algebraic expressions, as required in the inequality, **Question 4(b)**, and in the quadratic equation in **Question 10 (a)** and **(b)**, was less successful than the manipulation of algebraic expressions already given, as in **Question 1**. Confidence in this aspect of mathematics could, with advantage, be applied elsewhere, such as in reverse percentage questions, where rules have been forgotten or have become confused. Algebra would provide a means of thinking through a problem from first principles.

Premature approximation sometimes resulted in the loss of marks. For example, in **Question 2 (a)**,

$\sin^{-1} \frac{3.73}{5.47} = \sin^{-1} 0.6819 = 42.99^\circ$. When this was shown as $\sin^{-1} 0.68$, the angle became 42.84° , which rounded to 42.8° and not the correct 43.0° . Also in part **(b)**, $PQ^2 = 6.246$. When this was shown as 6.2, PQ became 2.489... which rounded to 2.49, not the expected answer of 2.50. In this case, both accuracy marks available in this question were lost.

In **Question 4 (c)(ii)**, an answer of 6.26 could have been obtained as follows. If $10.44 \div 1.45$ is done in stages and $1 \div 1.45 = 0.6896$ is rounded to 0.6, another correct method step leads to 6.26. However, 6.26, without this evidence shown in the working, did not score.

Comments on specific questions

Section A

Question 1

- (a) Of the two approaches, the first step of $A = 4mh + h^2$ gave the best chance of achieving the correct final answer. A common error in this step was to write $2h$ instead of h^2 . When the other approach was chosen, starting with $\frac{A}{h} = 4m + h$, more complicated expressions could arise for m , such as

$$\frac{\frac{A}{h} - h}{4}$$

, which sometimes led to errors in the final answer. The presence of h^2 in the first approach sometimes led to the introduction of a square root sign in subsequent steps.

- (b) This type of factorisation is well understood. Correct solutions were well organised and neatly set out.



- (c) Candidates were expected to arrive at $5x - 1 = \pm 9$, thus having two simple equations to solve. Candidates generally chose to cross-multiply and use the formula for the solution of a quadratic equation. The cross-multiplication was often badly expressed, with such as $5x - 1(5x - 1)$ frequently seen. Answers with reversed signs were also seen, usually from a poorly written formula, but occasionally from those who reached $5x^2 - 2x - 16$ and attempted factorisation but wrote $(5x - 8)(x + 2)$.

Answers: (a) $m = \frac{A - h^2}{4h}$ (b) $(3a + 5b)(x - 2y)$ (c) $x = 2$ or -1.6

Question 2

- (a) The sine of the required angle can be written down directly from the right angled triangle BAP . Some candidates preferred to write down the sine rule in full. There is more room for error this way. Some candidates used cosine here without adjusting their answer to the required angle. Some incorrectly chose to use tan. There were some solutions that just found the length AB .
- (b) The cosine rule was generally used effectively here. Some candidates forgot the final square root stage. Others combined terms incorrectly, arriving at $(5.32^2 + 3.73^2 - 2 \times 5.32 \times 3.73) \cos 25$. Candidates beginning with the cosine rule with the angle as the subject were likely to go astray. Solutions treating triangle APQ as a right angled triangle, an isosceles triangle, or assigning a value to $\hat{A}PQ$ in order to apply the sine rule, were seen.
- (c) (i) There was a tendency to apply a poorly remembered rule, adding 180° to the 25° given in the diagram, rather than to consider the problem from first principles. Answers of 255° and 65° were sometimes given.
- (ii) $\tan^{-1} \frac{30}{100}$ and $\tan^{-1} \frac{100}{30}$ were seen frequently, from which the correct answer was sometimes chosen. In many cases the complementary angle was given. The use of sin instead of tan was seen, usually from an incorrectly drawn diagram. The intrusion of angles from **parts (a) and (b)** ruled out a number of solutions.

Answers: (a) 43.0 (b) 2.50 (c)(i) 245° (ii) 16.7°

Question 3

- (a) (i) The shading in the diagram ruled out rotational symmetry of order 5, or 5 lines of symmetry, both of which were common responses. Rotational symmetry of an infinite order was also popular.
- (ii) There was a tendency to try to arrive at a numerical ratio too quickly, perhaps from numbers obtained by measuring the diagram, rather than allowing the ratio to emerge from considered steps using the area information given in the question. Many responses made no mention of the formula for the area of a circle.
- (b) (i) This part was noticeably better answered, with a good proportion of complete answers seen. It was expected that candidates would find $\hat{A}OB$ first and work from there. Commonly, this angle was thought to be 126° . Starting with $\hat{A}CB = 108^\circ$ was accepted if this was seen to be independently arrived at, for example using the interior angle of a regular pentagon. Usually, 108° came directly from the given 252° .
- (ii) This was not always seen as depending on the idea of the length of an arc of a sector, the angle of which had been established in the previous part. As in **part (a)(ii)**, with the formula for the area of a circle, many responses made no mention of the formula for the length of an arc.

Answers: (a)(i) One line of symmetry (ii) 10 : 1 (b)(ii) 7

Question 4

- (a) (i)(a) This was usually well answered, but sometimes incomplete, the answer being left as 120%.
- (b) Again this was usually well answered, but the answer was sometimes left as 75%.
- (ii) Those who could not remember the correct method produced answers such as 6, from 60% of \$10. They were unable to think through the problem from first principles.
- (b) (i) Good solutions were seen here which used all the information given to build up the required inequality. Some candidates did not engage with the appropriate algebra of inequalities. Numbers were seen in the working and answer spaces without any inequality signs.
- (ii) The best solutions here carried on from a successful **part (i)**. Some candidates were able to recover at this stage and reach the expected result. Numerical working, not always clear, sometimes led to answers of 30 or 93, or to answers such as 94. The working of a question such as this should show clearly the appropriate algebraic steps.
- (c) (i) This currency conversion was well answered.
- (ii) This was also generally successful.

Answers: (a)(i)(a) 20 (b) 25 (ii) 6.25 (b)(i) $63 \times 6 + 4x \leq 500$ (ii) 93 (c)(i) 435 (ii) 7.20

Question 5

- (a) The general idea of this question seemed to be understood. Simplifying the intermediate steps in the matrix multiplication caused problems for some candidates, particularly, what to do with $0 \times y$.
- (b) (i)(a) This was well answered. Sometimes the order of multiplication was incorrect.
- (b) This was also well answered. Again, sometimes the order of multiplication was incorrect.
- (ii) A reasonable response was seen here. The previous **parts (i)(a)** and **(b)** were sometimes not referred back to.
- (iii) Another reasonable response was seen here with reflection remembered more often than the x – axis. Again, some candidates, who did not gain marks here, did not make use of correct work in **parts (i)(a)** and **(b)**.

Answers: (a) $x = 5$ $y = 4$ (b)(i)(a) (a, c) (b) (b, d) (ii) $\begin{pmatrix} 1 & -3 \\ 3 & -2 \end{pmatrix}$ (iii) Reflection in the x - axis

Question 6

- (a) This was usually correctly answered. $\begin{pmatrix} 6 \\ 16 \end{pmatrix}$ was a common incorrect answer. Sometimes the idea of a column vector did not seem to be fully understood.
- (b) The gradient was well understood and generally answered correctly.
- (c) It was expected that P and Q would be found directly by substitution. Many candidates seemed to prefer to construct the equation of the line AB . These candidates seemed to find it more difficult to find P and Q accurately.
- (d) (i) Many candidates found the correct coordinates.
- (ii) The idea of distance using coordinates is well understood. Not all candidates used the coordinates of A and C .
- (iii)(a) A reasonable response was seen here. Some candidates could have benefitted perhaps by making more use of the grid.

- (b) What was required in this part was not always understood. For answers in the requested form, $\frac{1}{2}$ was commonly given instead of 2.

Answers: (a) $\begin{pmatrix} 6 \\ 2 \end{pmatrix}$ (b) $\frac{1}{3}$ (c) $P = -3$ $Q = 21$ (d)(i) (18, -5) (ii) 13 (iii)(a) (12,11) (b) $2\overline{AB}$

Section B

Question 7

- (a) (i) Since triangle ABC is equilateral with side 8 cm, it was expected that the sine formula for the area, $\frac{1}{2} \times 8 \times 8 \times \sin 60$, would be used. More complex methods were of course accepted. These generally afforded more opportunities for approximations and hence the likelihood of ending up with an inaccurate answer. $\frac{1}{2} \times 8 \times 8$ and $\frac{1}{2} \times 4 \times 8$ were common versions of the given area.
- (ii) Convincing explanations started with relevant angles clearly stated and continued with appropriate working leading to 120° . Attempts such as stating $\hat{AFD} = 60^\circ$ without any support leading to $\hat{AFB} = 120^\circ$ were not accepted.
- (iii) A good number of successful applications of the sine rule were seen in this part.
- (b) (i) This was usually seen to follow on from previous work. There were attempts that started again from scratch. Difficulty was experienced by some candidates in deciding the number of faces of the pyramid. 3 and 5 were common choices.
- (ii) The correct height, VF , required the use of a sufficiently accurate value of AF from **part (a)(iii)**. Commonly, the height was taken to be 8 cm, or BD , or even AF . Another common response was to use the area from **part (b)(i)** as the area of the base of the pyramid. Sometimes $\frac{1}{3} \times 8 \times 8$, or even $\frac{1}{3} \times 8 \times 8 \times 8$, was given as the answer.
- (c) (i) There were some successful longer solutions seen using their volume figures. This approach gave more room for error than going directly from the ratio of volumes to the ratio of sides. Candidates sometimes found the ratio of their volumes but did not calculate its cube root.
- (ii) Candidates struggled with this last part of the question.

Answers: (a)(i) 27.7 (iii) 4.62 (b)(i) 111 (ii) 60.3 (c)(i) 2 (ii) 8

Question 8

- (a) (i) This was not always seen by candidates to depend on multiples of \$25. A common incorrect answer for example, was \$537, presumably because in 8 years, \$25 increased by \$37.
- (ii) Plotting the points was generally done accurately.
- (iii) Again, the dependence on multiples of \$25 was not always seen. A lot of answers suggested that the graph had been read at $y = 68$.
- (b) (i) Candidates struggled with this part. \$55 was commonly given as the answer.
- (ii) This was generally understood. Candidates should be encouraged, when drawing graphs known to be straight lines, to join an appropriate number of points using a ruler. Many candidates plotted numerous points and joined them by freehand.

- (c) The general principle here was known in many cases.
- (d)(i) Again some level of success was seen here. Some candidates who had drawn the correct tangent did not calculate its gradient and gave \$55 as the answer.
- (ii) It was expected that this would be deduced from the equation given in **part (b)(ii)**. Candidates struggled with this part and it was often omitted.
- (iii) Candidates also struggled with this part and it was often omitted.

Answers: (a)(i) 1240 (iii) 4.6 (b)(i) 1100 (c) 4.8 (d)(i) $6 \leq \text{gradient} \leq 7$ (ii) 3.75 dollars per year (iii) 2

Question 9

- (a) Of the responses that did not achieve full marks, some noted only the appropriate equal right angle, or only one pair of equal sides, or both. Some responses included references to all these elements, but did not achieve full marks because other angles or sides were included without justification.
- (b) Not many solutions engaged effectively with the pair of congruent triangles in **part (a)**. Most responses to this question made statements such as PB is perpendicular to QC , or triangle BMC is a right angled triangle, that merely restate the question.
- (c)(i) The response to this part was better. Again, common responses such as because ANB is a right angled triangle, or because AN is perpendicular to BN , merely restate the question and do not answer it.
- (ii) Quite a good response to this part of the question was seen.
- (iii)(a) This part was well answered.
- (b) Not many convincing solutions were seen. Candidates generally assumed that $MN = AN$.
- (c) Candidates also struggled with this part although some were able to follow through the question to this stage and achieve the correct result.
- (d) Many candidates found this part difficult. Few solutions linked the area of triangle APB to the congruent triangle BQC in order to use the right angled triangles QMB and BMC . There were some correct solutions using $BQ = \sqrt{45}$ and the right angled triangle APB directly. When this approach was used, a common error was to take BQ as 6 cm.

Answers: (c)(i) Angle in a semicircle (ii) Centre B Scale factor 2 (iii)(a) 6 (c) 12 (d) 45

Question 10

- (a)(i) This was generally well answered.
- (ii) Constructing the appropriate algebraic expression proved difficult for many candidates. This part was sometimes omitted.
- (b)(i) There were some correct reductions seen but again this part was often omitted. The response by some candidates at this point was to solve the equation.
- (ii) This was well answered with many giving the roots as asked for in the question. Candidates did not always write down the formula carefully, for example, drawing a fraction line of uncertain length. Some errors were clearly due to this. There were incorrect versions of the formula quoted. With b of the formula = -28, some candidates had difficulty achieving correct evaluations.
- (iii) Usually, after **part (ii)** correct, the correct solution was selected, but not always for the right reason. At this stage, 26.1 was not seen as an alternative width, so 1.88 was selected because the width of a rectangle is smaller than the length.

(iv) After correct work in the previous part, this was not always successful.

Answers: (a)(i) $3x$ (ii) $7 - 2x$ (b)(ii) 1.88 and 26.1 (iii) 1.88 (iv) 10.6

Question 11

(a) (i) Many very good cumulative frequency curves were seen. When not completely correct, it was usually the first plot that was incorrectly placed, often at (0,5).

(ii) A good proportion of candidates understood the requirement to read their graphs at the cumulative frequency of 90. There were some candidates who gave 90 as their answer.

(iii) Again, this was well understood and a good overall response was seen.

(iv) It was important here to remember to subtract the reading at 50 years from 120, and then to add in 12.

(b) (i) The tree diagram was generally completed accurately. A few candidates gave answers such as 8 and 4 for the first disc.

(ii)(a) This probability was generally accurately calculated.

(b) Not many candidates realised that this probability was $1 - \text{part (ii)(a)}$. There were some successful longer methods, but many of these gave only two of the three required products.

(iii) A lot of correct answers were seen. $\frac{4}{12} \times \frac{3}{11} \times \frac{3}{11}$ was a common response.

Answers: (a)(ii) 43 (iii) 18 (iv) 26 (b)(i) $\frac{8}{12}$ and $\frac{4}{12}$ for the first disc, $\frac{7}{11}$, $\frac{4}{11}$ and $\frac{8}{11}$ for the second disc

(ii)(a) $\frac{1}{11}$ (b) $\frac{10}{11}$ (iii) $\frac{1}{55}$