MATHEMATICS D (CALCULATOR VERSION)

> **Paper 4024/11**
> **Paper 11**

General comments

The presentation of the scripts was often good. It is important that candidates show working. As indicated in the instructions on the front page, this should be completed in blue or black pen. Some candidates completed their working in pencil, often erasing their solutions, making it impossible for Examiners to award marks for the intermediate steps. Others overwrote their pencil answers in pen (which gave a double image) making it very difficult for Examiners to read the work. At times, the amount of rubber debris left behind after candidates erased their working made the script less clear to read.

Candidates should take care when transcribing their answers from the working to the answer line. It is important that the decimal point is clear and placed above the dotted line given for the answer. If an answer is changed, it is far better to delete the wrong answer and re-write it rather than attempt to overwrite it.

A number of candidates misread their own writing, particularly 6 for 0.

There were a number of scripts where no attempt had been made at the later questions, most likely due to the difficulty of the topics rather than lack of time to complete the paper.

Comments on specific questions

Question 1

(a) This part was answered well. The most common wrong answer was 8.3 and, on a few occasions, the decimal point was omitted.

(b) This part was generally correctly answered with the most common mistake being the misplacing of the decimal point.

Answers: **(a)** 7.7 **(b)** 0.039

Question 2

(a) This part was well answered. A few candidates converted $\frac{16}{21}$ to $1\frac{5}{21}$ or gave an answer of $\frac{4}{10}$.

(b) Candidates were aware that a fraction had to be inverted but occasionally it was the first rather than the second which was changed leading to an answer of $\frac{4}{3}$.

Answers: **(a)** 16/21 **(b)** 3/4

Question 3

(a) This part was answered well. It is important that candidates read the question carefully. answer was not always reduced to a fraction in its lowest terms or the answer was written decimal.

(b) Although there were many correct answers, a common error was to add the 2 masses, both with or without changing the units, or to write the answer as 0.725 i.e. in kg. A few candidates found $\dfrac{1600}{875}$.

Answers: **(a)** 3/5 **(b)** 725

Question 4

(a) There were a large number of correct answers although some left the answer as 5^1. The common mistake was to think $4^0 = 0$.

(b) Some candidates did not complete their working leaving the answer as $\dfrac{1}{1/16}$. Wrong answers included 8, 2, $\dfrac{1}{2}$ or $\dfrac{1}{16}$.

Answers: **(a)** 5 **(b)** 16

Question 5

(a) Many candidates found this part challenging. The position of the additional shaded square was frequently placed between the existing two.

(b) This part also proved very challenging for many candidates. Generally the 4 extra shaded squares were placed in positions to give a figure with one line of symmetry rather than with rotational symmetry of order 3. Often one pair of squares was shaded correctly but the second pair was not.

Answers: **(a)** and **(b)** Correct squares shaded.

Question 6

The concept of 'upper and lower bounds' continues to be a topic that candidates find difficult.

(a) There were a number of correct answers but an answer of 41 was common.

(b) Many candidates, who gave the correct lower bound in **(a)**, reverted back to 41 × 0.3 for the answer to this part, producing an answer of 12.3 or giving the lower bound of 12.3 as 12.25. Others, who used their answer in **(a)**, frequently forgot to change the units of their answer or multiplied by 0.03 rather than 0.3.

Answers: **(a)** 40.5 **(b)** 12.15

Question 7

Many candidates correctly found $k = 36$. Some then used $y = \dfrac{k}{x}$ to give an answer of 18. Some candidates also used direct rather than inverse proportion.

Answer: 9
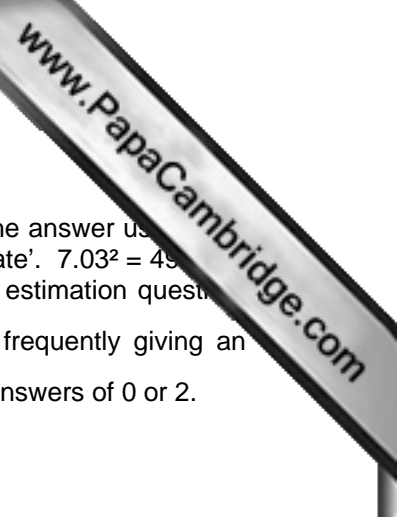
Question 8

Candidates should take care to read the question carefully as many tried to work out the answer us~~ing~~ multiplication and long division – they should be encouraged to look for the word 'estimate'. $7.03^2 = 49$ ~~.~~ was commonly found before rounding it to 49 or 50 which defeats the purpose of an estimation ques~~tion.~~ Those who reached $\dfrac{0.4 \times (49 \text{ or } 50)}{2}$ often experienced difficulties dealing with 0.4, frequently giving an~~swer~~ answer of 98. Occasionally 7^2 was given as 14, or 0.387 was corrected to 0 leading to answers of 0 or 2.

Answer: 10

Question 9

(a) Candidates showed their solution in the working, frequently reaching 4.5 < x but were unable to rearrange the inequality to read x > 4.5 on the answer line. There were many answers of 4.5 > x, x < 4.5 or just 4.5. At times $\dfrac{18}{4}$ was incorrectly converted to 4.2 or the answer was written as $-4\dfrac{-2}{4}$.

(b) Although -2 was sometimes seen as an answer, the correct pair of values was much less common. Some candidates included -3⅓, -1 or 0. Occasionally the question was misread as -10 ≤ 3n - 3 leading to an answer of - $\dfrac{7}{3}$.

Answers: **(a)** x > 4½ **(b)** -3, -2

Question 10

(a) This part was generally well answered. Occasionally the mean was found.

(b) Candidates often found the mid-value of the list as written rather than putting them in order first. At times the list was rewritten in order, but leaving out the repeated numbers, leading to an answer of -0.5. A few candidates reversed the answers to **(a)** and **(b)**.

Answers: **(a)** 2 **(b)** ½

Question 11

(a) This part was usually well answered. The common errors were answers of 74, 106 or 140.

(b) This part was answered well.

(c) Candidates recognised the answer was to be found by working out 360 –answer**(a)** – answer**(b)** but occasionally arithmetic errors were made resulting in an incorrect follow-through.

Answers: **(a)** 40 **(b)** 74 **(c)** 246

Question 12

(a)   This part was generally well answered with a number of candidates giving 13x - 0 or
Occasional sign errors were made in multiplying out the second bracket giving -15x -12 or -15

(b)   Many candidates used a common denominator of 12y² leading to an unsimplified answer of $\dfrac{y}{12y^2}$

   or $\dfrac{y}{3y4y}$. Another common wrong answer was $\dfrac{y}{12y}$.

(c)   Many candidates could answer this part correctly. Occasionally the answer was left without
collecting all the powers together.

Answers: **(a)** 13*x* **(b)** 1/(12*y*) **(c)** $12a^3b^4$

Question 13

(a)   This part was generally well answered. Some candidates only took out a common factor of *a*.
Others gave the correct answer in the working but the answer line showed 2a (8-3). A few tried to
factorise into 2 brackets.

(b)   Many candidates recognised that pairs of terms had to be factorised. They were more successful
with the first pair than the second where the mistakes were generally related to signs or only taking
out a factor of 2. They were then often unable to proceed to the final factorisation. Solutions to an
equation were sometimes given.

Answers: **(a)** 2*a*(8*a*-3) **(b)** (3*x*-4)(*y*+2)

Question 14

(a)   This part was sometimes answered correctly with errors in converting to standard form, giving a
common answer of 18×10^6, and answers often involved the digits 3 or 5 (from $3 \times 10^5 \times 1/60$).

(b)   Answers frequently contained the digit 5 but were not often written in standard form. Answers
sometimes came from using speed/distance.

Answers: **(a)** 1.8×10^7 **(b)** 5×10^{-4}

Question 15

(a)   Candidates, who correctly started with 100/360 x 2 x 3.14 x 9, often then experienced problems
cancelling. Others reached 5652/360 and were unsuccessful with the long division attempted.
Using πr², 2πr² or πr were the usual errors and using a quarter of the circumference was also seen.
A few candidates used 22/7 for π, which sometimes led to an answer of 15.5.

(b)   Of those candidates who attempted this part, many were able to follow through their **(a)** answer but
a few then rounded the final answer to a whole number. Others only added 9 or started again
using the area. A few thought the perimeter was the arc length, giving an answer of 15.7 in **(b)** and
then deleting their answer of 15.7 in **(a)** and replacing it with one using the area.

Answers: **(a)** 15.7 **(b)** 33.7

Question 16

(a)   On the whole this part was only answered correctly by the most able candidates. There we

answers of -1, 3 or -3 or answers including x, in particular - $\frac{1}{3}$ x. The majority of candidates u

the given equation but some chose to use the formula for gradient with 2 points from the graph.

(b)   It was often difficult to understand the shading given by candidates as the instructions to shade and
label the correct region were not always followed. This part was not answered well by candidates.
Some were able to identify the region between the 2 sloping lines but not x > 0, resulting in shading
the triangle between the 2 sloping lines and to the left of the y axis. A common wrong answer was
to shade the triangle below both sloping lines but above the x axis.

Answers: **(a)** -⅓ **(b)** Correct region shaded

Question 17

(a)   The majority of candidates were able to score at least 1 mark for 4 or more correct elements in the
matrix. There were difficulties with negative signs and errors included giving -1 instead of 1 and 10
instead of -2 or misreading their own figures.

(b)   Candidates had significant problems deciding on the correct size for the matrix, frequently giving a
2 x 3 or 3 x 1 matrix for the answer. A number of candidates thought it was impossible to give a
matrix for CA. Those who correctly worked out the size of the matrix usually gave the correct
answer although (9   0 -2) was seen on occasions.

Answers: **(a)** $\begin{pmatrix} 3 & -2 & 1 \\ 0 & 6 & -6 \end{pmatrix}$ **(b)** (8 0 -2)

Question 18

Both elimination and substitution methods were attempted. Substituting for *y* in the first equation often

correctly gave $\frac{5}{3}$ x = -10 but candidates were then unable to correctly calculate *x*. Substituting for *x* correctly

gave y = ⅓(8 − 2y) + 9 but problems were experienced in dealing with ⅓. Those candidates eliminating *x* by
multiplying the second equation by 3 often did not multiply 9 by 3 and those eliminating *y* missed out a

negative sign giving $\frac{5}{3}$ x = 10. Most candidates were then able to follow through their first value to find the

second.

Answers: *x* = -6, *y* = 7

Question 19

Throughout this question, a number of candidates gave probability answers which were either numbers or greater than 1.

(a) A number of candidates were successful but others, who knew the answer came from $\frac{2}{5} \times \frac{2}{5}$, then wrote $\frac{4}{10}$ or $\frac{4}{15}$. It was common to see $\frac{2}{5} + \frac{2}{5} = \frac{4}{10}$ or $\frac{4}{5}$.

(b) This part was sometimes answered correctly but answers such as $\frac{0}{any\ number}$ were also seen. $\frac{2}{5}$ was also a common answer.

(c) There were problems in deciding which fractions to add or subtract. Able candidates, who made sensible attempts, sometimes omitted one of the 3 possibilities (usually the probability of black then red) or found the probability of at least one black and the correct answer was rare.

Answers: **(a)** 4/25 **(b)** 0 **(c)** 12/25

Question 20

(a) A few candidates answered this part correctly but it was challenging for many. Some incorrectly left PQ in their answers. Diagrams were sometimes drawn with unsuccessful results. Wrong answers included 1:3 and 6:1.

(b)(i) This part was reasonably well answered. There were a variety of answers including incorrect answers of (2,3), (2,4) or (4,2).

(ii) A good proportion of candidates gave the correct answer. Others correctly substituted in the given x and y values but errors in signs led to answers such as 5.

Answers: **(a)** 1:6 **(b)(i)** (3,2) **(ii)** $k = -5$

Question 21

(a) Most candidates thought cos *ABD* was 0.53. Others, who recognised that there should be a change of sign for obtuse angles, changed sin rather than cos. Often the given numbers were subtracted from 180 or 1 then added. 4sin *CBD* + 4cos *CBD* was also seen.

(b) Many started correctly with cos $b = BC/4$ but this was sometimes followed by substitution of the wrong trigonometrical function or by cos 0.53 or by arithmetic slips. A few, who used longer methods, were able to pick up at least one mark. Occasionally attempts at the sine rule or cosine rule were seen.

Answers: **(a)** 0.32 **(b)** 2.12

Question 22

(a) Many correct answers were seen although some candidates did not understand the concept of cumulative frequency and simply copied the given table. Those who used the correct method occasionally made arithmetic slips, not recognising that the final number in the table had to be 70.

(b) Attempts at this part varied. Incorrect answers included 1st or 3rd group.

(c) Few candidates understood frequency density. There were many incorrect answers of 20, 24 from using sequencing or 10, 8 taken from the original table.

Answers: **(a)** 36, 52, 62, 70 **(b)** $3 < t \le 4$ **(c)** 10, 4

Question 23

(a)   Many candidates were able to follow on the pattern but a few found the 6th line in error.

(b)   Generally only the more able candidates answered this part correctly. Some of those who corre
        understood the concept then gave the (n-1)th line or the (n+1)th line. A number of differen
        numerical answers were given.

(c)   Candidates did not always read the question correctly and so attempted long multiplication or
        difference of 2 squares to reach an answer. A number of candidates left the answer as 4 x 520.

(d)   Of those attempting this part only the more able candidates were successful. Again a number of
        candidates did not use the pattern.

Answers: **(a)** 8² - 6² = 4 x 7 **(b)** (n + 1)² - (n – 1)² = 4n **(c)** 2080 **(d)** x = 122 and y = 120

Question 24

(a)   The correct answer of 'reflection' was quite common but the equation of the line was often
        incorrectly given as x = -½, y=½, y=x or was given in words such as 'on the mirror line -0.5'.
        Common incorrect transformations were rotation and shear and occasionally two transformations
        were given.

(b)(i) Few correct answers were seen. Some triangles had the correct orientation but were incorrectly
        placed, others were the wrong size.

(ii)   There were very few correct answers. The matrix was often the incorrect size, commonly 2 x 3 or
        3 x 1, and any 2 x 2 matrix answer often contained the number 2.

Answers: **(a)** Reflection in y = -½ **(b)(i)** Triangle with vertices (-1,0), (-2,0) and (-2,2) **(ii)** $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

Question 25

This question revealed a poor understanding of speed/time graphs.

(a)   Many candidates read off the speed at t = 22.5 rather than finding the gradient. Others tried to find

        4/22.5, 2/22.5 or $\dfrac{22.5 - 20}{2 - 4} \left(i.e. \dfrac{x}{y} \right)$.

(b)   Many realised the answer was found by using areas under the graph.   Sometimes their
        explanations were too vague (not showing their calculations for areas of a rectangle + a triangle or
        a trapezium clearly) or not numerical. A number of candidates started with the answer of 90,
        divided by 25 to give 3.6 then reversed the argument to return to an answer of 90.

(c)   The ruled section from (0, 0) to (20, 80) was often correct but the curve from (20, 80) to (25, 90)
        was often a straight line or curve drawn the wrong way. A number of candidates were able to draw
        a graph from (0, 0) to (25, 90) but others drew a graph which finished at (25, 100) or finished on the
        x axis or was horizontal for some part of the graph.

Answers: **(a)** (-)4/5   **(c)** Correct graph drawn.

Question 26

(a) Only the most able answered this part correctly. Some of those who quoted correct [...] angles also involved side BC giving AAS as a reason for similarity. Others thought the 2 ang[...] D were equal, quoted 3 ratios of corresponding sides as a reason for similarity or thought [...] triangles were congruent or isosceles. A quotation of what similar triangles are, i.e. all the angle[s] are the same and the sides are in proportion, was sometimes given rather than an explanation as to why these particular triangles were similar.

(b) Only the most able showed correct working leading to an answer of 5. Some candidates thought the triangles were isosceles so BC = CD or DC = AD. Others tried to use ratios of corresponding sides in triangles CBD and ADC. $\dfrac{x}{4} = \dfrac{6}{4}$ was a common error as was thinking the small triangle was half the size of the large triangle.

Answers: **(b)** 5

Question 27

(a) There were a number of correct answers. Common errors were to give an answer of 90 or 90.7 or to read off the protractor the wrong way.

(b) This part was frequently constructed accurately. Sometimes it was left blank – this may have been due to lack of time or lack of geometrical instruments.

    (i) This part was generally answered well by those attempting the question. Occasionally the radius was measured inaccurately, the arc was not of sufficient length or arcs on AC and BC were drawn then joined with a straight line.

    (ii) Candidates generally found this part more challenging with a perpendicular bisector or a median drawn.

(c) Those who scored the previous 2 marks usually shaded the correct region successfully although some shaded the whole of the region (inside the triangle) to the left of the arc 8 cm from C. Others drew another smaller arc around A and then shaded the region to the left of the arc 8 cm from C and above the angle bisector but excluding the region inside this arc.

Answers: **(a)** 96° to 98° **(c)** Correct region shaded.

MATHEMATICS D (CALCULATOR VERSION)

General comments

The questions assessed candidates of all abilities.
The questions that were most accessible to candidates were 1, 4**(a)**, 5**(a)**, 6**(a)**, 9**(b)(i)**, 15**(a)**, 18**(a)** and 27**(a)**, 27**(b)**.

Questions that proved particularly difficult were 3**(b)**, 4**(b)**, 9**(b)(ii)**, 18**(b)**, 20 **(b)**, 21, 25 and 26**(a)**.

It was noticable 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. Others had difficulty in manipulating fractions correctly. Some candidates were very competent at performing standard techniques, and yet seemed to find it difficult to recognise the appropriate mathematical procedures for a given situation. Some candidates appeared not to understand that a probability must have a value between 0 and 1 inclusive.

Candidates need to improve their skills in manipulating fractions and in basic arithmetic. Work, that was otherwise good, was spoilt by calculations like $\frac{1}{7} + \frac{1}{7} = \frac{2}{14} = \frac{1}{7}$; 6 : 75 = 2 : 15 ; 240÷3 = 60; 0 − 3 = 3 and $(-6) - (-4) = -10$. Candidates need to be aware of the advantage in simplifying products of fractions by cancelling a number in the numerator with one in the denominator at the beginning rather than doing this at a later stage. Thus $\frac{6}{7} \times \frac{5}{6}$ is equal to $\frac{5}{7}$ by cancelling the 6s, rather than by the process $\frac{6}{7} \times \frac{5}{6} = \frac{30}{42} = \frac{15}{21} = \frac{5}{7}$.

Presentation of the work was usually good. Some scripts were quite disorganised and marks were lost through carelessly planned work and misreading of figures. Many candidates did not heed the Instructions on the front page - that they should write in dark blue or black pen. Some wrote the answers in pencil, then wrote over them in ink making a double image which was very difficult to read. Some wrote in pencil and even erased their workings, making it impossible for Examiners to award marks for intermediate steps. Some of these left such a mass of rubber and paper debris from the erasing that it interfered with the clarity of their answers.

There was a small number of scripts that contained answers only, with no supporting workings. Occasionally workings on separate sheets were inserted in the answer booklet, indicating that some Centres were issuing rough paper. This practice tends to disadvantage candidates as it is not often possible to identify easily which working applies to a particular question and to award marks for appropriate results or working. A small minority of candidates wrote all their workings, often in a disorganised form, in the margins reserved "For Examiner's Use".

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 a very well answered question on the whole. A few candidates gave the answer $1\frac{-4}{21}$.

(b) Well answered, although some answers were not expressed in the lowest terms requested in the question.

Answer: **(a)** $\frac{17}{21}$ **(b)** $\frac{5}{12}$

Question 2

(a) Most candidates made a good attempt at this question. Some made an error in the positioning of the decimal point, and gave answers such as 7, or 0.7, or 700.

(b) There were many correct answers. Some candidates evaluated $\frac{8.1}{2}$ as 4.0. Others gave the answer 4.1, or 4.5 or 0.5 (from 4.3 – 3.8).

Answer. **(a)** 70 **(b)** 4.05

Question 3

(a) Many candidates seemed to be familiar with standard form. The most common wrong answer was 7.06×10^5. A few, incorrectly, replaced 7.06 with 7 or 7.1.

(b) Most candidates did not attempt to express the profit ($30 000) as a percentage of the original price ($20 000). Some of those who did, either made an error in simplifying the zeros, or else subtracted 100 and gave an answer of 50.

Common wrong answers were 60 (from $\frac{30000}{50000} \times 100$) or 250 (from $\frac{50000}{20000} \times 100$).

Answer. **(a)** 7.06×10^{-5} **(b)** 150

Question 4

(a) This part was usually answered correctly.

(b) Most candidates seemed unable to interpret the statement "within 2.5 °C of 1 °C" correctly, as being from –1.5 °C to 3.5 °C. Common wrong answers were 2 (using 1 °C to 2.5 °C), or 3 (using 1 °C to 3.5 °C), or 1. A few gave a temperature instead of a number.

Answer. **(a)** 7 **(b)** 6

Question 5

(a) This part was often answered correctly. Common wrong answers were 1650, or 0.75, or 3.15.

(b) Some candidates overlooked the different units of length and gave 8 : 1. Many started with 24 : 300 but made an error in the reduction to the lowest terms. A few gave an answer that did not contain two integers.

Answer. **(a)** 1.65 **(b)** 2 : 25

Question 6

Some candidates need to be reminded of the difference between "factorise" and "solve".

(a)　　This part was usually answered correctly. Common wrong answers were $(2t - 3)(2t - 3)$, or (2t – 3)(4t + 3), or trying to solve a non-existent equation.

(b)　　This part was often answered correctly. The usual wrong answer was $(3x + 2)(x - 1)$. A few candidates used the quadratic solution formula to obtain $x = -2$ and $x = 1/3$.

Answer: **(a)** $(2t - 3)(2t + 3)$ **(b)** $(3x - 1)(x + 2)$

Question 7

Many candidates are clearly familiar with this type of question, but need to exercise more care in identifying the key features of "directly proportional" and "the square of x". Some used "proportional to x" and obtained the answer 30. Others tried to use inverse proportion or "the square root of x". A few went from $y = 2x^2$ to an answer of 6, or 9.

Answer: 18

Question 8

Many candidates made a reasonable attempt at this question. The usual error was not to put the square root symbol around both the numerator and the denominator. Others omitted to take the square root, thus obtaining an expression for x^2 instead of for x, or gave $\sqrt{2x^2}$ as $2x$. A few gave a numerical answer, having "solved" an equation.

Answer: $\sqrt{\dfrac{y - 3}{2}}$

Question 9

(a)　　Many candidates answered this part correctly, although others were unaware of the modulus notation. Common errors were to use $3 + 4 = 7$ or $3 - (-4) = 7$. Others tried to use $\sqrt{3^2 - (-4)^2}$; or $4 \times (-3) = -12$, or gave a vector, such as $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$; or coordinates, such as $(3, -4)$; or merely replaced the modulus symbol with brackets.

(b)(i)　　This part was generally well done. The usual error was to confuse x and y coordinates and to give the answer 8 from $3 \times 0 + 4 \times 2$.

(ii)　　The x coordinate of 1.5 was often correct. It was uncommon to see the y coordinate given as 0. Many candidates thought that B was $(3, -4)$, and obtained a y coordinate of -1. Others obtained a y coordinate of 1 or 2. A few tried to use the equation of AB.

Answer: **(a)** $(\pm)\,5$ **(b)(i)** 6 **(ii)** $(1.5, 0)$

Question 10

(a) This part was usually answered correctly. Common errors were to leave the answer as 1, write 5^{-1} as 0.5, to give the answer of 6 from $1 - (-5)$, or to give the answer of 5 from $5^{0-(-1)}$. A gave 0^{-1}.

(b) Most candidates were able to give either the correct value of 25 or the correct power of x, but not always both. Common wrong answers were $25x^3$, $25x^5$, $5x^6$, 5^2x^6 or $25x^9$.

(c) This part proved more challenging than the earlier parts. Common wrong answers were $\dfrac{16}{n^8}$, $\dfrac{8}{n^8}$, $\dfrac{4}{n^4}$, $\dfrac{1}{n}$ (by cancelling the 16s), or the answer was left unsimplified as $\left(\dfrac{2}{n^4}\right)^2$.

Answer: **(a)** $\dfrac{4}{5}$ **(b)** $25x^6$ **(c)** $\dfrac{4}{n^8}$

Question 11

(a) Many candidates did not realise that the answer is a number rather than a set and so gave answers such as {3, 6, 9}. Some chose the same subset on the Venn diagram and gave 3 as their answer. Others gave 44, from $2 + 3 + 4 + 5 + 6 + 7 + 8 + 9$.

(b) The most common error was to include 10 or 1 or 3 with the correct set. Others seemed to misread P for P' and gave {2, 3, 4}.

(c) The most common, but incorrect answer, was $\frac{1}{3}$. Some candidates did not realise that a probability has to be a number between 0 and 1 inclusive. Some gave an answer that was a whole number (usually 3), others gave a set of numbers.

Answer: **(a)** 8 **(b)** {5, 6, 7, 8, 9} **(c)** 0.3

Question 12

(a) The majority substituted 5 for x and obtained $6 - \frac{5}{2}$. Not everyone could evaluate this expression correctly, with $\dfrac{6-5}{2} = \dfrac{1}{2}$ occurring quite often. A few candidates started, incorrectly, by replacing f(x) with 5.

(b) The more able candidates successfully answered this part. Errors were made in removing the fractional 2 or in dealing with a negative sign. For example, $y = 6 - \dfrac{x}{2}$ became $2y = 6 - x$; $2y = 12 - x$ became $x = 2y - 12$ or $x = 2y + 12$. Some candidates gave their answer in terms of y rather than x. Weaker candidates frequently gave a numerial answer or attempted to find the reciprocal of f(x).

Answer: **(a)** $3\frac{1}{2}$ **(b)** $12 - 2x$

Question 13

(a)   Many candidates did not seem to be aware of the word "irrational" to describe a type of
Wrong answers were "square root", or "prime", or an attempt to give a value for $\sqrt{89}$.

(b)   Many candidates realised that Pythagoras's theorem was needed in this part. Many of these had
difficulty in evaluating $(\sqrt{89})^2$, using 44.5 or 9 or 9.4 or 89 for $\sqrt{89}$. Common wrong answers
were $\sqrt{56}$ or $\sqrt{114}$.

Answer: **(a***)* irrational **(b)**   8

Question 14

Most candidates attempted this question sensibly, although errors in strategy, or in basic arithmetic, occurred
frequently.

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

Question 15

(a)   The majority of candidates made a good attempt at this question. The usual wrong answer was $4.

(b)   Those candidates who are competent at percentage change obtained the correct answer. The
common wrong answers were 12, or 48 (from 60 – 12), or 72 (from 60 + 12).

Answer: **(a)** 16 **(b)** 75

Question 16

(a)   This part was answered well by many. Most wrong answers arose through carelessness in
subtracting of the negative numbers.

(b)   Many candidates correctly based their answer on the matrix $\begin{pmatrix} 0 & 3 \\ 1 & 2 \end{pmatrix}$. The usual error was in
evaluating the determinant of the matrix **A** as 3 instead of –3.

Answer: **(a)** $\begin{pmatrix} -1 & -2 \\ 0 & -2 \end{pmatrix}$ **(b)** $\begin{pmatrix} 0 & -1 \\ -\frac{1}{3} & -\frac{2}{3} \end{pmatrix}$

Question 17

(a)   Many candidates made a good attempt at this part, although errors in arithmetic were quite
common.   The common wrong answers were $\begin{pmatrix} 180 & 160 & 150 \\ 360 & 160 & 0 \end{pmatrix}$, or (490 520), or (1010), or
$\begin{pmatrix} 4.90 \\ 5.20 \end{pmatrix}$.

(b)   Answers to this part were rather variable. Most sensible wrong answers mentioned the number, or
the cost, of flowers.

Answer: **a)** $\begin{pmatrix} 490 \\ 520 \end{pmatrix}$ **(b)** The cost, in cents, of each bunch.

Question 18

(a) There were many correct answers to this part. The common wrong answers were 14.5, or

(b) Many candidates read off the value 170, but some of these gave this value as their answer. Oth
read off 154 instead of 170 and gave this as their answer, or else gave 46 (from 200 – 154).

Answer: **(a)** 14.7 **(b)** 30

Question 19

Some candidates have a very good understanding of tree diagrams whereas others have very little understanding.

(a) This part was generally well answered, although many gave the answer $p = \dfrac{6}{6}$ and $q = \dfrac{0}{6}$ instead

of the simpler $p = 1$ and $q = 0$. A common wrong answer was $p = \dfrac{5}{6}$ and $q = \dfrac{1}{6}$. A few gave probabilities with a denominator of 7.

(b)(i) This part was generally attempted sensibly and answered fairly successfully.

(ii) Few candidates answered this part by the more direct method of subtracting their part **(i)** answer from 1. Most preferred to select the appropriate two outcomes from the probability tree. Many of these were successful, although there was much wrong working (by adding or subtracting probabliities instead of multiplying them) and incorrect manipulation of the correct fractions.

Answer: **(a)(i)** $p = 1$, $q = 0$ **(b)(i)** $\dfrac{5}{7}$ **(ii)** $\dfrac{2}{7}$

Question 20

(a) There were many good attempts, with $3x > 7$ occurring more frequently than $4x + 4y < 35$. The usual errors were to write the wrong inequality symbol or in attempting to simplify the equation of a line.

(b) Very few correct answers were seen. The most common pair of integer coordinates quoted was (4, 4). Some attempted to find the coordinates of B by solving equations. Answers with non-integer coordinates occured quite frequently.

Answer: **(a)** $3x > 7$, $4x + 4y < 35$ **(b)** (5, 3)

Question 21

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

(a) The answers to this part were varied and often incorrect. A few misunderstood "tenth of a degree" to mean "ten degrees" and gave an answer such as 48.4°.

(b) Very few correct answers were seen for this part. Many earned partial credit by using a correct method and making an error with one of the bounds.

Answer: **(a)** 53.35° **(b)** 65.15°

Question 22

Attempts at this question revealed that many candidates need to acquire a clear understanding of s̶i̶ figures and the role that zeros play.

(a) (i)   Wrong answers varied, with 16, 16000.000, 15800, 15000, 15823.77 being the most common.

(ii)   Common wrong answers were 0030, 30, 0, 0.00, 0.003, 0.0031, 0.00305, 0.0030000.

(b)   Many candidates chose not to obey the instruction "Use your answers to part **(a)**" and started afresh. Some of these used values corrected to one significant figure, thus evaluating 20000 × 0.003 and giving the answer 60, for which some credit was given. Others performed lengthy long multiplications.

Answer: **(a)(i)** 16 000 **(ii)** 0.0030 **(b)** 50

Question 23

Attempts at this question tended to be either good, or very poor. Part **(b)** was the most successful where many candidates showed that they were aware that "angles in the same segment are equal". The other parts, which required more processing to arrive at the correct answers, met with less success. Some candidates appeared to make guesses and gave the values 123, 57, 33 in the wrong answer spaces.

(a)   Many used the theorem that "angles in opposite segments are supplementary" correctly. The common wrong answer was 114°.

(b)   This part was often correct.

(c)   Answers were varied for this part. The more able candidates used the fact that angle *CDF*, being an angle in a semicircle, is 90°.

(d)   The successful candidates used either the fact that triangle *DOF* is isosceles, or the property that angle *DOF*, being at the centre of the circle, is twice angle *FCD*. A common wrong answer was 61.5°.

Answer: **(a)**   123° **(b)** 57° **(c)** 33° **(d)** 66°

Question 24

Many candidates did not attempt this question and the attempts that were made showed that many candidates are unfamiliar with vectors.

(a)   This was the most successful part. Some candidates used **AB** and **CA** instead of the **p** and **q** stipulated in the question.

(b)(i)   The most common answer was "parallelogram". The correct answer was seen more frequently than the occasional answers of "triangle", "rhombus" or "kite".

(ii)   This part was answered correctly quite often.

(iii)   There were very few correct answers to this part. Many started with an equation like DA + AE = 3**p** + **q** + **p** + *k***q** from which an expression such as $k = \dfrac{4\mathbf{p} + \mathbf{q}}{-\mathbf{q}}$ was erroneously obtained.

Answer: **(a)** 3**p** + **q** **(b)(i)** trapezium **(ii)** **p** + *k***q** **(iii)** $\frac{1}{3}$

Question 25

Attempts at this question showed that most candidates need to gain a better understanding of the p... of a speed-time graph, and to appreciate that the "D-S-T triangle" is not a valid method when there... acceleration or deceleration.

(a)   Most candidates assumed that the time taken to travel $2D$ metres is twice the time taken to travel D metres and so gave the answer 40. Some correctly used the property of the area under the graph from $t = 0$ to $t = 20$ to establish $D = 10u$. Few could go on to interpret this result to find that the additional time to travel the next D metres is 10 seconds.

(b)   Only the more able candidates realised that the graph for the remainder of the journey after $t = 60$ was a straight line joining $(60, u)$ to $(100, 0)$. Very few were able to progress from this result, and to use the fact that the time taken to lose three-quarters of the speed is three-quarters of the time from $t = 60$ to $t = 100$, to get the correct answer. A small number of candidates used the alternative method of equating the deceleration given by the gradient of the line from $(60, u)$ to $(t, \frac{u}{4})$ to half the acceleration between $t = 0$ to $t = 20$. Most of these attempts made errors in the manipulation of the equation, or in the sign of the gradient of the deceleration.

Answer: **(a)** 30 **(b)** 90

Question 26

(a)   Many candidates do not seem to realise that $\cos DAC = -\cos(180° - DAC) = -\cos CAB$. The most common wrong answers were $\frac{4}{5}$, or $180 - \frac{4}{5}$, or $\cos(180 - \frac{4}{5})$.

(b)   Candidates who realised that the Sine Rule was required were usually successful, although some made errors in manipulating the fractions. Common wrong answers were $16\frac{2}{3}$ from $\frac{3}{5} = \frac{10}{AC}$, or 7.5 from $\frac{3}{4} = \frac{AC}{10}$.

Answer: **(a)** $-\frac{4}{5}$ **(b)** 16

Question 27

(a)   The majority of candidates answered this part correctly. A minority thought "order" meant that an angle was required and gave an answer such as 120°, sometimes with "clockwise" added. Other common wrong answers were 6, or "fan".

(b)   Candidates usually answered this part well.

(c)   Many candidates wrote down a correct expression for an arc length, although some used an expression for the *area* of a sector. Most candidates omitted to take into account the length of wire needed for the radii, and so very few equated their arc length to an appropriate length of wire. Common wrong answers were 10, 30 and 90.

Answer: **(a)** 3 **(b)** 80 **(c)** $7\frac{1}{2}$

MATHEMATICS D (CALCULATOR VERSION)

| Paper 4024/13 |
| Paper 13 |

General comments

The questions assessed candidates of all abilities.

The questions that were most accessible to candidates were 1, 4**(a)**, 5**(a)**, 6**(a)**, 9**(b)(i)**, 15**(a)**, 18**(a)** and 27**(a)**, 27**(b)**.

Questions that proved particularly difficult were 3**(b)**, 4**(b)**, 9**(b)(ii)**, 18**(b)**, 20 **(b)**, 21, 25 and 26**(a)**.

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. Others had difficulty in manipulating fractions correctly. Some candidates were very competent at performing standard techniques, and yet seemed to find it difficult to recognise the appropriate mathematical procedures for a given situation. Some candidates appeared not to understand that a probability must have a value between 0 and 1 inclusive.

Candidates need to improve their skills in manipulating fractions and in basic arithmetic. Work, that was otherwise good, was spoilt by calculations like $\frac{1}{7} + \frac{1}{7} = \frac{2}{14} = \frac{1}{7}$; $6 : 75 = 2 : 15$; $240 \div 3 = 60$; $0 - 3 = 3$ and $(-6) - (-4) = -10$. Candidates need to be aware of the advantage in simplifying products of fractions by cancelling a number in the numerator with one in the denominator at the beginning rather than doing this at a later stage. Thus $\frac{6}{7} \times \frac{5}{6}$ is equal to $\frac{5}{7}$ by cancelling the 6s, rather than by the process $\frac{6}{7} \times \frac{5}{6} = \frac{30}{42} = \frac{15}{21} = \frac{5}{7}$.

Presentation of the work was usually good. Some scripts were quite disorganised and marks were lost through carelessly planned work and misreading of figures. Many candidates did not heed the Instructions on the front page - that they should write in dark blue or black pen. Some wrote the answers in pencil, then wrote over them in ink making a double image which was very difficult to read. Some wrote in pencil and even erased their workings, making it impossible for Examiners to award marks for intermediate steps. Some of these left such a mass of rubber and paper debris from the erasing that it interfered with the clarity of their answers.

There was a small number of scripts that contained answers only, with no supporting workings. Occasionally workings on separate sheets were inserted in the answer booklet, indicating that some Centres were issuing rough paper. This practice tends to disadvantage candidates as it is not often possible to identify easily which working applies to a particular question and to award marks for appropriate results or working. A small minority of candidates wrote all their workings, often in a disorganised form, in the margins reserved "For Examiner's Use".

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.

<u>**Comments on specific questions**</u>

Question 1

(a)   This was a very well answered question on the whole. A few candidates gave the answer $1\frac{-4}{21}$.

(b)   Well answered, although some answers were not expressed in the lowest terms requested in the question.

Answer: **(a)** $\frac{17}{21}$ **(b)** $\frac{5}{12}$

Question 2

(a)   Most candidates made a good attempt at this question. Some made an error in the positioning of the decimal point, and gave answers such as 7, or 0.7, or 700.

(b)   There were many correct answers. Some candidates evaluated $\frac{8.1}{2}$ as 4.0. Others gave the answer 4.1, or 4.5 or 0.5 (from 4.3 – 3.8).

Answer: **(a)**   70   **(b)**   4.05

Question 3

(a)   Many candidates seemed to be familiar with standard form. The most common wrong answer was 7.06×10^5. A few, incorrectly, replaced 7.06 with 7 or 7.1.

(b)   Most candidates did not attempt to express the profit ($30 000) as a percentage of the original price ($20 000). Some of those who did, either made an error in simplifying the zeros, or else subtracted 100 and gave an answer of 50.

Common wrong answers were 60 (from $\frac{30000}{50000} \times 100$) or 250 (from $\frac{50000}{20000} \times 100$).

Answer: **(a)** 7.06×10^{-5} **(b)**   150

Question 4

(a)   This part was usually answered correctly.

(b)   Most candidates seemed unable to interpret the statement "within 2.5 °C of 1 °C" correctly, as being from –1.5 °C to 3.5 °C. Common wrong answers were 2 (using 1 °C to 2.5 °C), or 3 (using 1 °C to 3.5 °C), or 1. A few gave a temperature instead of a number.

Answer: **(a)**   7   **(b)**   6

Question 5

(a)   This part was often answered correctly. Common wrong answers were 1650, or 0.75, or 3.15.

(b)   Some candidates overlooked the different units of length and gave 8 : 1. Many started with 24 : 300 but made an error in the reduction to the lowest terms. A few gave an answer that did not contain two integers.

Answer: **(a)**   1.65   **(b)**   2 : 25

Question 6

Some candidates need to be reminded of the difference between "factorise" and "solve".

(a)   This part was usually answered correctly. Common wrong answers were $(2t - 3)(2t - 3)$, or (~~~ 3)(4t + 3)$, or trying to solve a non-existent equation.

(b)   This part was often answered correctly. The usual wrong answer was $(3x + 2)(x - 1)$. A few candidates used the quadratic solution formula to obtain $x = -2$ and $x = 1/3$.

Answer: **(a)** $(2t - 3)(2t + 3)$ **(b)** $(3x - 1)(x + 2)$

Question 7

Many candidates are clearly familiar with this type of question, but need to exercise more care in identifying the key features of "directly proportional" and "the square of x". Some used "proportional to x" and obtained the answer 30. Others tried to use inverse proportion or "the square root of x". A few went from $y = 2x^2$ to an answer of 6, or 9.

Answer: 18

Question 8

Many candidates made a reasonable attempt at this question. The usual error was not to put the square root symbol around both the numerator and the denominator. Others omitted to take the square root, thus obtaining an expression for x^2 instead of for x, or gave $\sqrt{2x^2}$ as $2x$. A few gave a numerical answer, having "solved" an equation.

Answer: $\sqrt{\dfrac{y - 3}{2}}$

Question 9

(a)   Many candidates answered this part correctly, although others were unaware of the modulus notation. Common errors were to use $3 + 4 = 7$ or $3 - (-4) = 7$. Others tried to use $\sqrt{3^2 - (-4)^2}$; or $4\times(-3) = -12$, or gave a vector, such as $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$; or coordinates, such as $(3, -4)$; or merely replaced the modulus symbol with brackets.

(b)(i)   This part was generally well done. The usual error was to confuse x and y coordinates and to give the answer 8 from $3\times0 + 4\times2$.

(ii)   The x coordinate of 1.5 was often correct. It was uncommon to see the y coordinate given as 0. Many candidates thought that B was $(3, -4)$, and obtained a y coordinate of -1. Others obtained a y coordinate of 1 or 2. A few tried to use the equation of AB.

Answer: **(a)** $(\pm)\, 5$ **(b)(i)**   6   **(ii)** $(1.5, 0)$

Question 10

(a)   This part was usually answered correctly. Common errors were to leave the answer as $1 - \frac{1}{5}$, to write 5^{-1} as 0.5, to give the answer of 6 from $1 - (-5)$, or to give the answer of 5 from $5^{0-(-1)}$. A few gave 0^{-1}.

(b)   Most candidates were able to give either the correct value of 25 or the correct power of x, but not always both. Common wrong answers were $25x^3$, $25x^5$, $5x^6$, 5^2x^6 or $25x^9$.

(c) This part proved more challenging than the earlier parts. Common wrong answers we~~re~~

$\dfrac{4}{n^4}$, $\dfrac{1}{n}$ (by cancelling the 16s), or the answer was left unsimplified as $\left(\dfrac{2}{n^4}\right)^2$.

Answer: **(a)** $\dfrac{4}{5}$ **(b)** $25x^6$ **(c)** $\dfrac{4}{n^8}$

Question 11

(a) Many candidates did not realise that the answer is a number rather than a set and so gave answers such as {3, 6, 9}. Some chose the same subset on the Venn diagram and gave 3 as their answer. Others gave 44, from 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9.

(b) The most common error was to include 10 or 1 or 3 with the correct set. Others seemed to misread *P* for *P´* and gave {2, 3, 4}.

(c) The most common, but incorrect answer, was $\frac{1}{3}$. Some candidates did not realise that a probability has to be a number between 0 and 1 inclusive. Some gave an answer that was a whole number (usually 3), others gave a set of numbers.

Answer: **(a)** 8   **(b)** {5, 6, 7, 8, 9}   **(c)** 0.3

Question 12

(a) The majority substituted 5 for *x* and obtained $6 - \frac{5}{2}$. Not everyone could evaluate this expression correctly, with $\dfrac{6-5}{2} = \dfrac{1}{2}$ occurring quite often. A few candidates started, incorrectly, by replacing f(*x*) with 5.

(b) The more able candidates successfully answered this part. Errors were made in removing the fractional 2 or in dealing with a negative sign. For example, $y = 6 - \dfrac{x}{2}$ became $2y = 6 - x$; $2y = 12 - x$ became $x = 2y - 12$ or $x = 2y + 12$. Some candidates gave their answer in terms of *y* rather than *x*. Weaker candidates frequently gave a numerial answer or attempted to find the reciprocal of f(*x*).

Answer: **(a)** $3\frac{1}{2}$ **(b)** $12 - 2x$

Question 13

(a) Many candidates did not seem to be aware of the word "irrational" to describe a type of number. Wrong answers were "square root", or "prime", or an attempt to give a value for $\sqrt{89}$.

(b) Many candidates realised that Pythagoras's theorem was needed in this part. Many of these had difficulty in evaluating $(\sqrt{89})^2$, using 44.5 or 9 or 9.4 or 89 for $\sqrt{89}$. Common wrong answers were $\sqrt{56}$ or $\sqrt{114}$.

Answer: **(a)** irrational   **(b)** 8

Question 14

Most candidates attempted this question sensibly, although errors in strategy, or in basic arithmetic, occurred frequently.

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

Question 15

(a) The majority of candidates made a good attempt at this question. The usual wrong answer

(b) Those candidates who are competent at percentage change obtained the correct answer.
common wrong answers were 12, or 48 (from 60 – 12), or 72 (from 60 + 12).

Answer: **(a)** 16   **(b)** 75

Question 16

(a) This part was answered well by many. Most wrong answers arose through carelessness in subtracting of the negative numbers.

(b) Many candidates correctly based their answer on the matrix $\begin{pmatrix} 0 & 3 \\ 1 & 2 \end{pmatrix}$. The usual error was in evaluating the determinant of the matrix **A** as 3 instead of –3.

Answer: **(a)** $\begin{pmatrix} -1 & -2 \\ 0 & -2 \end{pmatrix}$ **(b)** $\begin{pmatrix} 0 & -1 \\ -\frac{1}{3} & -\frac{2}{3} \end{pmatrix}$

Question 17

(a) Many candidates made a good attempt at this part, although errors in arithmetic were quite common. The common wrong answers were $\begin{pmatrix} 180 & 160 & 150 \\ 360 & 160 & 0 \end{pmatrix}$, or (490 520), or (1010), or $\begin{pmatrix} 4.90 \\ 5.20 \end{pmatrix}$.

(b) Answers to this part were rather variable. Most sensible wrong answers mentioned the number, or the cost, of flowers.

Answer: **(a)** $\begin{pmatrix} 490 \\ 520 \end{pmatrix}$ **(b)** The cost, in cents, of each bunch.

Question 18

(a) There were many correct answers to this part. The common wrong answers were 14.5, or 14.55.

(b) Many candidates read off the value 170, but some of these gave this value as their answer. Others read off 154 instead of 170 and gave this as their answer, or else gave 46 (from 200 – 154).

Answer: **(a)** 14.7   **(b)** 30

Question 19

Some candidates have a very good understanding of tree diagrams whereas others have very little understanding.

(a) This part was generally well answered, although many gave the answer $p = \frac{6}{6}$ and $q = \frac{0}{6}$ instead of the simpler $p = 1$ and $q = 0$. A common wrong answer was $p = \frac{5}{6}$ and $q = \frac{1}{6}$. A few gave probabilities with a denominator of 7.

(b)(i)   This part was generally attempted sensibly and answered fairly successfully.

(ii)   Few candidates answered this part by the more direct method of subtracting their part **(i)** from 1. Most preferred to select the appropriate two outcomes from the probability tree. Many of these were successful, although there was much wrong working (by adding or subtracting probabliities instead of multiplying them) and incorrect manipulation of the correct fractions.

Answer: **(a)(i)** $p = 1,\ q = 0$ **(b)(i)** $\dfrac{5}{7}$ **(ii)** $\dfrac{2}{7}$

Question 20

(a)   There were many good attempts, with $3x > 7$ occurring more frequently than $4x + 4y < 35$. The usual errors were to write the wrong inequality symbol or in attempting to simplify the equation of a line.

(b)   Very few correct answers were seen. The most common pair of integer coordinates quoted was $(4, 4)$. Some attempted to find the coordinates of *B* by solving equations. Answers with non-integer coordinates occured quite frequently.

Answer: **(a)** $3x > 7,\ 4x + 4y < 35$ **(b)** $(5, 3)$

Question 21

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

(a)   The answers to this part were varied and often incorrect. A few misunderstood "tenth of a degree" to mean "ten degrees" and gave an answer such as $48.4°$.

(b)   Very few correct answers were seen for this part. Many earned partial credit by using a correct method and making an error with one of the bounds.

Answer: **(a)** $53.35°$ **(b)** $65.15°$

Question 22

Attempts at this question revealed that many candidates need to acquire a clear understanding of significant figures and the role that zeros play.

(a)(i)   Wrong answers varied, with 16, 16000.000, 15800, 15000, 15823.77 being the most common.

(ii)   Common wrong answers were 0030, 30, 0, 0.00, 0.003, 0.0031, 0.00305, 0.0030000.

(b)   Many candidates chose not to obey the instruction "Use your answers to part **(a)**" and started afresh. Some of these used values corrected to one significant figure, thus evaluating 20000×0.003 and giving the answer 60, for which some credit was given. Others performed lengthy long multiplications.

Answer: **(a)(i)**   16 000   **(ii)**   0.0030   **(b)**   50

Question 23

Attempts at this question tended to be either good, or very poor. Part **(b)** was the most successful where many candidates showed that they were aware that "angles in the same segment are equal". The other parts, which required more processing to arrive at the correct answers, met with less success. Some candidates appeared to make guesses and gave the values 123, 57, 33 in the wrong answer spaces.

(a)   Many used the theorem that "angles in opposite segments are supplementary" correctly. The common wrong answer was $114°$.

(b)   This part was often correct.

(c)   Answers were varied for this part. The more able candidates used the fact that angle
an angle in a semicircle, is 90°.

(d)   The successful candidates used either the fact that triangle *DOF* is isosceles, or the property
angle *DOF*, being at the centre of the circle, is twice angle *FCD*. A common wrong answer was
61.5°.

Answer: **(a)** 123°   **(b)** 57°   **(c)** 33°   **(d)** 66°

Question 24

Many candidates did not attempt this question and the attempts that were made showed that many candidates are unfamiliar with vectors.

(a)   This was the most successful part. Some candidates used **AB** and **CA** instead of the **p** and **q** stipulated in the question.

(b)(i)   The most common answer was "parallelogram". The correct answer was seen more frequently than the occasional answers of "triangle", "rhombus" or "kite".

   (ii)   This part was answered correctly quite often.

   (iii) There were very few correct answers to this part. Many started with an equation like DA + AE = 3**p**
+ **q** + **p** + *k***q** from which an expression such as $k = \dfrac{4\mathbf{p} + \mathbf{q}}{-\mathbf{q}}$ was erroneously obtained.

Answer: **(a)** 3**p** + **q**   **(b)(i)** trapezium   **(ii)** **p** + *k***q**   **(iii)** $\frac{1}{3}$

Question 25

Attempts at this question showed that most candidates need to gain 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)   Most candidates assumed that the time taken to travel 2*D* metres is twice the time taken to travel *D* metres and so gave the answer 40. Some correctly used the property of the area under the graph from $t = 0$ to $t = 20$ to establish $D = 10u$. Few could go on to interpret this result to find that the additional time to travel the next *D* metres is 10 seconds.

(b)   Only the more able candidates realised that the graph for the remainder of the journey after $t = 60$ was a straight line joining (60, *u*) to (100, 0). Very few were able to progress from this result, and to use the fact that the time taken to lose three-quarters of the speed is three-quarters of the time from $t = 60$ to $t = 100$, to get the correct answer. A small number of candidates used the alternative
method of equating the deceleration given by the gradient of the line from (60, *u*) to ($t, \dfrac{u}{4}$) to half
the acceleration between $t = 0$ to $t = 20$. Most of these attempts made errors in the manipulation of the equation, or in the sign of the gradient of the deceleration.

Answer: **(a)** 30   **(b)** 90

Question 26

(a)   Many candidates do not seem to realise that cos *DAC* = − cos (180° − *DAC*) = − cos *CAB*. The
most common wrong answers were $\dfrac{4}{5}$, or $180 - \dfrac{4}{5}$, or $\cos(180 - \dfrac{4}{5})$.

(b) Candidates who realised that the Sine Rule was required were usually successful, a[...]e
made errors in manipulating the fractions. Common wrong answers were $16\frac{2}{3}$ from $\frac{3}{5}$[...]

7.5 from $\frac{3}{4} = \frac{AC}{10}$.

Answer: **(a)** $-\frac{4}{5}$ **(b)** 16

Question 27

(a) The majority of candidates answered this part correctly. A minority thought "order" meant that an angle was required and gave an answer such as 120°, sometimes with "clockwise" added. Other common wrong answers were 6, or "fan".

(b) Candidates usually answered this part well.

(c) Many candidates wrote down a correct expression for an arc length, although some used an expression for the *area* of a sector. Most candidates omitted to take into account the length of wire needed for the radii, and so very few equated their arc length to an appropriate length of wire. Common wrong answers were 10, 30 and 90.

Answer: **(a)** 3 **(b)** 80 **(c)** $7\frac{1}{2}$

MATHEMATICS D (CALCULATOR VERSION)

> **Paper 4024/21**
>
> **Paper 21**

General comments

The paper gave opportunities and challenges for candidates to demonstrate their ability. Generally candidates provided working to support their answers and they should be aware that failure to do so prevents credit being awarded for correct methods used when wrong answers are given. Candidates would be advised to consider the number of marks available for each part as it gives an indication of the amount of working necessary to obtain an answer (see, for example, **Question 5b(ii)**).

Only a small minority of candidates answered more than the required 4 questions from **Section B** and those not attempting 4 questions appeared to be limited by knowledge rather than time.

Many candidates scored well by applying standard routines with the quadratic equation formula and attempting the Cosine rule. It was pleasing that very few candidates had their calculators mistakenly set on Rads or Grads instead of degrees. Candidates need to be aware that calculations should use 4 figure accuracy if the final answer is to be given to 3 significant figures and premature approximation of values used in any working can result in the loss of accuracy marks.

Sometimes candidates would benefit by taking a little more care in reading the question and making sure the right question has been answered.

Comments on specific questions

Section A

Question 1

(a) (i) A lot of correct answers were seen, with a good understanding shown of the substitution involved. Any incorrect answers came from small slips or trying to rearrange the formula before substituting.

(ii) There were fewer correct answers in this part. Candidates must remember that every term needs to be multiplied when clearing fractions so in this case the 15 needed multiplying by 4. Some candidates tried to use the figures from part **(i)** which caused difficulties.

(b) (i) Many candidates successfully removed 7 as a factor. Some left the answer at that stage whilst others were able to recognise the difference of two squares. A few used $4d$ rather than $2d$ at this stage. Some recognised the need for a pair of brackets but those who tried to find them without removing the 7 first were generally unsuccessful.

(ii) The general idea of quadratic factors was often appreciated. Candidates needed to concentrate on the factors required to produce $3x^2$ and -6 and attempts to factorise this quadratic by splitting the $7x$ into two parts were often unsuccessful. A number of candidates did not attempt this part.

(c) Many candidates attempted to clear the denominator $(7 - y)$ although a few forgot to use the brackets. The subsequent isolation of y was often successful with any incorrect answers usually due to wrong signs being used.

Answers: **(a)(i)** -55 **(ii)** $4(P - 15)/7$ **(b)(i)** $7(c - 2d)(c + 2d)$ **(ii)** $(3x + 2)(x - 3)$ **(c)** 6.2

Question 2

(a)(i) Many correct answers were seen and any incorrect answers were usually a result of fin̶ wrong angle or inverting the tan ratio used. Use of the Sine rule in right-angled triangles popular and many candidates found the hypotenuse as a first step. If the figures used in this method are not used to at least 4 figure accuracy then the final answer will be out of the acceptabl range.

(ii) There was a mixed response to this part which suggested some misunderstanding of the angle of depression. Some correct answers were seen along with answers using 180° – BÂC, 90° + BÂC and BÂC.

(b)(i) On the whole this part was well attempted. There were many correct answers along with common errors that included adding the squares of the two sides or just subtracting the values of LS and SP.

(ii) There was limited success in this part. Candidates would be advised to show a drawing in their working and identify which angles are being found. Too often some good trigonometry was seen but when it could not be linked to specific angles no marks could be awarded. The actual angle required for the bearing was not always understood but credit could be given for clearly finding angles P or S.

(iii) Not many correct answers were seen yet the method mark was often awarded. Candidates understood that distance needed to be divided by time but few were able to correctly obtain the time in hours and convert the distance to kilometres. The subtraction of the times was often written as 48 minutes (or even 1 hour 8 minutes or 1 hour 48 minutes).

Answers: **(a)(i)** 74.8 **(ii)** 15.2 **(b)(i)** 500 **(ii)** 293 **(iii)** 9.75

Question 3

(a)(i)-(iv) Marks were often awarded in this section with the most success coming with angles $V\hat{P}U$ and $T\hat{P}R$. The angles $Q\hat{T}R$ and $U\hat{P}T$ presented more difficulty since more than one step was needed to find these. Some candidates assumed there to be right-angles in the diagram in order to gain their answers.

(b) Very few correct answers were seen for this part. It would be helpful if candidates made it clear which part of the diagram any equations produced referred to. Marks were available for using the isosceles triangle OAB, or OÂC = 90° if their use could be identified. Many candidates left this part blank.

Answers: **(a)(i)** 38 **(ii)** 38 **(iii)** 74 **(iv)** 68 **(b)** ½(90 – x)

Question 4

(a)(i) This mark was often obtained. The intention was for the subset P to be separate from E and M and some candidates drew it with some overlap with E and M. It was not always clear if candidates understood the implications of any overlap but credit was given if the overlapping areas were empty.

(ii) Candidates needed to take care that all the 12 integers in the given range were included in their diagrams and marks were lost for careless omissions. 21 was often omitted and 10 was sometimes included in both E and M but not in the overlap.

(b)(i) The individual elements were sometimes listed suggesting that the n(…) notation was not fully understood.

(ii) This was reasonably well done although some gave J∩K and some had extra elements, even all of J.

(iii) This was not so well done and some gave 10, presumably from all the elements in *J* and *K*.

(iv) A few correct answers were seen with some incorrect answers using a deno~~~~~~ (presumably from the number of elements in *J*) and some with a numerator of 2.

(c) (i) and (ii) Candidates that attempted these parts often put the information from the question on~~ overlapping Venn diagram. Candidates need to be able to then read off the information require~ answer the question and few were able to provide the correct answers to both parts.

Answers: **(b)(i)** 10 **(ii)** { b, c, d, f, g } **(iii)** 2 **(iv)** 3/5 **(c)(i)** 3 **(ii)** 51

Question 5

(a) This was well answered. A few candidates used the balance rather than the deposit. A few simply divided 1760 by 100.

(b) (i) This was generally well answered although some included the balance in the multiplication. A number subtracted $7040 from the amount paid instead of the balance of $5280.

(ii) Many candidates simply divided their answer for part **(i)** by 3 to answer this part but when 3 marks are available candidates should realise that more working is needed. Some attempted to use the formula PRT/100 but often used $7040 instead of $5280. Consequently not many correct answers were seen.

(c) Candidates need to think carefully about the starting point of the deal (i.e. the 100% value) and few recognised that the $7040 value represented 130%. The common mistake was to work out 30% of 7040.

Answers: **(a)** 25 **(b)(i)** 2376.12 **(ii)** 15 **(c)** 1625

Question 6

(a) (i) Many showed a good understanding of calculating a mean. Some candidates didn't take the frequencies into account when totalling the number of televisions which lead to a total of 10 and some, having found the correct total, divided by the number of categories (4) instead of the number of households. It was not necessary to approximate the answer to 1 or 2 figures but no marks were lost for doing so.

(ii) Those answering part **(i)** were usually able to score here as well. A few candidates mistakenly added 5 to the number of televisions. Mistakes similar to those in part **(i)** were apparent again here but those using the wrong total of televisions were able to score a follow through mark here for correctly dividing by 45.

(b) (i) Marks awarded to this part varied considerably but most candidates were able to make an attempt at the pie chart with good labelling shown. Candidates should show the calculation of the sector angles so that if they are inaccurately drawn, credit can be given for the working.

(ii) Some candidates missed this part out but those that answered it often made good attempts. Some gave the number who **were** wearing blue socks and many gave the answer as a fraction (2/7). Possibly more careful reading of the question would have prevented these errors.

Answers: **(a)(i)** 2.25 **(ii)** 2 **(b)(ii)** 6

Section B

Question 7

(a) (i) Candidates should be aware that when a question says "state" that the answer can be written down without the need for working. Some mistakenly used calculations involving the length and breadth of the tank. Candidates need to know conversions such as 1000 cm^3 = 1 litre.

(ii) This was generally well answered and the method was understood.

(iii) Marks were often awarded in this part but the inclusion of a top surface often prevented full marks being scored.

(iv) Marks were only scored in this part by the more able candidates. Candidates needed to be aware that to find the required time the volume 9600 would have to be divided by a volume per second and often only the speed or an area was used.

(b) (i) The total volume of the spheres was often found and even those who correctly divided by 20x30 in part **(a)(ii)** often omitted to divide in this part. Less able candidates tried to use the given formula for volume in this part.

(ii) Some candidates successfully used the given formula and rearranged to make r^3 the subject of the formula. Candidates should take note of the instruction given on the first page that answers should be given to 3 significant figures since many lost marks for insufficient accuracy in finding the cube root. A few candidates tried to use r as 2.6.

Answers: **(a)(i)** 9.6 **(ii)** 16 cm **(iii)** 2 200 cm^2 **(iv)** 191 **(b)(i)** 11 **(ii)** 0.853 cm

Question 8

This was a popular *Section B* question which yielded some marks to most candidates.

(a) Many candidates scored full marks for the table with some losing just one mark for giving the y-value as 0 when x=0. Candidates need to remember that the squares of negative numbers are positive and negative values resulted for the considerable number who forgot this.

(b) The points were generally accurately plotted and a suitable curve drawn. There was very little use of straight lines to join the points this year. Those with wrong values in the table could still score marks for plotting their points and drawing a curve through them. Candidates should be aware that when the curve needs to kink to go through one of their points then the point is probably wrong and needs recalculating.

(c) (i) There was a mixed response to this part with some candidates offering no graph, possibly not understanding the f(x) notation. Most calculated and plotted many points, sometimes with wrong plots, which could have been corrected had candidates recognised that the graph was a straight line. Some gave the values of f(x) as x + 7/2, possibly by using the calculator without the use of brackets, which gave a steeper line.

(ii) Some candidates obtained the correct answer, not usually by using their graph, but by algebraic means. The most common wrong answer was to find f(3)=5. A few thought that f^1(3) meant the reciprocal of f(3) so gave the answer as 1/5.

(iii)(a) Those with a quadratic shaped curve and a long enough line were able to read off the required two intersections. Some misread the negative value as –2.1 instead of –1.9.

(iii)(b) Only a few more able candidates could equate the graphs and rearrange it into the correct quadratic form. Some tried to use their answers from part **(a)**, occasionally successfully, while others left this part unanswered.

Answers: **(a)** 15, 8, 3, 0, –1, 0, 3, 8, 15 **(ii)** –1 **(iii)(a)** –1.9 and 2.4 **(b)** $2x^2 - x - 9 = 0$

Question 9

(a)   BÂC was often correctly identified and the Sine rule applied to find BC. Occasionally th
angle was used in the Sine rule but this was generally well answered.

(b)(i)   Many candidates were well prepared at using the Cosine rule and any inaccuracies usually came
from using the negative value of the cosine incorrectly. A few used incorrect algebra in collecting
up the individual terms to arrive at the form $kcos\theta$ but this was possibly seen less than in recent
years.

   (ii)(a) This part was quite well answered.

   (ii)(b) The formula ½absinC was successfully applied by many candidates. The actual area in m^2 was
found by many candidates. However the intention was to use the values found in part **(a)** to find
the area on the plan in cm^2, and this was not fully understood.

   (ii)(c) Most multiplied by 5 and candidates need to be aware that the two dimensions of area require a
factor of 5^2.

Answers: **(a)(i)** 26 **(ii)** 11.8 **(b)(i)** 104 **(ii)(a)** 11 and 14 **(b)** 71.4 **(c)** 810

Question 10

This was the least popular *Section B* question.

(a) (i)   Marks were often scored here although some candidates omitted the vector $\overrightarrow{BC}$ to get to their
answer.

   (ii)   Many candidates realised that Pythagoras was needed to find this, although not all understood that
the notation referred to length. The squaring of negative numbers again caused difficulties for
some.

   (iii)   The intention here was to find the vectors for $\overrightarrow{EF}$ and $\overrightarrow{HG}$ and show that they were identical. Not
many candidates tried this method and sometimes a diagram was mistakenly given to "show" the
required result. Candidates must realise that "show that" requires some mathematical calculations.

(b)   Those attempting this part often scored a mark for "enlargement". With 3 marks available for this
answer candidates should be aware that more was expected. Some gave the scale factor but few
also gave the centre of enlargement.

(c) (i)   Marks were often scored in this part after correct matrix multiplication. A few only used the
coordinates of *O*, *U* and *V* and so obtained just two of the three values needed. Candidates must
be aware that the order of the multiplication is important and some found difficulties by putting the
coordinate vector first.

   (ii)   Few candidates realised that the inverse matrix was required here so very few marks were
awarded for this part.

Answers: **(a)(i)** $\begin{pmatrix} 14 \\ -4 \end{pmatrix}$ **(ii)** 14.6 **(b)** Enlargement, centre (–2, 4), scale factor 2 **(c)(i)** (5,0) (7,3) (2,3)

   (ii) $\dfrac{1}{15}\begin{pmatrix} 3 & -2 \\ 0 & 5 \end{pmatrix}$

Question 11

(a) Candidates must realise that the units of the terms compared in a ratio must be consistent understanding this often produced the correct ratio although a common wrong answer wa Some mistakenly tried to express the ratio as 1:n.

(b) (i)(a) Many used the correct method although not all candidates appreciated that the small amount over 1000 ml required an additional bottle.

(i)(b) The candidates that had calculated the number of ml required and had the correct answer for part **(a)** usually scored this mark. Those who calculated the number of bottles in part **(a)** directly sometimes got confused when trying to convert back to ml.

(ii)(a) The more able candidates made an attempt to set up the basic equation although many others left this part blank. When the answer is given in the question candidates must be extra careful developing their initial equation and not anticipate the final answer too soon.

(ii)(b) Candidates generally performed well here and it was sometimes the only part of this question attempted. When using the quadratic equation formula candidates must remember that the whole of the numerator is divided by 2 and pay careful attention to the accuracy required.

(ii)(c) More able candidates could take the positive answer from part **(b)** and produce the required length. Some others thought the positive answer was all that was needed.

Answers: **(a)** $3 : 1000$ **(b)(i)(a)** 3 **(b)** 487.5 **(ii)(b)** 5.67, -39.67 **(c)** 44.0

MATHEMATICS D (CALCULATOR VERSION)

General comments

There were many neatly presented scripts which contained responses to all the questions in **Section A** and to four questions in **Section B**. The time allowed for the examination enabled this to be achieved comfortably. There were some infringements of the rubric, with candidates doing all five questions in **Section B**.

In some types of questions, candidates could be encouraged to draw diagrams to accompany their solutions. For instance, in trigonometry, there would be some advantage in drawing the particular right-angled triangle relevant to a particular part of a question, especially if it is being abstracted from a 3-D situation such as in **Question 9.**

Candidates could be reminded that to gain full credit for accuracy in numerical questions, 3 significant figure accuracy is required. Where expressions can be evaluated at intermediate stages in a problem, at least 4 figure accuracy should be maintained in order to achieve an acceptable 3 significant figure answer at the end. This may be related to the use of the calculator. Ideally, the greater number of figures should be retained on the calculator. Candidates should also check that their calculators are set in the correct mode before evaluating trigonometrical expressions.

Comments on specific questions

Section A

Question 1

(a) (i)   There were many correct answers but the factor $(x + y)$ was sometimes left. Unorthodox cancelling of x's and y's separately led to answers such as $\dfrac{0}{8+8}$ or $\dfrac{1}{8+8}$. The answer 8 was common.

(ii)   The general ideas of removing brackets and grouping terms were understood. A common error when removing the brackets was to obtain -5 rather than +5, and sometimes - 2 instead of $-2x$.

(b)   The removal of the brackets here did not have the problem of the negative sign, so credit was given only if $3t - 4 = 7 + 2t + 6$ or better was obtained. A common, expensive, error was to imagine a bracket where none existed as $9(t + 3)$ was sometimes evaluated as an intermediate step.

(c)   This type of factorisation is well understood. Some candidates gave incomplete answers such as $x(5p - 7q) + 2y(5p - 7q)$, but this showed evidence of a correct approach.

(d) (i)   The instruction to show all working was followed. To gain full marks, candidates were still expected to indicate clearly which expression had the greater value.

(ii)   Full credit was gained only when $x < $ - 0.5, or its equivalent, was the final answer. Some candidates who reached this went on to give $x > 0.5$ as their final step. Some candidates were under the misapprehension that there were two inequalities to solve, $3x + 4 < 2$ and $4 < 2 - x$.

Answers: **(a)(i)** $\dfrac{1}{8}$ **(ii)** $5 - 2x$ **(b)** $t = 17$ **(c)** $(5p - 7q)(x + 2y)$ **(d)(i)** $2 - x$ **(ii)** $x < $ - 0.5

Question 2

(a) (i)   This part was answered very well with many correct answers seen.

(ii)   This was again often correctly answered. The usual error was to use multiplication again instead of division.

(iii)   This part was often well answered. The usual errors were to omit multiplication by 1.21 (after successful division by 1.87), or to combine the two rates incorrectly and multiply $850 by (1.87 – 1.21).

(b)   The correct method was usually seen. The question was in essence working out the exchange rate between dollars and rupees, so the amount of rupees received for each dollar was expected to be given to 2 decimal places. Due credit was given for accurate work that was rounded to 3 significant figures.

(c) (i)   This part was well answered.

(ii)   The idea of simple interest was usually understood. To gain the full method marks, it had to be clear that what was required was $\dfrac{1}{36}$ th of the total of all the simple interest plus the principal of $27 000. The common error was to forget to include the $27 000 in this calculation. After dealing with the simple interest, some candidates forgot to divide by 36.

Answers: **(a)(i)** 935   **(ii)** 600   **(iii)** 550   **(b)** 51.95   **(c)(i)** $ 375 **(ii)** $ 1087.50

Question 3

(a)   The interior angle of a regular polygon can be found by first calculating the exterior angle. Alternatively the angle sum of all the interior angles of the regular polygon can be calculated first in order to find the interior angle. Both methods were used successfully. Some candidates using the first method stopped at 36°. The wording given in the question, "Calculate the interior angle of a regular 10-sided polygon", did not mean the total sum of all the interior angles. Some candidates using the second method stopped at 1440°. Both of these answers when seen were given some credit for being correct steps towards evaluating the interior angle.

(b)   For a complete method, it was expected that the sum of all 5 angles of the pentagon *ABCDE* was equated to 540°, or all 4 of the angles of the quadrilateral *ABCH* was equated to 360°. A common error here was to give the angle sum of the pentagon as 360°. This gained the method marks for deducing by symmetry the values of all the unmarked angles in the diagram. Solutions to this question were rarely accompanied by a diagram. Drawing a diagram could have been helpful to candidates, perhaps bringing to their attention its symmetry properties.

(c) (i)   There was abundant evidence that the standard formula for the area of a trapezium was well known. A common error was to leave the height of the trapezium as 2*h*. Perhaps a separate diagram of the trapezium *QRST,* drawn to accompany this part of the question, would have helped to avoid this error.

(ii)   A common error here was to equate the expression found in part **(c)(i)** to 221. Some candidates used 2*h* as the height of triangle *PTQ*.

Answers: **(a)** 144°   **(b)** 38   **(c)(i)** ½(10 + 12)*h*,   **(ii)** 13

Question 4

(a) (i) It was expected to see $\tan SPQ = \dfrac{9}{7}$ leading to angle $SPQ = 52.1°$. More complicated me

such as finding *SP* first, by using the cosine rule for a general triangle, were sometimes attempte

but these are not advised. There were some attempts to use 35° incorrectly at this stage,

assuming it to be the value of angle *PSQ* of triangle *PQS*.

(ii) Again, the most efficient solutions used the cosine ratio directly in the right-angled triangle *SQR*. Using the sine rule for a general triangle was not always successful.

(b) Candidates had to find the right-angled triangle in which to work by first drawing the perpendicular line from *C* to *AB*. Drawing a diagram as part of the solution was a help here. The slant height could then be found directly using the ratio for $\sin 20°$. A common error was to see $\dfrac{4}{l} = \tan 20°$, candidates possibly thinking that slant height meant the same as height. Another common error was to see $\dfrac{8}{l} = \sin 40°$.

Answers: **(a)(i)** 52.1° **(ii)** 7.37 cm **(b)** 147 cm^2

Question 5

(a) Some candidates showed which value in the distribution would represent the median, and correctly identified the interval in which it lay.

(b) Calculating an estimate of the mean is a standard procedure but many candidates made errors in the calculation. A common error in forming the numerator was to use column widths in the numerator products instead of mid-interval values. Denominators of 6 were also common.

(c) (i) Only a minority of candidates seemed to understand what was required here.

(ii) In this part, candidates who had succeeded in the previous part did not always find the height for the required rectangle. It was expected that the ratio of the column heights would be seen to be the same as the ratio of the frequency densities. It was not always clear what candidates were trying to do here. Any mark earned in this part was usually for the correct column width.

Answers: **(a)** $90 < m \le 95$, **(b)** 93.2 g **(c)(i)** 4 **(ii)** 1 cm and 10 cm

Question 6

The instructions given at the start of this question were largely adhered to.

(a) (i) This was usually correct and in the expected place and orientation.

(ii) The loci were very well drawn in both parts.

(b) The majority of candidates who had got part **(a)** correct shaded the correct region.

(c) (i) Good solutions indicated the precise points S_1 and S_2. In some cases, letters were written in approximately the right places and credit was given whenever possible. Some credit was given if both S_1 and S_2 were clearly marked on the correct bearing from *A*.

(ii) The angle was usually correct for clearly identified points on the correct bearing from *A*.

(iii) If a relevant angle was measured, it was not always correctly written as a bearing from *B*.

Answers: **(c)(ii)** 10° **(iii)** 336.

Section B

Question 7

(a) Most candidates used the area of the rectangles correctly to obtain their expressions for *AB* and *PQ*.

(b) Care was needed in constructing the equation to give the difference in the right order, and further care was needed to simplify correctly. When the answer is given in a question, each step must be absolutely correct.

(c) Good marks were earned solving this equation. Some candidates lost a mark here by anticipating that only the positive root would be required later, and therefore this was all that needed to be evaluated here.

(d)(i) The four figure number that rounded to 14.9 needed to be seen here. Credit was given for the intention to evaluate a correct numerical expression using the positive root of the equation.

(ii) This was reasonably well answered. Credit was again given for a correct calculation using their positive root.

Answers: **(a)(i)** $\dfrac{13}{x}$ **(ii)** $\dfrac{13}{x+5}$ **(c)** 2.78 and $-$ 7.78 **(d)(ii)** 4 cm.

Question 8

(a) The value of *p* was usually correctly answered.

(b) Plotting the points and drawing the curve were generally very well done. Care was needed that the *y* value calculated in part **(a)** was plotted at $x = 4.5$, and not at $x = 5$.

(c) This part was understood by most candidates. Some candidates omitted this part.

(d)(i) This was well answered. It was expected that the gradient would be calculated from the points stated rather than from other values read from the graph.

(ii) It was not always appreciated that a tangent parallel to the chord in part **(d)(i)** was needed. Sometimes the tangent was drawn at one end of the chord.

(e)(i) This part was well done in many cases. Incorrect lines usually went through the point (0,6) and were often horizontal. This part was omitted in some solutions.

(ii) Some credit was usually gained here by most candidates.

(iii) The principle required here was known and successful solutions were seen. Many attempts were seen where the *x* value from part **(e)(ii)** was substituted into $x^3 + Ax + B = 0$ and so no credit could be given.

Answers: **(a)** 6.9 **(c)** 2.5 **(d)(i)** 0.4 **(e)(ii)** 3.5 **(iii)** $A = 5$ and $B = - 60$

Question 9

(a) This part was usually correct.

(b)(i) Following on from part **(a)** it was expected that the area of triangle *ABD* would be used in the g̶ formula for the volume of a pyramid. Credit was given if ½×5×5 was used appropriately. Howeve̶ often this could not be awarded.

(ii) It was expected that this would follow from realising that the triangle was an equilateral triangle with sides of length $\sqrt{5^2 + 5^2}$, found by using Pythagoras' theorem. The formula ½*ab*sin*C* then gives the required area directly. More complicated methods were attempted, such as using *CD* as base with the perpendicular height from *B* to *CD*. This was rarely successful. Candidates tended to misinterpret Diagram II and assume this perpendicular height was the same as the perpendicular from *A* to *CD* + *AB*.

(iii) Many candidates carried through their results from parts **(b)(i)** and **(ii)** to find this height.

(c)(i) This was often correctly answered.

(ii) This part was less successful.

(iii) This part was also not successfully answered.

Answers: **(a)** 5 cm   **(b)(i)** 20.8 cm³   **(ii)** 21.6 cm²   **(iii)** 2.89 cm   **(c)(i)** 14   **(ii)** 24   **(iii)** 36

Question 10

(a)(i) Descriptions needed to be clear and involve only one transformation, either Rotation or Enlargement. A common error was to mention or imply Reflection.

(ii) It was expected to see both equal and parallel stated for full credit.

(b)(i) This was very well answered.

(ii) The correct matrix multiplication was seen. Care was needed to multiply the appropriate matrices in the right order.

(iii) This was generally well answered. Candidates were given credit for applying the translation T to the vertices of the triangle obtained in part **(ii)**.

(iv)(a) The strategy required here was to let the matrix be $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and use matrix multiplication to reach $\begin{pmatrix} 0 & a & b \\ 0 & c & d \end{pmatrix}$ which could then be compared with $\begin{pmatrix} 0 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$ to find *a*, *b*, *c* and *d*. Less systematic approaches sometimes led to one correct column of the required matrix.

(b) Even when the matrix in part **(a)** was correct, it was unlikely to be recognised as representing a Stretching. The question contained enough information to make parts **(a)** and **(b)** independent. An accompanying diagram showing triangles *A* and *E* may have alerted candidates to the fact that lengths in the x direction were being doubled, and lengths in the *y* direction trebled. Common misunderstandings led to the description Enlargement or Shear, with some attempt at combining 3 and 2 to come up with a numerical factor to explain the change in size.

Answers: **(a)(i)** Rotation of 180° or Enlargement with scale factor − 1, the centre of Rotation or Enlargement the midpoint of *RS*   **(ii)** Equal and parallel   **(b)(i)** $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ **(ii)** (0,0), (2,0), (0,1)

(iii) (2,3), (4,3), (2,4)   **(iv)(a)** $\begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}$ **(b)** A Stretching of 2 units in the *x* direction and 3 units in the *y* direction.

Question 11

(a)   The need for the cosine rule for a general triangle was recognised here and used effectively.

(b)(i)   The necessary 2-D right-angled triangle was recognised in the 3-D context and the tangent ratio was used effectively to find *PX*. It was expected that the value 3.8627 km would be corrected to 3 900 m. It was often left as 3 860 m.

(ii)(a) Solutions beginning by adding the 2 minutes 54 seconds to 39 minutes 6 seconds were more successful than those beginning by attempting to subtract 39 minutes 6 seconds from 15 03. This calculation, with its mixture of units, hours, minutes and seconds, proved more difficult to negotiate, and even to get in the right order, with attempts at subtracting 15 03 from 39 minutes 6 seconds seen. When the final answer was not achieved, credit was given for a correct, initial step, such as obtaining the time of 42 minutes.

(b) Amongst candidates familiar with the general idea of average speed, there seemed to be some difficulty in choosing the correct time of 2 minutes 54 seconds in order to get the average speed required on this occasion. A time of 42 minutes in the denominator was a common error.

Answers: **(a)**   19.6 km   **(b)(i)**   3 900 m   **(ii)(a)**   14 21   **(b)**   352 km/h