MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

Read the question carefully and answer precisely what is asked. Do not round at a partway stage of a calculation as this is likely to lead to an inaccurate answer.

General comments

The standard of the responses from the candidates was very good. Many marks were lost however through carelessness causing errors often where it was clear that the method of solution was well known. Apart from the reasons mentioned in the key messages, marks were lost due to a lack of working which meant a response close to the correct answer might well have gained a method mark if working had been seen.

Comments on specific questions

Question 1

This question was very well answered although a small number of candidates added the temperatures leading to answers of 13 or −13.

Answer. 5

Question 2

Candidates found this question challenging. There were many variations of incorrect or no responses showing a lack of understanding of rotational symmetry.

Question 3

(a) The vast majority of candidates gave the correct answer to this part.

(b) This was well answered although 3, 30 and 300 were the most common incorrect responses.

Answers: **(a)** 14 **(b)** 3000

Question 4

Most candidates had no difficulty working out the volume of the cuboid but a significant number found or attempted to find the surface area. Another error seen a number of times was halving the correct volume.

Answer. 3600

Question 5

Although this was a very straightforward question which the vast majority did correctly, there were some who found the median rather than the mean. Some others added correctly but either left the sum as the answer or divided by 2. Another error was to round to the whole number, 35, even though this was an exact answer. This, together with other incorrect responses, was often seen without working and so couldn't be awarded the method mark.

Answer. 35.5

Question 6

(a) Most candidates understood standard form but some felt the 6.29 had to be rounded to 6.3 while others did not give the first part as a number between 1 and 10. Just dropping the zeros to give 629×10^3 was quite common as were other incorrect powers of 10.

(b) This part was not so well answered, with 0.000821 and 0.0821 being common incorrect responses. Also seen many times was the fraction $\frac{821}{100000}$ or a fraction with denominators having other powers of 10 written as the answer.

Answers: **(a)** 6.29×10^5 **(b)** 0.00821

Question 7

While the question was well answered by most candidates, many lost a mark by using 3.14 or $\frac{22}{7}$ for π, leading to inaccurate answers. A number of candidates found the area of the plate but the main error was to use an incorrect formula, or misread diameter for radius resulting in an answer twice the correct one.

Answer. 84.8

Question 8

This question was not very well answered with many candidates rounding at least the denominator values to the nearest whole numbers rather than to 1 significant figure. Some performed complex long multiplication of the actual numerator numbers (since a calculator was not to be used) and then rounded for the division. Many candidates used multiplication instead of subtraction in the denominator. A correct answer was only credited if the correct working was seen but the vast majority who correctly rounded gained the 2 marks.

Answer. $\frac{10 \times 20}{90 - 40} = 4$

Question 9

The factorising was well done by those who understood the topic, although a number of candidates only gained one mark for an incomplete factorisation. An answer seen a number of times was $5c(3c - c)$ which could not score. Those who did not fully understand the topic continued from a correct answer to combine the terms to produce an answer of $10c$, $10c^2$ or $3c^3$.

Answer. $5c(3c - 1)$

Question 10

There was some confusion over the terms factor and multiple which resulted in a number of large numbers as answers, presumably attempts at lowest common multiple. Many answered the question correctly but equally seen was the answer of 3 which gained one mark. Most attempted a split into multiplication of factors (not always prime ones) but some took the common 3×3 to lead to 3^4 or 81 as the answer.

Answer. 9

Question 11

(a) The vast majority of candidates gained the mark on this part but 9 (from 9 – 0) or leaving the range as 9 –1 was seen sometimes. Some did not know the term or confused the two parts of this question.

(b) The only significant incorrect answer seen, apart from total lack of knowledge, was 6 alone or included on the assumption of two modes.

Answers: **(a)** 8 **(b)** 2

Question 12

The question was quite well answered although some candidates used division instead of multiplication. Although the first stage could be changing 400 euros to dollars (400 × 1.09) or 1 euro to rupees (62 × 1.09), many gave 24 800 from 400 × 62 as their answer.

Answer. 27 032

Question 13

Most candidates used the correct trigonometry function, tangent, although not all were able to correctly work out the angle. There were a significant number who worked out the value of the tangent but wrote it down with insufficient accuracy, often just 0.44 or 0.45, which resulted in an inaccurate answer. Some candidates worked out sine, even when tan was written in the working. Long methods usually at best produced an answer with insufficient accuracy while some did not know the topic and tried a non-trigonometry solution, usually the result of a Pythagoras' theorem calculation.

Answer. 24.2

Question 14

(a) Whilst this was very well answered, there were a considerable number of candidates who chose the wrong heights to subtract. In particular, the answer 2 was common, presumably from classes D and A.

(b) Most answers were correct as the working was very straightforward. However, many did not show the working and a small arithmetic error meant the method mark could not be awarded if their height was incorrect, due either to an error in calculation or from drawing the bar.

Answers: **(a)** 9 **(b)** Bar from E to height 23

Question 15

(a) There were very few incorrect answers to this part although 1 was seen a number of times.

(b) Again this was well answered but 24 was a common incorrect answer.

(c) This was the least well answered of the three parts but still most candidates found the correct next term. Responses of 37 and 39 were often seen.

Answers: **(a)** –1 **(b)** 25 **(c)** 65

Question 16

(a) Candidates found this slightly different approach to the property challenging. Many either showed just a diameter or a right angle between two radii. There were an appreciable number of blank responses to this part.

(b) Most responses to the construction of an equilateral triangle were correct and accurate, with arcs. However, there were a significant number of candidates who constructed an isosceles triangle, most intentionally although some were a poor attempt at an accurate equilateral triangle. Just bisecting the line *AB* was seen quite a few times. Again there were some blank responses.

Question 17

Most candidates knew how to divide fractions and few scored zero marks. However, many lost the final mark by not reading that the question asked for a mixed number answer. Many simply ended with $\frac{4}{3}$ and some introduced decimals with 1.33. The main errors in the process were to invert the first improper fraction or not invert the second fraction when multiplying. Quite a number used the acceptable alternative method of leaving the question as division but putting the individual fractions to a common denominator, almost always 6.

Answer. $1\frac{1}{3}$

Question 18

(a) Most candidates gained one mark on this question, most often from expanding the first bracket. The usual problem of the negative before the second bracket or the sign problems combining the like terms meant the second mark was not often gained. Once again, some made good progress but then combined the terms to give a single term answer. A few gave an acceptable factorised form but some just gave $9w + 7$. Other common incorrect answers were $18w + 10$ and $-2w - 2$.

(b) This was answered well but there were a significant number who gave w^7 or w^{25} from adding or squaring respectively.

Answers: **(a)** $18w + 14$ **(b)** w^{10}

Question 19

The vast majority of candidates used the compound interest formula and many had correct solutions. However, marks were lost through ignoring the rounding to 2 decimal places instruction and an inability by some to go from $\left(1+\frac{7.5}{100}\right)^3$ to 1.075^3. This was another question where over-rounding at an intermediate stage led to an inaccurate answer. A number of candidates found the interest on the investment rather than the requested total value and a small number applied simple, rather than compound interest.

Answer. 2981.51

Question 20

Many candidates did not show any attempt to measure the angle for sleeping, for example, $\frac{60}{24}$ was calculated, and others thought the angle was 45° or 225°. Although many did divide the angle by 360°, the result was not always multiplied by 24; multiplying by 5 was seen a number of times. A common assumption was that sleeping was one-third of the time leading to an answer of 8 hours.

Answer: 9

Question 21

(a) This part was generally correct but some made errors, usually in adding two negative values. There were a few who wrote a fraction line between the components but these were nearly always candidates who did not understand addition of vectors.

(b) (i) There were quite a number of blank responses to this part as well as a position of point *C* bearing no relation to the components of the vector. (7, 1) was a common error from applying the components in the wrong order and counting the squares also produced incorrect positions, for example (2, 5).

(ii) Leading from the previous part, blank responses were again common. Poor reading of the question often led to $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$ from the vector to *B* instead of to *C*. $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ was a common error due to giving the vector from *C* to *A*, while a variety of answers showed a lack of knowledge of the order or sign implication of the components of vectors.

Answers: **(a)** $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ **(b)(i)** Point at (3, 5) **(ii)** $\begin{pmatrix} 1 \\ -3 \end{pmatrix}$

Question 22

(a) While the vast majority of candidates gained this mark, a number subtracted 4 from 10.

(b) This equation was solved correctly by most candidates but $5x + 8$ for the expansion and 75 + 40 were common errors.

(c) This was not so well answered as the previous parts with an answer of –2 being very common. Some showed the correct value embedded but then gave the answer 2. Other incorrect responses were 9 and 3^5, the latter being the correct divisor but not the value of the requested x.

Answers: **(a)** 2.5 **(b)** 7 **(c)** 5

Question 23

(a) In working out the gradient, the vast majority of candidates used the co-ordinates of two points. However, many were not clear about the formula and did not show two points actually on the line. It also did not seem to be well known that the value of the constant was the *y*-value at the point of intersection with the *y*-axis. Consequently, there were not many full marks seen on this part although most candidates did get some credit from either the gradient or the intercept.

(b) While there were many correct responses, a very common incorrect line was through (–1, 0) and (0, 1) and therefore not a parallel line. Other lines satisfied one, but not both of the conditions given in the question.

Answers: **(a)** [y =] $-2x + 3$ **(b)** Ruled line $y = -2x - 1$ drawn

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

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 level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates occasionally had problems with rounding. For example, premature rounding part way through a calculation was evident in **Question 19** and over rounding of the answers was evident in **Questions 7** and **9**. Candidates were very good at showing their working and so more method marks were awarded as a consequence.

Comments on specific questions

Question 1

This was generally well answered. There were quite a few candidates who factorised to $2(9w + 7)$, which was an acceptable alternative answer. Sometimes there was an incorrect attempt to simplify further to $9w + 7$ which usually scored 1 mark if sufficient working was shown. Other common errors were to expand the right-hand bracket to $-2w - 2$, leading to $18w + 10$, or $-2w + 1$, leading to $18w + 13$ along with other arithmetic and simplifying slips.

Answer: $18w + 14$

Question 2

The majority of candidates efficiently set compasses to the length of *AB* to draw a pair of arcs and the correct triangle. Some chose the slightly less efficient method of constructing 60° angles using pairs of arcs from *A* and *B*. A number of candidates gained 1 mark for drawing the triangle accurately by measuring angles or sides rather than constructing; candidates are advised when the question asks them to use a straight edge and compasses only, then measuring with a ruler is not the correct method. It was quite common to see the perpendicular bisector of *AB* going through a set of arcs which were shorter than *AB* but then the correct triangle was drawn by measuring. The most common reasons for not scoring were to construct an isosceles triangle with the two equal sides being shorter than *AB* or to construct the triangle out of tolerance for accuracy.

Question 3

Most candidates rounded each of the four numbers correctly to 1 significant figure and reached $\frac{200}{50}$ then 4 as the answer. Some did no rounding at all and either used a calculator or mental arithmetic to work out an accurate figure which they then rounded. Some rounded the two figures in the numerator to 10 and 20 but rounded the denominator to $89 - 43$ (= 46) and then attempted $200 \div 46$. On a few occasions the subtract sign in the denominator became a multiplication sign and $\frac{10 \times 20}{90 \times 40}$ followed by an answer of $\frac{1}{18}$ was sometimes seen.

Answer: 4

Question 4

The best solutions began with the working $7.31 = 7\left(1 + \frac{1.1}{100}\right)^k$ and usually this was followed by the expected method of trial and improvement to solve this. Some candidates used logs to solve this, usually successfully, but not always. Some were unsure how to proceed from this starting point and either stopped at this point or crossed it out and switched to an alternative incorrect method that they were able to solve. Sometimes this correct starting point was followed by $7.31 = 7.077^k$ with 1 being a common incorrect answer following this misconception. Working was not well laid out in many cases. Many used a simple percentage increase approach, dividing 0.31 by 0.077 reaching 4.02 which did not score any marks. 95 was another common incorrect answer from solving $7.31 = \frac{(7 \times 1.1 \times t)}{100}$. There were a number of candidates who offered no response to this question.

Answer: 4

Question 5

This was very well answered with very few incorrect answers seen. Those that were seen were often as a result of an arithmetic slip. The most common incorrect answer was 31 arising from the correct $2 \times 3 + 16 \times 3^2$ followed by $6 + 16 + 9$.

Answer: 150

Question 6

The majority of candidates used the expected method of multiplying the decimal by a power of 10 and subtracting to eliminate the recurring part of the decimal. Some did not gain the final mark because they gave a fraction with a decimal as part of it, usually $\frac{1.6}{9}$. Some made a correct start but then did not completely understand the concept of eliminating the recurring part, for example 1.777 – 0.1777 = 1.5993. Others did not consider the recurring part of the decimal at all, stating 1.7 – 0.17 = 1.53 and then $\frac{1.53}{9}$. Other common errors were to write the digits over a power of 10 e.g. $\frac{17}{100}, \frac{1777}{1000}$ etc. or to treat the value as $0.\dot{1}\dot{7}$. A small number of candidates gave the answer $\frac{8}{45}$ with no working at all; as there was an instruction in the question to show all working, this scored 0 marks.

Answer: $\frac{8}{45}$

Question 7

The correct method was followed by most candidates who attempted 9.25 × 7.65 and 9.35 × 7.75 and often they gave the answers of 70.7625 and 72.4625. However the final answer was often these figures rounded to 70.8 and 72.5 or 70.76 and 72.46 which meant the final accuracy mark could not be scored. Candidates are advised that these bounds are exact answers that should not be rounded. The most common incorrect method was to calculate 7.7 × 9.3 = 71.61 and to give bounds for that number, often 71.605 and 71.615. A few gave the bounds for 9.3 as 9.3 ± 0.5 and for 7.7 as 7.7 ± 0.5 so they attempted 8.8 × 7.2 for example. Sometimes an upper bound was multiplied by a lower bound in error.

Answer: 70.7625 and 72.4625

Question 8

This was a well answered question with the majority of candidates scoring at least 2 marks. The main loss of marks was due to candidates leaving their answer as $\frac{4}{3}$, or a few times $1\frac{5}{15}$, rather than writing it as a simplified mixed number as required in the question. Working was well laid out and clear. Some candidates were unable to give $\frac{10}{3}$ or sometimes $\frac{5}{2}$, making arithmetic slips, but they usually followed this by the correct method. $\frac{3}{10}\times\frac{5}{2}$ was seen occasionally where candidates chose the wrong fraction to take the reciprocal of.

Answer: $1\frac{1}{3}$

Question 9

This was also generally well answered with most candidates correctly using Pythagoras' theorem. A few forgot to use half of the length of the diagonal *AC* and reached an answer of 10.54 from $\sqrt{20^2 - 17^2}$. A small number tried longer methods, usually starting by finding the length of a side of the base, but these were rarely successful, with $\sqrt{20^2 - 6.01^2}$, finding the height of one of the triangle faces, being a common incorrect method. An answer of 18 was often given with no more accurate answer seen. Candidates are advised that the requirement on the front of the question paper is to give non-exact answers correct to three significant figures in order to gain the accuracy marks.

Answer: 18.1

Question 10

The vast majority of candidates understood the concept of finding the original price and gained full marks. There were two extremely common misconceptions, the first of which was to find 12% and either subtract this from or add it to \$924 resulting in answers of \$813.12 and \$1034.88. The second was to calculate $924 \div 0.12$, giving an answer of \$7700 or \$6776 if \$924 was subtracted.

Answer: 1050

Question 11

The majority of candidates scored 2 or 3 marks in this question with a mark of 0 being very rare. Many candidates did give the correct answer, often without showing any intermediate steps. Some of those who did show an intermediate step did not always label their shapes and are advised that labelling shapes is good practice. The most common error was to do the two steps in the reverse order, i.e. finding TM(*A*) instead of MT(*A*). Some did not know how to combine the transformations and it was common to see the original shape both reflected and translated. A few candidates did the translation the wrong way round. Most did the reflection correctly. Some candidates seemed to want to form matrices to do this work and there was a lot of incorrect matrices work with no diagrams drawn at all for some.

Question 12

Candidates usually gained 3 marks on this question. Those who did not score full marks were often awarded M1. They had a correct starting point and found the correct constant of proportionality, 400, but then they would divide this by 10 rather than 10^2. Those who did not score any marks for this question usually did not know how to start or used the wrong proportion, for example, direct proportion or the square root of x instead of x squared.

Answer: 4

Question 13

Factorisation was generally well done with the answers to both parts usually being correct. In **part (a)** partial factorisation was hardly ever seen and the few incorrect answers that were seen were usually the result of a missing or extra letter. In **part (b)** partial factorisation was sometimes seen for 1 mark. The most common cause of an incorrect result was a sign error.

Answer: **(a)** $5c(3c-1)$ **(b)** $(2p-m)(k+3)$

Question 14

The overwhelming majority of candidates plotted the point correctly in **part (a)** with the occasional error of using $\begin{pmatrix}0\\-4\end{pmatrix}$ or treating as co-ordinates and plotting at (4, 0). **Part (b)** was also well attempted, with $\begin{pmatrix}-1\\3\end{pmatrix}$ being the most common incorrect answer along with other combinations of ±1 and ±3. The vector $\begin{pmatrix}5\\-3\end{pmatrix}$ was also seen a number of times, being the vector $\overrightarrow{AB}$. **Part (c)** caused the most problems and $\begin{pmatrix}\pm4\\0\end{pmatrix}$ were the most common incorrect answers, scoring 1 mark as they had a magnitude of 4. There were many unnecessary calculations seen involving the magnitude when it could simply be counted. Vectors containing $\begin{pmatrix}\pm5\\+3\end{pmatrix}$ were seen frequently for various reasons; the co-ordinates of *C* being (3, 5), the combination of vectors $\begin{pmatrix}1\\-3\end{pmatrix}$ and $\begin{pmatrix}-4\\0\end{pmatrix}$ and $5^2 - 3^2 = 16$. A number of candidates were able to score 1 mark for an answer of $\begin{pmatrix}0\\\pm k\end{pmatrix}$, i.e. for recognising the perpendicular aspect of the question.

Answer: **(a)** Point at (3, 5) **(b)** $\begin{pmatrix}1\\-3\end{pmatrix}$ **(c)** $\begin{pmatrix}0\\4\end{pmatrix}$ or $\begin{pmatrix}0\\-4\end{pmatrix}$

Question 15

In **part (a)** most candidates gave the correct answer. The usual incorrect solution was to divide the powers to give t^6. In **part (b)** most candidates gave the correct answer. The most common error was to add the powers to give x^7. In **part (c)** most candidates managed to get the correct power for the letter, m^6, but there were more frequently errors in the coefficient. Some gave the coefficient as a power e.g. 3^3, and $81m^6$ was a common incorrect answer too.

Answer: **(a)** t^{20} **(b)** x^{10} **(c)** $27m^6$

Question 16

Nearly all candidates correctly answered **part (a)**. Candidates who got this incorrect usually gave 4 as their answer from dividing the wrong way round, or sometimes 900 or 450. A significant majority of candidates obtained 2 or 3 marks in **part (b)**. Of those who did not get full marks, many gained 2 marks for an answer of 450, where they missed the instruction to give the answer in kilometres or made an incorrect attempt to convert, for example dividing by 100 or multiplying by 1000 instead. It was also very common to award the SC1, usually for 900 m followed by 0.9 km, as 15×60 was a common incorrect method with the working 'distance = speed × time' often seen.

Answer: **(a)** 0.25 **(b)** 0.45

Question 17

Set notation and Venn diagrams proved challenging for quite a few candidates with incorrect responses seen quite frequently in each part of this question. In **part (a)(i)** it was reasonably common to see the numbers given in the question, 6, 7 and 9, placed on the diagram with no awareness of the total being incorrect. 6 was usually in place of the 4 and the 7 was in place of the 5 with the intersection left empty and no appreciation that the 6 should be the total of set *B* and 7 should be the total of set *L*. Others attempted to use the total in a calculation and gave a diagram with 6, 7 and 7 in the three internal spaces. Some candidates reversed the situation described in the question, treating set B as the set of trucks that passed the test for brakes. They were usually awarded SC1 if this was correctly applied to both sets. Correct answers were seen more often in **part (a)(ii)** as many were able to identify the number required from their Venn diagram with the correct answer 9 or a correct follow through mark often being awarded. A relatively common incorrect response was to give $\mathrm{n}(B \cap L)$. **Part (b)** was also often correct although the shading was sometimes carelessly done. The most common incorrect answers were to shade $(P \cup Q) \cap (P \cap Q)'$, that is all of *P* and *Q* except for the intersection, or to shade Q'. Several other shading options were seen as well.

Answer: **(a)(ii)** 9

Question 18

Candidates were well practised in dealing with matrices and the question was very well answered with full marks for one or both parts being very common. In **part (a)** the majority of errors occurred from simple arithmetic slips, especially involving negative numbers either in the multiplication or additions e.g. the calculation –30 + 6 seen in the working with 24 in the matrix. Those who didn't score any marks were generally multiplying or adding incorrect combinations of elements together. **Part (b)** was also well attempted, although there were more errors than in **part (a)**. The negative numbers caused errors again; 7 was often seen as the determinant from –10 + 3. The determinant was also calculated the wrong way round, resulting in 13 from 3 – –10. Candidates were seen on many occasions to calculate –13 correctly but then use $\frac{1}{13}$ for the inverse. 1 mark was often gained for finding the correct adjoint matrix with an incorrect or no determinant or for finding the correct determinant but having an incorrect adjoint matrix.

Answer: **(a)** $\begin{pmatrix} 27 & -24 \\ -5 & -10 \end{pmatrix}$ **(b)** $-\frac{1}{13}\begin{pmatrix} -2 & -3 \\ -1 & 5 \end{pmatrix}$

Question 19

In **part (a)** most candidates used the correct method of $\frac{1}{2} \times 2.8 \times 8.3 \times \sin 79$ although some used cos or tan in place of sine. Some did not include the $\frac{1}{2}$ and therefore gave an answer of 22.8. A few clearly had their calculators in the wrong mode. Some candidates used a less efficient method of using trigonometry to find the height of the triangle followed by $\frac{1}{2}$ × base × height calculation; this often resulted in a less accurate answer due to premature rounding part way through the calculation. It was also common to see sin 79 prematurely rounded to 0.98 with $\frac{1}{2} \times 2.8 \times 8.3 \times 0.98$ followed by an answer of 11.3876 which was outside the range of acceptable answers. In **part (b)** the common method was to multiply each of the two lengths by 4.5, so calculating $\frac{1}{2} \times 12.6 \times 37.35 \times \sin 79$. Only the more able used the more efficient method of multiplying their answer to **part (a)** by an area scale factor of 4.5^2. The most common error was to multiply their answer to **part (a)** by just 4.5 and not 4.5^2 with 51.3 being the most common incorrect answer. Others used the same incorrect method for finding the area of the triangle as they had used in **part (a)**; sometimes this resulted in the follow through mark being awarded but not generally. A few candidates added 4.5 to 2.8 and 8.3 with common incorrect working being $\frac{1}{2} \times 7.3 \times 12.8 \times \sin 79$ and consequently an incorrect answer of 45.9 was quite common.

Answer: **(a)** 11.4 **(b)** 231

Question 20

Most candidates were able to gain 3 marks for **part (a)**. If they did not score full marks they often scored 1 mark for a correct intercept of 3 or a gradient of 2, or more frequently 2 marks for $y = 2x + 3$. Working for the gradient calculation was sometimes unclear, with change in x co-ordinates divided by change in y co-ordinates being a common incorrect method and there were many arithmetic slips with the signs. A significant number of candidates incorrectly used the co-ordinates (3, 0) instead of (0, 3) in their gradient calculation. Some used a calculation to find an incorrect intercept rather than seeing that this was not necessary because the line passed through the y-axis at (0, 3). Those who answered **part (a)** correctly usually gave a correct answer for **part (b)** too. Part marks were awarded more for the substitution of (3, –1) into their $y = mx + c$ rather than a follow through gradient from their incorrect **part (a)**. Some candidates mixed the x and y around when trying to substitute. It was common to see a parallel line attempted rather than a perpendicular one.

Answer: **(a)** $y = -2x + 3$ **(b)** $y = \frac{1}{2}x - \frac{5}{2}$

Question 21

Part (a) was well answered by a significant number of candidates with the correct answer frequently seen. Occasionally there were slips such as misreading –0.5 as 0.5 and it was also common to see the first step towards solving incorrectly written as $x - 3 = -0.5 \times 4$, forgetting to multiply the 3 by 4 as well and so 1 was a common incorrect answer. The most common incorrect answer however was –3.125 where candidates found f(–0.5) instead of solving f(x) = –0.5. **Part (b)** was also well attempted by a significant number of candidates. The most common errors were the answers $\frac{x-7}{6}$ from an error in finding the inverse operation; $\frac{y+7}{6}$ from forgetting to interchange the x and y; and $\frac{1}{6x-7}$ from finding $(g(x))^{-1}$ instead of finding $g^{-1}(x)$. A significant number of candidates scored at least 1 mark in **part (c)**. It was common for candidates to reach $f(13) = \frac{1}{4}$ or $2^x = 0.25$ with the correct answer often seen. However a significant proportion of candidates were then unsure how to proceed from here; 2 was a common incorrect answer as was 2^{-2}. Many candidates used the expected method of going from $\frac{1}{4}$ to $\frac{1}{2^2}$ then to 2^{-2} but some used logs to solve $2^x = 0.25$. A number of candidates attempted to solve f(x) = 13 with x = 64 often seen and many found $2^{0.25}$ with 1.19 being a very common incorrect answer.

Answer: **(a)** 10 **(b)** $\frac{x+7}{6}$ **(c)** –2

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae, show all working clearly and use a suitable level of accuracy. Particular attention to mathematical terms and definitions would help a candidate to answer questions from the required perspective.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper and made an attempt at most questions. Although a number of questions have a common theme, candidates should realise that a number of different mathematical concepts and topics may be tested within the question. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings.

Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set.

Comments on specific questions

Question 1

(a) (i) This part on identifying the required square number was largely successful. Centres should note that as this is a one mark question, 6 or 6^2 are not acceptable responses.

(ii) Writing the given number in words proved more challenging for a number of candidates with a variety of incorrect answers seen including 300 000 030 030, 3 000 330, 330 030 and 3 000 335.

(iii) This part on identifying the required cube number was largely successful. Centres should note that as this is a one mark question, 5 or 5^3 are not acceptable responses.

(iv) This part on identifying the factors of 16 was largely successful although common errors of writing the first 5 multiples of 16, and attempting a prime factorisation which led to 1, 2, 2, 2, 2 were seen.

(v) This part on finding a common multiple was largely successful.

(vi) This part on identifying the required prime number was largely successful.

(b) (i) Writing the given number correct to the nearest ten proved challenging for a number of candidates with a variety of incorrect answers seen including 567.489, 56.74892, 560, 57, and 570.0000.

(ii) Writing the given number correct to two decimal places proved to be more successful for a number of candidates although a variety of incorrect answers were seen including 567.48, 56.78, 56748.92 and 567.5

(c) This part on completing the given calculations was generally answered well, although common errors were seen in **part (i)** of 5, in **part (ii)** of 3 or –48, and in **part (iii)** of 100 or $\frac{1}{10}$.

Answers: **(a)(i)** 36 **(ii)** 3 000 330 **(iii)** 125 **(iv)** 1,2,4,8,16 **(v)** any multiple of 24 **(vi)** 23 or 29 **(b)(i)** 570 **(ii)** 567.49 **(c)(i)** 7 **(ii)** –3 **(iii)** 0.01

Question 2

(a) The majority of candidates correctly identified the transformation as a reflection although a significant number didn't give a line of reflection or gave an incorrect answer such as the x-axis or $y = 0$.

(b) (i) This part which required the drawing of a reflection proved to be less successfully answered. Common errors included reflections drawn in $y = 0.5$ or $y = –0.5$ or $x = 2$, reflections with one of the points at (0, 0), and drawing a rotation with a variety of centres.

(ii) The majority of candidates were able to correctly identify this transformation as a rotation although reflection was a common error. The angle of rotation was generally corrected stated although common errors of 90° clockwise and anticlockwise were seen. The centre of rotation proved more challenging and was often not given.

(c) (i) This part which required the drawing of an enlargement proved to be less successfully answered and was sometimes left blank. Those who did attempt the drawing either scored full marks or, more commonly, one mark for a correct enlargement from a different centre.

(ii) This part proved challenging for many candidates with the majority making the incorrect assumption that the area scale factor was also 3, rather than $3^2 = 9$. Evidence of calculating the two areas, easiest by counting squares, giving areas of 45 and 5, was rarely seen.

Answers: **(a)** reflection in the *y*-axis **(b)(ii)** rotation, 180°, (0,0) **(c)(ii)** 9

Question 3

(a) (i) There were a number of excellent and clear explanations seen which gained full marks. As this was a 'show that' question the given value of 32 could not be used as part of the explanation. A common example of such an unacceptable reverse method was $\frac{5}{8}\times 32+\frac{3}{8}\times 32 = 20+12 = 32$.

(ii) This part was generally answered well with the majority recognising that the number of boys and girls in Mr Patel's class had to be found first, and then combined with the number of boys and girls in Mrs Singh's class. Common errors included the use of 8 : 5, the use of 3 : 2 with 72, just using Mr Patel's class, and incorrect simplification of the ratio 44 : 28.

(b) This part was generally answered very well with the majority of candidates showing their working, often in stages, fully and clearly. Common errors included the omission of the free teacher tickets, use of three free tickets, and very occasionally giving free tickets to the students.

(c) This part on time proved to be challenging for less able candidates with many using three intervals of 20 minutes leading to the incorrect answer of 16 45. The common method employed was finding the intermediate times after each part of the play and each interval. Those who calculated the total time of 175 minutes or 2 hours 55 minutes tended to be more successful.

(d) Finding the required percentage increase proved challenging for a significant number of candidates. The most successful method was to use $(3.60 - 3.20)/3.2\times 100$.

(e) (i) This part was generally answered well although candidates who gave their answer as a decimal must have given their answer to at least three significant figures.

(ii) This part was generally answered well although common errors of $\frac{4}{72}$ and 68 were seen.

Answers: **(a)(ii)** 11:7 **(b)** \$430.50 **(c)** 16 25 **(d)** 12.5 **(e)(i)** $\frac{17}{18}$ **(ii)** 4

Question 4

(a) This part, using the definition of an obtuse angle, was generally answered well, although common errors of 90 and 360, 180 and 360, 91 and 179 were seen.

(b) This part on lines of symmetry and rotational symmetry proved challenging for all but the most able candidates. The identification of the kite having one line of symmetry but no rotational symmetry was the most successful. There was little evidence of drawing diagrams to help with the answers.

(c) The majority of candidates were able to write down the values of the three angles although giving a correct geometrical reason proved more challenging. Identifying angle *a* as being vertically opposite to 56° was the most successful reason given. Centres should note that F and Z angles are not acceptable without the use of corresponding and alternate.

(d) (i) The measurement of the given bearing was reasonably well answered although a significant number of candidates found this challenging. Common errors included bearings of 67, 157, 203, 247, 327 and the distances of 5 cm or 7.5 km.

(ii) This part was generally answered well with the majority of candidates giving an answer within the accepted range.

(iii) The drawing of a given bearing and distance was generally well done although incorrect bearings of 186, 287 and 84 were often seen.

Answers: **(a)** 90 , 180 **(b)** parallelogram , rhombus , kite **(c)** a = 56 , vertically opposite , b = 56 , corresponding angles , c = 73 , alternate angles **(d)(i)** 113 **(ii)** 7.5 km

Question 5

(a) (i) This part was generally answered well although the common error of 20 minutes was often seen.

(ii) This part was generally answered well, particularly with a follow through allowed, although the common errors of 0.25 or $\frac{15}{100}$ giving $\frac{3}{20}$ were often seen.

(b) This part was generally answered well, particularly with a follow through allowed, although the common errors of $\frac{18}{15}$ giving 1.2, or $\frac{18}{0.15}$ giving 120 were seen.

(c) This part was generally answered well although the common errors of 85×24 giving 2040, 85×0.24 giving 20.40 and $\frac{85}{24}$ giving 3.54 were seen.

(d) This part was generally answered well, particularly with a follow through allowed.

(e) The drawing of the travel graph was generally well answered although a very common error was to plot the final point at Clear Lake at a distance of 34 km not 52 km. A small but significant number read the scale wrong and mis-plotted the first two points.

Answer: **(a)(i)** 15 **(ii)** $\frac{1}{4}$ **(b)** 72 **(c)** 34 **(d)** 52

Question 6

(a) (i) This part was generally answered well although the common errors of $\frac{5}{11}$, $\frac{1}{11}$ and 6 were seen.

(ii) This part was generally answered reasonably well although there was little evidence of the method used.

(b) (i) This part was generally answered well although common errors of 7 *wb* or 1.55 were seen.

(ii) This part was generally answered well although common errors of 13 *wb* or 2.90 were again seen.

(iii) Some very good solutions to the simultaneous equations were seen although less able candidates were often unable to attempt this part. The majority of candidates used the elimination method to solve their equations. The setting out was generally very clear with very few errors or slips being made and only the rare candidate choosing the wrong operation for the elimination. On the rare occasion when candidates did choose to use the substitution method, most were able to rearrange one of the equations and correctly substitute into the other. However this method did cause more candidates to lose accuracy marks with numerical and algebraic errors leading to incorrect final values for *w* and *b*.

(c) This part was generally answered reasonably well although a small number of candidates had problems with the concept of upper and lower bounds. The use of 'correct to the nearest 5 g' seemed to cause a few problems. Common errors included 34.5 and 35.5, 30 and 40, 34 and 36, and 30 and 5.

(d) A small but significant number of candidates were unable to answer this part suggesting that they were unfamiliar with the terms used in the question. However those candidates who attempted the drawing of a net proved to be generally successful. A common error was to draw the net for a cuboid rather than for the required cube or to draw an open box with only five faces.

Answer: **(a)(i)** $\frac{6}{11}$ **(ii)** 4 **(b)(i)** 155 **(ii)** $3w + 10b = 290$ **(iii)** $w = 20$, $b = 23$ **(c)** 32.5 , 37.5

Question 7

(a) This part was generally answered well with the majority of candidates able to correctly and accurately plot the two points.

(b) The majority of candidates were able to correctly identify the type of correlation shown.

(c) (i) The majority of candidates were able to correctly draw the line of best fit although a significant number of candidates incorrectly thought that it had to pass through the origin and a small number were seen that were not a single straight ruled line.

(ii) With a follow through allowed from their line of best fit, if in an acceptable form, the majority of candidates were able to give the correct value.

(d) (i) This part was generally answered reasonably well although there was little evidence of the method used. Most candidates were able to identify 3, 2 or 1 of the 'good estimators' although responses were often spoilt by incorrect answers.

(ii) The majority of candidates were able to work out the required perimeter, although common errors of 34 + 44 giving 78, 34 × 44 giving 1496 were seen.

(iii) Those candidates who recognised the need for Pythagoras' theorem were generally successful. Common errors included 34 + 44 giving 78, 0.5 × 34 × 44 giving 748, and 17 × 22 giving 374.

(e) This part was answered reasonably well. The most common method was to use the formula for the area of a trapezium, although the addition of a rectangular area and a triangular area, and the subtraction of a triangular area from a rectangular area were also seen. Common errors included the omission of the $\frac{1}{2}$ in the trapezium and/or triangular formulas, incorrect substitution into the trapezium formula, and the incorrect calculation of the 28 needed for the triangular area.

Answers: **(b)** positive **(c)(ii)** 16 to 19 **(d)(i)** D, H, I **(ii)** 156 **(iii)** 55.6 **(e)** 1020

Question 8

(a) (i) The majority of candidates were able to draw the required angle bisector although the required arcs were not always seen or clearly used. Common errors included drawing *AC*, bisecting *AB* and/or *AD*, and drawing a single arc from *A*.

(ii) This part was generally well answered following a successful **part (i)**. Common errors included shading the wrong side of their bisector, and incomplete shading of the required region often caused by using the construction arcs as boundaries for the region.

(b) (i) The majority of candidates were able to draw the required perpendicular bisector although the required arcs were not always seen or clearly used. Common errors included drawing angle bisectors at either *G* or *H*, and just drawing arcs from *G* and/or *H*.

(ii) This part was generally well answered following a successful **part (i)**. Again the common errors included shading the wrong side of their bisector, and incomplete shading of the required region often caused by using the construction arcs as boundaries for the region.

(iii) This part was generally poorly answered with many candidates appearing not to know the definition of a reflex angle. Common errors included 23, 113, 157, 217, and 293.

(c) This part of the question caused the most problems for candidates with many not realising that they simply needed to draw two arcs in order to construct the required region. Common errors included drawing straight lines from *N* and/or *M*, just drawing the intersection of the two arcs, and shading the incorrect region.

Answer: **(b)(iii)** 337

Question 9

(a) The table was generally completed very well with the majority of candidates giving four correct values for two marks.

(b) The graph was generally plotted very well. The majority of candidates were able to draw a smooth curve with very few making the error of joining points with straight lines or joining the points (1, 8) and (–1, –8).

(c) The identification of the equations of the lines of symmetry proved challenging for a number of candidates with x or $y = \frac{1}{8}$ or attempts at using $y = mx + c$ being common errors. Those candidates who drew the two lines of symmetry were more successful but a significant number who drew the correct two lines were unable to state the two equations.

(d) Candidates found this part challenging with *P* marked at (0, 0) being a very common error.

Answer: **(a)** –2, –4, 8, 4 **(c)** $y = x$, $y = -x$ **(d)** point at (2.8, 2.8) or (–2.8, –2.8)

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the Extended syllabus. The recall of formulae, mathematical facts and techniques in varying situations is required as well as application to problem solving and unstructured questions. Work should be clearly and concisely expressed with answers written to at least three significant figures unless directed otherwise.

General comments

This paper proved to be accessible to almost all of the candidates. Most were able to attempt all of the questions, and solutions were usually well-structured with clear methods shown in the working space provided on the question paper.

Candidates appeared to have sufficient time to complete the paper and omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time.

The standard of algebraic manipulation was high and graphs were attempted neatly in pencil. Directed numbers and terms did cause some difficulty for a number of candidates in **Questions 8** and **11** however.

There were a number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving answers correct to at least three significant figures in **Question 6(a)(ii)** and parts of **Question 8**.

The questions on the topics of ratio and percentages, graphs of functions, probability, manipulative algebra, statistics and trigonometry were very well answered by candidates.

Slightly weaker areas for some candidates were some aspects of transformations, reasoning with angle properties, problem solving with sectors of a circle, forming and graphing inequalities in two variables, problem solving with lengths and angles of polygons and sequences in context.

Comments on specific questions

Question 1

(a) This was well answered, usually using the method $\frac{8}{35} \times 100$. Some used $\frac{8}{35} \times 5635 = 1288$ then correctly found this as a percentage of 5635. Some lost an accuracy mark after a correct method by giving an answer of 22.8 without showing a more accurate value. A few gave an answer of 1288.

(b) This was very well answered. Many candidates used working from **part (a)** here and were given credit for it.

(c) This part caused a few problems. Many were able to find the correct answer of 5000. Some, having shown a correct method, used a rounded value for 1.0242^5 such as 1.13 or 1.126 which resulted in an inaccurate final answer. A few did not appreciate that the problem involved a reverse calculation and worked out 5635×1.0242^5. The only other common error was to use 1 – 0.0242 as the multiplier and not 1 + 0.0242.

(d) This was usually answered correctly.

(e) Candidates nearly always used the correct method for the conversion to dollars. Many gave a final answer of 1.976 or 2 instead of rounding to the nearest cent as required.

Answers: **(a)** 22.9 **(c)** 5000 **(d)** 9950 **(e)** 1.98

Question 2

(a) (i) Almost all candidates identified the transformation as a rotation, but fewer were able to give a completely correct description with the centre of rotation often incorrect or omitted.

(ii) Almost all candidates gave translation as the transformation but a number gave an incorrect vector in either or both of the components.

(iii) Enlargement was usually given but a few were confused by the fact that the image was smaller than the object shape and gave descriptions such as a reduction. Some confused the scale factor and gave answers such as –3 or $-\frac{1}{3}$. Many considered the centre but fewer were able to give the co-ordinates correctly.

A few candidates in all three parts gave additional transformations such as rotation followed by a translation and in these cases any marks earned are then spoiled by this additional incorrect work.

(b) (i) Many candidates drew the reflection correctly but the mirror line of $y = x$ caused difficulty and confusion for others and errors included reflection in the y-axis or x-axis.

(ii) This was well answered. Many recalled the correct matrix for the transformation or used the unit square transformation. Those that tried to set up working involving co-ordinates and four unknown elements of the required matrix were usually unsuccessful.

Answers: **(a)(i)** Rotation, 90° anticlockwise, (9, 5) **(ii)** Translation, $\begin{pmatrix} -8 \\ -14 \end{pmatrix}$ **(iii)** Enlargement, $\frac{1}{3}$, (–8, –2)

(b)(ii) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.

Question 3

(a) Nearly all candidates correctly found the required values.

(b) Most candidates plotted the points correctly. The curve was usually well drawn although a minority joined their plots with ruled lines and there were a few very untidy curves with thick lines. Some candidates plotted the points at $x = -2$ and $x = -1$ at $y = +0.56$ and $y = +0.33$ respectively.

(c) Nearly all candidates were able to interpret the given equation and read off the value of x from their graph at the point where $y = 3.5$.

(d) This part of the question was where many candidates made errors. A significant number did not follow the instructions given to draw a straight line to solve the equation and attempted to draw the graph of $y = 1.5^x - x - 2$, instead of rearranging the given equation to give $1.5^x - 1 = x + 1$. Those who recognised the required straight line were able to draw this successfully and continued to find the correct values of x. A number omitted this part.

(e) (i) This was answered very well with the point (5, 5) plotted correctly.

(ii) This was also very well answered and most candidates ruled a line from *A* to touch their curve.

(iii) This was nearly always correctly answered when **parts (e)(i)** and **(ii)** had been done correctly. A few candidates incorrectly divided the difference in *x*-coordinates by the difference in *y*-coordinates and some selected points very close together which gave inaccurate results.

Answers: **(a)** 0, 0.5, 1.25 **(c)** 3.6 to 3.8 **(d)** –1.55 to –1.40 and 4.55 to 4.8 **(e)(iii)** 1.2 to 1.4

Question 4

(a) Candidates answered this part well with most demonstrating that they understood that the sum of the probabilities in this situation is 1 and then carrying out the fraction calculations correctly. Some gave an answer to $1-\left(\frac{1}{6}+\frac{1}{4}+\frac{1}{3}\right)$ but then did not attempt to divide this by 2.

(b) This was answered very well. The most common error was to give $\frac{1}{4}\times\frac{1}{3}=\frac{1}{12}$.

(c) (i) This was also answered very well. The most common error was to add instead of multiplying the probabilities.

(ii) Most candidates identified the two ways of obtaining a sum of 3 and went on to earn full marks. Some only identified one of the ways and gave $\frac{1}{4}\times\frac{1}{6}=\frac{1}{24}$.

(d) Virtually all candidates answered this correctly.

Answers: **(a)** $\frac{1}{8}$ **(b)** $\frac{7}{12}$ **(c)(i)** $\frac{1}{16}$ **(ii)** $\frac{2}{24}$ **(d)** 12

Question 5

(a) (i) Although many candidates were able to factorise the given quadratic expression, answers such as $x(3x+11)-4$ were also seen. It was also clear that other candidates used the quadratic formula or used a calculator to answer **part (a)(ii)** first and then inserted the results into **part (i)** giving $\left(x-\frac{1}{3}\right)(x+4)$ as their incorrect factorised answer.

(ii) Most candidates were able to find the two solutions but gained no credit if their decimal answer appeared only as 0.33 or 0.3. The accurate answer of $\frac{1}{3}$ or $0.\dot{3}$ or the three significant figure answer 0.333 were required.

(b) (i) Many candidates preferred to deal with the algebraic fractions first before bringing in the equality to $\frac{1}{2}$. The common denominator of the single fraction was nearly always correct and then correctly expanded. The most common error was to expand $-(2x+11)$ as $-2x+11$ and not $-2x-11$. Some candidates never showed the stage in the numerator with brackets and they usually made this sign error. The final mark was sometimes lost when candidates omitted brackets earlier in the working or omitted '= 0' in their working.

(ii) Many candidates were able to use the quadratic formula successfully in this part of the question, showing sufficient working. Marks were lost if the discriminant was given as $\sqrt{57}$ with no evidence of how this was obtained, or for badly written expressions where the division by 2×2 appeared to apply only to the discriminant and not to the -3. Candidates also lost marks if they did not give their answers to two decimal places as required or lost accuracy by truncating the value of $\sqrt{57}$ before using it.

Answers: **(a)(i)** $(3x-1)(x+4)$ **(ii)** $\frac{1}{3}$ and −4 **(b)(ii)** −2.64 and 1.14

Question 6

(a) (i) This was almost always correct with candidates recognising the alternate angles.

(ii) This part was answered well with most candidates using similar triangles correctly. Many went on to accurately give the answer of 3.89 but a significant minority did not use the expected three significant figures and instead rounded to 3.9 without showing a more accurate value. Others incorrectly rounded to 3.88. A few candidates correctly used the less efficient approach of applying the sine rule to find angle *GZF* and hence angle *HZE*, and then the sine rule again to find *EZ*. Candidates who used this approach often lost accuracy by rounding prematurely. A few candidates attempted to use similar triangles but with wrong ratios.

(b) Many fully correct answers were given here from a variety of correct approaches. The vast majority of candidates were able to achieve at least one mark either by finding the value of a relevant angle usually written on the diagram. Many candidates showed angles on the diagram but some candidates couldn't score part marks from their working due to lack of clarity about which angle they were finding, either by using no angle notation at all or by using, for example, angle *C* instead of angle *BCD*. Common incorrect answers came from assuming that, for example, *AD* and *BC*, or *AB* and *OC* were parallel and thus using alternate angles inappropriately.

(c) (i) The vast majority of candidates recognised that angles *QPS* and *QRS* were 90°. Candidates were not as successful in giving the reason, often giving a lengthy description that nevertheless did not convey critical information about the angle formed at the circumference and from a diameter.

(ii) Again the majority of candidates were able to state that angle *SQP* = 27° but attempts to give the reason were often insufficient, frequently mentioning only tangent.

(iii) Many correct answers of 'rectangle' were seen along with a variety of incorrect or inadequate answers such as rhombus, square, parallelogram or trapezium.

Answers: **(a)(i)** 27 **(ii)** 3.89 **(b)** 76 **(c)(i)** 90°, angle in semicircle = 90° **(ii)** 27°, angle between tangent and radius = 90° **(iii)** rectangle

Question 7

(a) Most candidates produced clear working to correctly calculate the mean. A few candidates made slips with the mid-interval values or in transferring the frequencies but were able to score method marks because their working was very clear. A few candidates incorrectly used the class widths rather than mid-interval values and these candidates scored no marks.

(b) (i) This was almost always answered correctly.

(ii) This was very well answered with accurately drawn cumulative frequency graphs. Only a few candidates made errors and these were either because they drew bars rather than a curve or they plotted the points at the mid-interval values rather than the upper end of the interval.

(iii)(a) The median was found accurately by the majority of candidates from their graph.

(iii)(b) The inter-quartile range was well answered, although a common error, made by a number of candidates, was to calculate upper quartile – lower quartile = 300 – 100 = 200 and then effectively find the median again by reading the value at 200.

(iii)(c) Most candidates were able to find the 60th percentile correctly.

Answers: **(a)** 72.7 **(b)(i)** 87, 209, 345, 371 **(iii)(a)** 69 to 70 **(iii)(b)** 20 to 23 **(iii)(c)** 72 to 75

Question 8

(a) (i) Most candidates approached this part by using the cosine rule and found the length of XY accurately. Errors in this method mainly arose from incorrectly working out $b^2 + c^2 - 2bc\cos A$ as $(b^2 + c^2 - 2bc)\cos A$. Other candidates were successful in using either angle TXY or angle TYX and the sine rule. Other longer methods were seen, such as finding XZ and YZ and then $XY = XZ - YZ$. Premature approximation affected the accuracy of a number of solutions where the trigonometrical values in particular had been rounded earlier in the calculation to two or three significant figures. This usually resulted in the loss of at least one mark depending on how much working had been shown.

(ii) This part was answered very well by most candidates. The main error came from misreading the question and finding YZ rather than TZ. A few, using the correct method, rounded prematurely again as in **part (a)(i)** and lost accuracy.

(b) Whilst most candidates were able to write down the correct method for the arc length for one sector, many candidates were unable to set up the correct expression for the total perimeter. Frequent errors included omitting multiplying the sector arc by 3 or omitting to add the two radii. A few candidates used the area of a sector. Of those candidates who had the correct expression, many struggled to rearrange for r correctly and others rounded prematurely earlier in their work giving a final answer which was not accurate correct to three significant figures.

Answers: **(a)(i)** 5.14 **(ii)** 15.6 **(b)** 3.79

Question 9

(a) Many candidates answered this correctly and set up the two required inequalities. A few candidates were inaccurate in their use of inequality signs and therefore did not score. Common errors included the lack of the inclusive/exclusive element needed or in having the signs the wrong way around.

(b) Many candidates were successful here but common errors were in using an incorrect inequality sign or omission of the number 3 from the inequality.

(c) Many correct solutions were seen with accurate ruled lines and the correct region left unshaded as required. The most frequent error was in the plotting of the $x + 3y = 21$ boundary line which was either drawn inaccurately or incorrectly as $x + y = 21$ or having drawn the correct boundary lines, incomplete shading of the regions not required.

(d) (i) The correct answer was frequently given either from a correct diagram or worked out from the information given in the question. A few candidates gave a fractional number of plants which was not practical given the context of the problem.

(ii) Most candidates who gave a correct answer in **part (d)(i)** were awarded the mark for this part.

Answers: **(a)** $x<10$, $y \geqslant 2$ **(b)** $x + 3y \leqslant 21$ **(d)(i)** 4 **(ii)** 20

Question 10

(a) (i) The majority of candidates were able to show that an interior angle of a hexagon is 120°, with many more opting to divide the total for the hexagon by 6 rather than using exterior and interior angles. As this was a question requiring a result to be shown, candidates were expected to show all of the required steps in their calculations. A significant number knew that the sum of the angles in a hexagon is 720° but lost marks by not establishing why this was the case.

(ii) More able candidates scored well on this part, obtaining and simplifying an expression for the length of *PQ*. Others reached a correct expression but didn't simplify it by eliminating the trigonometrical ratios, such as 2*x* sin60. A variety of methods was seen, some applying the sine or cosine rule to triangle *PAQ* and others applying simple trigonometry in half of triangle *PAQ*. The latter method sometimes led to errors with candidates stating $\frac{1}{2}PQ = x\sin 60$, finding *PQ* and then doubling their answer. Many made errors in applying the trigonometry and a significant number took *P* as the midpoint of *AF* and calculated a numerical value rather than an expression in terms of *x*.

(iii) This was another question requiring candidates to show a particular solution and fully correct solutions were few and far between. In order to show the solution, a labelled diagram would have been a useful start. Many candidates attempted solutions that could not be linked to any diagram. Some attempted to use trigonometry but often made little or no progress. Those with a diagram tended to earn the higher marks for method that could be clearly followed. Less able candidates often wrongly stated that $PS = 2(10 - x) = 20 - x$ or gave calculations that simplified to the correct answer. The best solutions seen came from candidates who clearly labelled the intersection of *PS* and *FB*, for example as *T*, and then, working with the right angled triangle *PTF*, stated that $PT = (10 - x)\cos 60$ leading to $5 - \frac{1}{2}x$ and hence $PS = 2\left(5 - \frac{1}{2}x\right) + 10$. Some candidates were not rigorous enough in this 'show that' question, for example, making and using unexplained statements such as $PT = \frac{1}{2}x$ as their starting point.

(b) Fully correct solutions were very rare. Many candidates did not heed the direction in the question to use their results from earlier question parts but some earned a mark for equating $20 - x$ to their earlier answer from **part (a)(ii)**. Others struggled to make further progress even when their previous answer was correct. A small number of candidates were able to solve their equation for *x* but lost out on the final mark by forgetting to calculate the length of the square. In most cases, attempts usually involved a variety of trigonometry or Pythagoras' theorem methods.

Answers: **(a)(ii)** $x\sqrt{3}$ **(b)** 12.7

Question 11

(a) Many candidates were able to interpret the situation described in this question and many correct sequences were seen. The error 2, 4, 6, 8, 10, 12, 14 was also very common.

(b) Following the common error in **part (a)** the incorrect expression 2*n* was often seen here. Candidates with a correct sequence in **part (a)** often gave the correct expression 2^n but again the error 2*n* was also seen or attempts to find a quadratic expression to describe the sequence.

(c) (i) The majority of candidates showed correctly that $2^4 - 2 = 16 - 2 = 14$. Most candidates with a correct sequence also stated that $2 + 4 + 8 = 14$ and hence scored full marks. Candidates with the common incorrect sequence often stated that $2 + 4 + 6 = 12$ and then added on an extra 2 without justification, or instead concluded that Ankuri was in fact incorrect. A question will never be set to mislead in this way and candidates should instead be encouraged to revisit and check their own work to identify their error.

(ii) Having been told in the previous part that the total number of text messages sent by the end of day 3 was $2^4 - 2$, candidates were expected to make the connection that at the end of day 5 the total number of text messages would be $2^6 - 2 = 62$. Many fully correct answers were seen here, but some used their incorrect sequence from **part (a)** and obtained answers 30 and 5.

(iii) The correct answer $2^{n+1} - 2$ was usually seen from candidates with correct solutions in **part (c)(ii)** but the error $2^n - 2$ was also common.

(iv) The majority of candidates recognised that they needed to equate their answer from **part (c)(iii)** to 1022 and solve to find *n*. A common error was to give 10 as the answer.

Answer: **(a)(i)** 4, 5, 6, 7 and 8, 16, 32, 64, 128 **(b)** 2^n **(c)(ii)** 62 and 6 **(iii)** $2^{n+1} - 2$ **(iv)** 9