MATHEMATICS

Paper 0980/12
Paper 12 (Core)

Key messages

Read questions with care, particularly worded context ones, in order to ensure answers are sensible and correct for the situation.

General comments

The vast majority of candidates tackled the questions confidently. Where working was needed it was shown well in general. Presentation too from most candidates was clear although care should be taken writing figures, particularly if written small, as indices.

Some questions required calculations that could be split into stages and this did cause some premature rounding, resulting in inaccurate answers.

Most candidates completed the questions within the time and many could have benefitted from a check through their work for clarity of presentation and answers that are sensible for the question.

Comments on specific questions

Question 1

Nearly all candidates answered this correctly, regardless of some very borderline spellings of some words that were condoned. A small number lost the mark as they wrote three instead of thirty or eight instead of eighty.

Question 2

Although most candidates gave a correct conversion of metres to centimetres, a considerable number divided by 100 (the reverse process) resulting in 43.65 centimetres. The other common error was to add one zero or three zeros to the number in the question.

Question 3

There was a very good response to this question on order of operations. A few candidates did not read the question correctly adding two pairs of brackets while just a small number put brackets in the wrong place.

Question 4

A clear majority of candidates were successful with this question. Some candidates, having worked out the correct number, gave it as a fraction of 120. A few others tried to add to the question by estimating how many times the calculator was not taken to the lesson. Not reading that the question asked for the number of times resulted in a few responding with 0.48 rather than an integer value.

Question 5

(a) Most candidates knew that one million had 6 zeros and so successfully subtracted 123. Some either did not know this or did not carefully input the correct number of zeros on their calculator. A common error was to have the correct figures but with a negative sign from subtracting the wrong way round. Occasionally a division rather than a subtraction was performed, probably a slip when using the calculator.

(b) Again in this part there was evidence of subtracting the wrong way round, often from the same candidates who had reversed them in **part (a)**. However, the vast majority of candidates did gain this mark.

Question 6

(a) Only a minority of candidates could identify the quadrilateral having only one pair of parallel sides. Parallelogram was common showing the importance of reading the description carefully, in particular the word 'only'. Other responses seen were triangle, circle, rhombus and rectangle showing a lack of familiarity with two dimensional shapes.

(b) There was a far better response to the type of angle but acute was often seen. A few gave reflex and some misread the question giving an actual value between 90 and 180.

Question 7

(a) There was a lot of variation in the way of filling in the required number of squares with some even completing part squares. However, just about the majority of candidates managed the correct number.

(b) Many candidates found visualising rotational symmetry challenging and so this was not so well answered. Many seemed to have little idea of rotational symmetry and their two squares seemed quite random. The most common incorrect answer was shading the square the other side of the given one on each side with only one square shaded.

Question 8

(a) This parts was found particularly challenging with few candidates able to recognise an angle alternate to *X*. Clarity of responses was also an issue with letters poorly written or overwriting of letters making it impossible to see what answer was intended. The response *c* was particularly common while *f* was often chosen in both parts.

(b) While more candidates gained the mark for identifying a corresponding angle in this part, this too was found challenging. A considerable number of candidates gave the correct letters in the two parts but the wrong way round.

Question 9

Completing a tally chart was very well done with just a small number incorrectly calculating the number remaining for the 'Purple' tally. There were some who were careless with the tally strokes but if working showed the correct number they gained partial credit. A small number did not understand the question, adding tallies to the other favourite colours.

Question 10

(a) The question was found challenging with a common error of rounding correct to 2 decimal places, resulting in 0.05, instead of 2 significant figures. Any zeros following an otherwise correct answer spoilt the two significant places requirement. Other incorrect answers seen at times were 48 and 0.48

(b) Standard form was far better answered than significant figures but an index of +3 instead of −3 was often seen, as was 527×10^5. Quite a number of candidates did not appear to understand how to write numbers in standard form.

Question 11

Many candidates were confused between highest common factor and lowest common multiple. One mark was often gained from a factor tree or equivalent but many who showed this working gave the LCM rather than the HCF. Some who knew what factors were gained some credit from 2 or 3, neither of which were the highest.

Question 12

A straightforward area of triangle question was well answered although a significant number did not halve the product of base and height. Adding instead of multiplying the base and height was seen at times as was using π or applying Pythagoras' theorem.

Question 13

Some candidates used the sine ratio incorrectly although some did find the other angle and then worked out the value of angle x. This longer method often produced inaccuracies from rounding. Those who did apply the direct method of cosine generally were successful but $\cos x = \frac{23}{6.2}$ was seen at times. Premature rounding of $6.2 \div 23$ caused a number of inaccurate answers.

Question 14

(a) Had the dimensions of the cuboid been given numerically it is likely that almost all candidates would have found the correct volume. In fact many did not realise that by counting the number of cubes in length, breadth and height, it was a straightforward volume calculation. The most common error was to find the surface area of the cuboid leading to a common answer of 192. There were 96 cubes in the visible surface area and this too was often seen as a response.

(b) Many candidates gave descriptions of the shapes rather than giving three dimensional solids for their answers. Those who did understand nets often gained both marks but the common errors for the second net were to write prism or qualify the correct solid with the description triangular.

Question 15

(a) While the ratio was answered quite well, many only gained partial credit for a ratio not in its simplest form, giving 6 : 16 or $\frac{3}{11} : \frac{8}{11}$ as their answers. A few used the total pencils in the ratio leading to 6 : 22 or 3 : 11 occasionally.

(b) Nearly all candidates appreciated the impossible situation and the vast majority did give a quantitative answer.

Question 16

(a) While there was a good response to this expansion many lost a mark with either the first term x^2 or the second term $7x$ or just -7. Some candidates, having found the correct answer, then combined the terms to a single item.

(b) The factorising was less well done than the expansion with quite a number of candidates combining to a single term. Other common incorrect answers were $y(y + y)$, $y(y + 0)$ and $y(y)$.

Question 17

(a) Many candidates wrote out the square roots of the numbers from 50 to 60 but nearly all did not write why this showed that no square number existed in that range so gained only partial credt. No mark was given for just writing $\sqrt{50}$, $\sqrt{51}$, etc. without any values of them or simplifications such as $\sqrt{50} = 5\sqrt{2}$. Those choosing to investigate the squares of integers soon realised and showed that none had a value in that range, which was all that was required.

(b) While this part was answered more successfully than **part (a)**, many candidates gave answers of 51 or 57. Some gave an even number for a prime. Although only one prime number was requested some gave both correct but others had one wrong so could not score the mark.

Question 18

(a) This type of question needed careful reading so while it was answered well, some found 3600 metres from thinking it was 1 minute to paint 80 metres.

(b) This part was found challenging by candidates. Again the lack of multiplying by 5 meant many gained just partial credit for 35. Others lost a mark due to not knowing that 1000 m = 1 km. A common incorrect answer was 560 from simply dividing 2800 by 5.

Question 19

(a) Most candidates found this part quite straightforward and realised what to multiply and what to add. Most who did make an error multiplied the indices, but clarity of figures need care as 5's and 6's written small can be difficult to differentiate. A small number added 5 and 2 or left out the m term by giving an answer of just 10^5.

(b) This was not quite so well answered as **part (a)** with some candidates performing the same addition of indices as previously. The only other significant error was to work out 8^3 to give 512.

Question 20

Most candidates answered the fraction question correctly and showed the necessary working. However a significant number of candidates, having formed a correct improper fraction for the first mark, did not show how the division was done. Some, having changed to a multiplication, cancelled appropriately but most did the multiplications of numerators and denominators before cancelling. The final mark was often lost by leaving the answer as an improper fraction instead of following the instruction for a mixed number or occasionally by not having the simplest form of the mixed number. The common denominator division method was applied by some and usually successfully. Some confused the methods and had $\frac{27}{12} \times \frac{28}{12} = \frac{27 \times 28}{12}$. Working in decimals wasn't seen often, although some thought the answer had to be in decimals.

Question 21

A small, but significant number of candidates omitted this question and only a few candidates gained full marks. Area was attempted by many but the main error was using $2\pi d$ instead of $2\pi r$. Then when the correct πr for the perimeter of the semicircle was found, some halved, thinking they had found the whole circumference. Only a few added the diameter to give the full perimeter and then some of these had either approximated prematurely or used 3.14 or $\frac{22}{7}$ for π.

Question 22

This was the most challenging question on the paper and a significant number did not attempt it. Many candidates did not realise that the lowest common multiple was needed but those who did, generally made progress at least to 630 seconds. Most candidates tried to perform a variety of operations on the two times of 90 seconds and 105 seconds, most commonly subtracting them. These nearly always produced a meaningless answer in the context of the question.

Question 23

This question required three distinct steps to isolate x but many started by changing either or both of $4y$ and 8 to terms on the left-hand side of the equation with sign errors often apparent. Those candidates who started correctly often tried to square root before dividing by 5. This led to the square root sign not covering the 5 although quite a number, having done the first two steps correctly, carelessly also did not show the square root sign over the whole expression. Some thought it was an equation needing a numerical solution. Candidates should also note that each step towards the solution they write should be a correct one, so for example $5x^2 - 3y = 4y + 8 + 3y$ is incorrect.

Question 24

(a) (i) While the vast majority of candidates did the construction correctly, some went over the arcs freehand making it difficult at times to see if compasses had been used. Just one pair of arcs was seen at times which is not enough and other arcs were too small or close together for an accurate bisector. A few candidates bisected one of the angles instead of the line. Apart from a few carelessly drawn bisectors, nearly all with correct arcs gained the two marks in this part.

(ii) Most candidates understood that the locus meant an arc, centre C, although a few used an incorrect centre or radius. There were quite a lot of blank responses for this part.

(b) Some candidates shaded a region which ended at the arc they had drawn for the bisector instead of going up to the bisector. Also some showed poor shading which left parts of the region without shading resulting in a region that wasn't clearly defined.

MATHEMATICS

Paper 0980/22
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

A significant number of candidates demonstrating an expertise with the content and showing good mathematical skills. Only a very small number of candidates were unable to cope with the demand of this paper. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time. Candidates showed particular success in the basic skills assessed in **Questions 4 (b)**, **5**, **6**, **7**, **8 (b)**, **12** and **14**. The more challenging questions were **Questions 10**, **16 (b)**, **18**, **21 (b)** and **24**. Candidates were very good at showing their working although sometimes stages in the working were omitted and credit for method could not always be awarded. It was rare to see candidates showing just the answers with no working.

Comments on specific questions

Question 1

This question was answered well. The majority of candidates found 53 as the prime number. A smaller number of candidates chose 59 and there were also a few who wrote both. The most common error was 51 followed closely by 57, with fewer choosing 55. It was unusual to see an even number given but a prime out of range was seen quite a few times.

Question 2

This question was generally well answered but a significant number of candidates did not gain credit as they gave an answer correct to only 2 or even 1 significant figure without a more accurate answer first. A small number truncated the answer to 0.838 rather than rounding. The most common evaluation error was to forget to square root.

Question 3

This was a well answered question with most candidates able to write down the correct answer. A common incorrect answer was $\frac{7}{10}$ or fractions that included a decimal in the numerator.

Question 4

Part (a) was generally answered well, with many candidates giving the correct answer. The most common incorrect answers seen were parallelogram, rectangle, rhombus and triangle. Some candidates struggled with the spelling of trapezium, but in most cases the intention was clear and so it was possible to award the mark. **Part (b)** was more successful for the candidates, the correct answer of obtuse was often seen. The most common error was to describe the angle as acute, and occasionally as a 'wide angle' or reflex. As with **part (a)**, some candidates struggled with the spelling, and sometimes the intention was not clear, for example 'obcute' could not be credited.

Question 5

This was answered well, with full credit gained by the majority of candidates. Many gained credit for the method by showing the distance divided by a time. The most common error in the time was the incorrect decimalisation to 4.3 hours. Less able candidates struggled to find the time difference and would have benefitted from working on strategies to do this.

Question 6

This question was very well answered with nearly all candidates getting the correct answer. When full credit was not awarded, it was sometimes because of an algebraic slip leading to either $9f + 3f$ or $23 + 11$ and in most of these cases a mark was scored as one of the sides was dealt with correctly. More candidates made an arithmetic error such as $9f - 3f = 3f$. Very few candidates gained no credit on this question. There was not much evidence of candidates checking their answers.

Question 7

This question was very well answered with nearly all candidates successfully applying the formula for the area of a triangle and achieving the correct answer using $0.5 \times 8.4 \times 3.5$. A small number of candidates used $0.5 \times 8.4 \times 3.5 \times \sin 90$. A few candidates took a longer approach of choosing their own measurements for the two parts of the base, calculating an angle, and then using $A = \frac{1}{2}ab \sin C$. Often this included premature rounding and a loss of the accuracy mark. The most common error was the calculation of the area of a rectangle instead of the triangle leading to $29.4\,\text{cm}^2$. A small number of candidates did not attempt the question at all.

Question 8

In **part (a)** many candidates were able to score this mark. The most common errors were either trailing zeros, giving an answer of 0.05 (confusing significant figures with decimal places) or an answer of 0.047 where they had simply truncated. **Part (b)** was answered correctly by most candidates. The main error was 3 instead of –3 in the power. Some also gave –2 or –4 but these were much rarer errors, as was 527×10^{-5}. Most candidates understood what was needed for standard form with few candidates leaving their answer as a decimal. Occasionally candidates incorrectly gave a rounded or truncated answer instead of the exact answer that was required.

Question 9

Prime factor decomposition was commonly seen, in a variety of forms, (e.g. repeated division, factor trees, etc.) and many candidates did so correctly to achieve at least partial credit. Some candidates used a combined table of repeated division which would have been acceptable if finding the LCM but in this case it did not give a clear distinction of prime factors for each separate number. Although many candidates gained full credit, a large number just gave 2 or 3 or 2×3 as a final answer. A number of candidates showed confusion between HCF and LCM, and gave an answer of 720.

Question 10

Only the most able candidates answered this question correctly. Most incorrect answers were some version including the figures 8.4, often from $\frac{33.6 \times 25\,000}{100\,000} = 8.4$. Many candidates did not realise that they were working with an area and that both 25 000 and 100 000 needed to be squared. A number of candidates calculated figures 336 ÷ figures 25 leading to answers of figures 1344. Those who correctly squared the 25 000, either forgot the $1\,00\,000^2$ or did not deal correctly with the unit change but did manage to achieve the method mark for the figures 21 in their answer.

Question 11

Quite a few fully correct matrices were seen. Those who did not score full marks often gave the special case version therefore scoring 1 mark. A common error was to give the correct matrix but with both 1's positive. The most common error was to write the 1's on the wrong diagonal normally with a combination of 1 and –1; it was very rare to see other numbers. A less common error was to give a matrix that had all elements as a combination of 1's and –1's. A small number of candidates left this question blank.

Question 12

Candidates demonstrated an excellent knowledge of the rules to deal with indices and both parts of the question were answered correctly by the majority of candidates. Common incorrect answers seen in **part (a)** were $10m^6$ and $7m^5$ with some attempting a factorisation, resulting in $m^2(5 \times 2m)$. There were even fewer errors in **part (b)** with x^{11} occasionally seen, alongside $3x^{24}$ or $3x^8$.

Question 13

This was another well answered question with many candidates gaining at least partial credit by converting $2\frac{1}{4}$ correctly to an improper fraction and then showing the next step of $\frac{9}{4} \times \frac{7}{3}$. Some candidates then did not convert their answer back into a mixed number. Others attempted to do so but either converted to decimal form and gave the answer as 5.25 or left the answer as $5\frac{3}{12}$. The question required the answer to be in its simplest form. Most candidates were able to show sufficient working to gain credit for the method but some did not show enough working or clearly switched to calculator use part way through. Less common, and not always as successful, was the method $\frac{63}{28} \div \frac{12}{28}$.

Question 14

Most candidates answered this question correctly. The majority of candidates used the elimination method, often multiplying by 10. A significant number used the substitution or equating method, not always as successfully. Those who used the elimination method and were incorrect tended to not know whether to add or subtract the two equations or did not do this consistently for all terms. Some candidates, who gained no credit for method, gained a mark for correctly substituting an incorrect value into one of the equations and finding two values that satisfied one of the equations. However, this mark was sometimes lost by premature rounding of decimals in their incorrect answers. Only a small number of candidates gained no credit.

Question 15

This question was often correctly answered by candidates. Almost all incorrect answers were from treating the $435.60 as 100% and trying to work out 112%, with candidates usually arriving at the answer $487.87. Other errors occurred when candidates found 88% of the sale price or used a reverse percentage method but with the start price as either 112% or 12% of the original. It was rare to award a mark for 435.60 identified as 88%, as those who made this link were normally then able to complete the question correctly.

Question 16

In **part (a)** often candidates did not correctly follow the instructions in the question. Many did not label their intended region with *R* and some seemed to be shading the wanted rather than unwanted regions as instructed in the question. Some shading was quite unclear making answers ambiguous. The correct triangular answer region extended across the *y*-axis but inadequate shading did not always make clear that the full triangle was intended. Incorrect answers were quite varied in the choice of region. There were a number of candidates who did not attempt the question. **Part (b)** was often poorly answered after a correct solution to **part (a)**. Lack of care in reading the question meant some candidates gave a non-integer answer whilst others gave co-ordinates or the calculation 2 + 5 rather than the largest value of $x + y$ as asked.

Question 17

There were some reasonable attempts at this question with some correct answers seen from the more able candidates. It was rare to see a final correct answer that was further incorrectly simplified. All but the least able candidates achieved a correct common denominator for the two fractions. Of the main approaches to the question, the most successful approach by far was to produce the single fraction $\frac{(x-5)(x+3)-2x(x-5)+(x+3)(x+3)}{(x-5)(x+3)}$ before simplifying the numerator. Candidates who tackled the two fractions first had problems with $\frac{-2x(x-5)+(x+3)(x+3)}{(x-5)(x+3)}$ often becoming $-\frac{2x(x-5)+(x+3)(x+3)}{(x-5)(x+3)}$.

Dealing with the 1 also caused problems with $1-\frac{3x^2-4x+9}{x^2-2x-15}=\frac{1-3x^2-4x+9}{x^2-2x-15}$ not uncommon.

Question 18

The most able candidates were successful with this question. A common error was for candidates simply to divide each frequency by 5, giving the incorrect answers of 6.4, 8.8 and 2.4. A few candidates successfully found the frequency densities of 6.4, 2.2 and 0.4, but then gave these values as their final answers.

Question 19

Candidates demonstrated competence in algebraic manipulation, with quite a few gaining full credit. Those candidates that were not able to complete the rearrangement were often able to complete the first stage correctly, usually squaring both sides of the equation. Many then also correctly multiplied both sides of the equation by *m*. It was the next stage in the process, namely isolating *m* that proved to be the most challenging part of the process. It was common to see terms in *m* remaining on both sides of the equation. Some of those who correctly gathered the terms in *m* on one side of the equation were able to factorise and divide correctly, obtaining the correct final rearrangement. Errors were sometimes made with a division where only one term on one side was divided, notably $m-m=\frac{k}{P^2}$ following the correct line of $P^2m-m=k$.

Candidates should be encouraged to keep each line of working separate as many were introducing their next step on the line they had just written down. This often led to incorrect statements for which they could not gain marks.

Question 20

Most candidates attempted this question and almost all scored at least partial credit. As the question asked for the method to be shown there was a need for the quadratic formula, or other method, to be correctly shown. In some cases there was no attempt to show the substitution, even if the quadratic formula has been written out correctly. When substitution was shown the general form of the equation was usually correct with some common errors. These include putting –2 instead of –(–2) for the –*b* term; omitting brackets around $(-2)^2$ in the discriminant; the fraction line being too short and not reaching across the full length of the formula; the square root sign being too short and not covering the whole discriminant or using $b^2 + 4ac$ in the discriminant. In some of these cases the mark was recovered later when a correct version was seen. Many candidates got the correct answers, although occasionally they were rounded incorrectly or to 1 or 3 decimal places instead of the 2 decimal places asked for in the question. In quite a few cases an incorrect substitution was followed by correct answers showing use of a calculator function for solving the equation. Very occasionally candidates used the completing the square method but the formula method was more common and more successful.

Question 21

Many candidates were able to shade the required region of the Venn diagram in **part (a)** with the most common error by far being to omit $X \cap Y$. There were a few correct answers for the probability in **part (b)(i)** and also many who gained partial credit for either the correct numerator or denominator. Those who made errors were generally not taking the conditional probability into account. The most common incorrect denominator was 68, the total number of gardeners and the most common incorrect numerator, 44, which includes those who do not grow any of the three vegetables. Other common numerators were 7 (those who only grow carrots) and 17 (the number that do grow carrots). **Part (b)(ii)** was the most challenging question on the paper, and only the most able candidates gave the correct answer of 46. It was much more common to see the values 6 or 44 given, 6 resulting from $(M \cap P) \cap C'$, and 44 arising from n(C') and ignoring the extra 2 in $M \cap P \cap C$. This question was also frequently left blank.

Question 22

Part (a) was generally well answered with most candidates gaining full credit. Common errors included arithmetic errors in calculating the determinant, for example $3 \times 1 - 0 \times 4 = -1$. This was usually with the correct adjoint matrix so partial credit was gained. Others found the determinant correctly but gave the adjoint incorrectly. Those who didn't gain any credit often gave the reciprocal of each term in matrix **A**, usually overlooking that 0 has no reciprocal, giving the answer $\begin{pmatrix} \frac{1}{3} & \frac{1}{4} \\ 0 & 1 \end{pmatrix}$. Others had no idea that they needed to calculate a determinant and possibly knew they needed to swap some of the elements around and/or change signs but not which ones. **Part (b)** was also generally well answered with most giving the correct matrix. Many realised that it should be a 1 by 2 matrix and a small number gave the answer as a 2 by 2 matrix, either by finding **AB** rather than **BA** or, in some cases, assuming that it should be a 2 by 2 and forcing their answer to fit. A few reached the correct answer but wrote a comma between the terms, making it appear like a co-ordinate pair and a similarly small number gave the answer as the column matrix $\begin{pmatrix} 9 \\ 8 \end{pmatrix}$.

Question 23

Part (a) was very challenging for many candidates although a sizeable minority reached the correct answer. There was evidence that many candidates did not read the question carefully enough. It was quite common to see $\overrightarrow{AM}$ rather than $\overrightarrow{AB}$ taken as **q** and similarly $\overrightarrow{AN}$ rather than $\overrightarrow{AD}$ taken as **p**. The other most common error was misusing the 3 : 2 ratio to make $\overrightarrow{AN}$ = 5**p** and so taking $\overrightarrow{DN}$ to be $\frac{2}{5}$**p**. Many candidates gave a partially correct answer (usually the –2**q**) or indicated a correct route, such as $\overrightarrow{MA} + \overrightarrow{AN}$. In **part (b)** many candidates answered correctly, sometimes with follow through, often $\frac{7}{10}$ from having $\frac{7}{5}$**p** – 2**q** in **part (a)**. However, there was often very unclear working, often unlabelled, so it was not clear which vector was being attempted. This meant that many candidates were unable to gain credit for method. A significant number of candidates left this part blank or offered no working.

Question 24

Many candidates found this question particularly challenging. Some were able to gain partial credit for a correct application of Pythagoras' theorem in 3D for a relevant line but most were unable to visualise the required angle so did not find any relevant lines. By far the most common incorrect working was to find $\angle GAC$ or $\angle AGC$ with the answers of 31.9 and 58.1 being more common than the correct answer. Very occasionally marks were lost by prematurely rounding to 3 figures in the working i.e. $\sqrt{193} = 13.9$ and then finding $\tan^{-1}\left(\frac{18}{13.9}\right)$ which gives 52.32, rather than a value in range.

Question 25

Most candidates were able to gain at least partial credit in **part (a)**. Generally, the transformation was described correctly as a rotation, together with at least one of the two further details necessary to describe it fully. Some candidates missed, or gave an incorrect, centre of rotation. The angle of rotation was sometimes described as being 90°, without including the direction of rotation. Most candidates correctly gave a single transformation in this part. It was more common in **part (b)** for candidates to use a combination of transformations rather than a single transformation as required by the question with enlargement and rotation often combined. As with **part (a)** the name of the transformation, enlargement, was usually given correctly. Errors were sometimes seen in the centre of enlargement and (2, 0) or (0, –2) were sometimes given, and more often seen in the scale factor of the enlargement. The scale factor of –2 was often given incorrectly as either 2 or $\frac{1}{2}$.

MATHEMATICS

Paper 0980/32
Paper 32

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 making an attempt at most questions. 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, particularly in those questions involving money. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer and the loss of the accuracy mark. In 'show that' questions, such as **Question 6(b)(iv)**, candidates must show all their working to justify their calculations to arrive at the given answer. 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. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) **(i)** Most of the candidates answered this part correctly. There were very few errors but common incorrect answers were 2.6 and $\frac{13}{50}$.

(ii) Most of the candidates answered this part correctly, usually giving $\frac{48}{100}$ or $\frac{12}{25}$ as their answer.

(b) **(i)** Most of the candidates answered this part correctly. $\frac{10}{18}$ was the most common response but other common answers included $\frac{25}{45}$, $\frac{15}{27}$ and $\frac{50}{90}$. A very small number wrote $\frac{5k}{9k}$ but didn't then evaluate this. Common incorrect answers include $\frac{4}{9}$, 0.55555 and $\frac{9}{5}$.

(ii) This part was generally answered well although common errors included 7, 11, 15, 14 or a full list of odd numbers.

(iii) The majority of candidates chose a correct decimal value with 0.04675 being the most common response and 0.04671 was also seen frequently. A common error was to include an extra decimal point (0.0467.5) or to include extra zeros (0.004672) or to omit the zero after the decimal point (0.4675).

(c) **(i)** This part was generally answered well although common errors included 67.8 from $3 \times \sqrt{512}$, with a number of other values arising from incorrect use of the calculator.

(ii) This part was generally answered well. Some candidates tried to simplify the expression by incorrectly applying indices rules, usually giving the answer 3^2 from $(6 \div 2)^{8-6}$.

(iii) A large majority of candidates gave the correct answer. The common errors were 0 and 7.

(d) Many candidates gave the correct answer but this part was found more challenging than previous parts for many. Most candidates understood the notion of what a multiple of 7 was but often gave 105 as the answer, appreciating the answer had to be above 100 but forgetting it should be even. Higher multiples were also seen such as 140 and 700. Though $16 \times 7 = 112$ was seen sometimes the candidate then went on to select the 16 as their answer.

(e) This part was not generally well answered and sometimes more than one answer was given. Candidates were unfamiliar with the terminology 'irrational number' and the whole range of possible options were seen.

Question 2

(a) This part was generally answered well although common errors of 14, 18 and 18 – 14 were seen.

(b) Many candidates found this part very challenging and full marks were rarely awarded. The multi-stage calculations required to use the information given in the question to complete the bar chart were not always appreciated. Many candidates were able to draw the bar for Mr Smith correctly at 15, although a small yet significant number misinterpreted the given scale and drew inaccurate bars at 14 or 16. The drawing of bars for Mr Jones and Mrs Brown caused more problems with the required calculations of $80 - (18 + 14 + 15) = 33$, followed by $33 \div 3 \times 2 = 22$ and $33 \div 3 \times 1 = 11$ rarely seen. Some candidates reached 33 but could not divide this in the correct ratio, often sharing equally rather than 1 : 2. Others drew bars for Mr Jones and Mrs Brown that had heights totalling 33.

(c) Although most candidates understood the term mode, this part was not generally answered well with the common error of giving the frequency (22) as the mode. Some candidates were able to score the mark from correctly following through from their incorrect bar chart.

(d) **(i)** This was answered well with the majority giving the correct probability $\frac{14}{80}$ often simplified to $\frac{7}{40}$, although common errors of $\frac{1}{14}$ and $\frac{1}{5}$ were seen.

(ii) This was also generally answered well. Many candidates showed their working, adding the frequencies for Mr House and Miss Patel then subtracting them from 80. A common error was to ignore the word 'not' in the question and give the answer as $\frac{32}{80}$, ignoring the subtraction. Those who had made errors drawing their bar chart had the opportunity to score follow through marks.

(e) Most candidates answered this part correctly, although common errors included $360 \div 18 = 20$ or $\frac{18}{80} \times 100$ instead of 360.

Question 3

(a) The majority of candidates answered this part correctly, showing the working clearly. Common errors included finding the correct cost of the apples but forgetting to find the change from \$10, and the incorrect calculations of 192 – 10 and 192 ÷ 10.

(b) The majority of candidates also answered this part correctly, showing the working clearly. A small yet significant number calculated the cost of only one type of grape correctly. Other common errors included 3.10 ÷ 0.6, 3.10 – 0.6, 2.80 ÷ 0.75, and 2.80 – 0.75.

(c) This part was generally answered well with mostly correct answers given. The most common error was to calculate $75 \times \frac{12}{100} = 9$.

(d) The majority of candidates answered this part correctly, showing the working clearly. A small number did the efficient calculation $1.6 \times 1.5 = 2.4$ although most did the calculation in two stages. A few candidates correctly obtained 60% of \$1.50 as 0.9 but then forgot to add it on whilst others spoilt this method by writing $1.50 - 0.9 = 0.6$. Other common errors included $1.5 + \frac{60}{100} = 2.1$ and $\frac{1.5}{60} \times 100 = 2.5$.

Part **(e)** was challenging for many candidates as the data was presented in a discrete distribution table rather than a simple list.

(e) **(i)** This part was not generally answered well with many of the candidates not able to find the correct range. The common error was to subtract the frequencies $14 - 0 = 14$.

(ii) Again this part was not generally answered well with many of the candidates not able to find the correct median. Common errors included ordering the frequencies 0, 2, 5, 8, 10, 11, 14 and giving the median value as 8, not ordering the frequencies and giving the median value as 5, the answer of 3 (the median number of bananas bought without considering the frequencies). Those candidates who appreciated that the 25/26th value was required were generally correct, although a few laboriously wrote out the 50 values as a list first.

(iii) Again this part was not generally answered well with many of the candidates not able to find the correct mean from the distribution table. Common errors included calculating Σf rather than Σfx and dividing by 7, or finding the total number of bananas, Σfx, correctly but again dividing by 7, $50 \div 7$, and $21 \div 50$. Arithmetic errors occurred when (0×14) and (1×0) were given as 14 and 1.

Question 4

(a) This part on the measurement of a bearing was not generally answered well. Common errors of 38, 52, 142, 218 and 232 were frequently seen.

(b) The majority of candidates were able to measure accurately at 12 cm and then use the given scale to correctly convert to give the actual distance required as 96 km. A very small number gave answers of 12 or $12 \times 100 = 1200$ km.

(c) This part on writing the scale in a particular form was not generally answered well and many candidates did not seem to appreciate that the scale of a map can be written in the form 1 : *n*. Common errors included 1 : 8, 1 :800, 1 : 8000, 1 :8*n*, 1 :12 and 1 :96.

(d) This part was generally answered well although not all candidates appreciated the context of the question, with many roads drawn not meeting the given road from *A* to *B*. These errors were probably caused by an incorrect bearing drawn from *C*.

(e) **(i)** This part was generally answered well with the majority of candidates able to work out the required time. A small yet significant number used an incorrect time notation such as 11.27pm, 11 hr 27 and 11°27°.

(e) **(ii)** **(a)** The majority of candidates were able to apply the correct formula to calculate the required journey time. However, many were then unable to convert into hours and minutes with 1.28 hours very often written as 1 hour 28 minutes, and less so as 1 hour 16 minutes.

(b) This part was generally answered well particularly with a follow through applied.

Question 5

(a) (i) This part on finding the perimeter of the given shape was generally well answered although a number of errors were seen, often as a result of attempting to use a formula rather than the simpler method of counting squares**.** Common errors included 12, 32, and 48.

(ii) This part on finding the area of the given shape was generally well answered although a number of errors were seen, often as a result of attempting to use a formula rather than the simpler method of counting squares**.** Common errors included 16, 24, 48 and 256 from $4 \times 4 \times 2 \times 2 \times 2 \times 2$.

(b) (i) This part was generally answered well.

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

(b) This part was generally answered well, although common errors of (5, *k*) and (7, 2) were seen.

(iii) This part was answered reasonably well although a small yet significant number of candidates were unable to attempt this part. Common errors included sign errors such as $\begin{pmatrix} 44 \\ -10 \end{pmatrix}$ and $\begin{pmatrix} 44 \\ 14 \end{pmatrix}$, $\begin{pmatrix} 49 \\ -12 \end{pmatrix}$, $\begin{pmatrix} 5 \\ 2 \end{pmatrix}$ and $\begin{pmatrix} 54 \\ -10 \end{pmatrix}$.

(c) (i) The majority of candidates were able to identify the given transformation as an enlargement but not all were able to correctly state the three required components. The identification of the centre of the enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (–4, 4) and (1 ,–3) being common errors. The scale factor also proved challenging with –2 and 2 being common errors. A small number gave a double transformation, usually enlargement and translation.

(ii) This part was generally answered well with the majority of candidates able to identify the given transformation as a rotation and more were able to correctly state the three required components. The identification of the centre of rotation proved the more challenging with a significant number omitting this part, and (0, 0), (8, 4) and (4, 9) being common errors. The angle of rotation was sometimes omitted with 90 being the common error.

Question 6

(a) (i) This part was generally answered well with the majority of candidates able to draw the next diagram in the sequence, although not all were ruled or included the internal lines.

(ii) This part was generally answered well with the majority of candidates able to complete the table.

(iii) This part was generally answered well, although common errors included $8n + 4$, $n + 8$, $8 - 4n$ and a number of numeric answers.

(iv) This part proved more challenging with a number of candidates not appreciating that equating their previous expression to 300 would give the correct answer. Common errors included $8 \times 300 - 4$, $300 \div 8$ and $300 \div 4$.

(v) This part proved most challenging and a good discriminator. The correct volume from $7 \times 7 \times 14$ was rarely seen. Candidates were not able to visualise the correct height for the open box, or incorrectly assumed it was a cube, using a height of 7 instead of 14. Other common errors included $7 \times 7 \times 6$, $7 \times 7 \times 9$, 7×12 and in particular $7 \times 7 \times 7$. A large number of candidates were able to correctly state the units of their answer, although common errors included 'units', cms and cm^2.

(b) (i) This part was generally answered well, although common errors included 1, 6, 9, and 27.

(ii) This was almost always correct with only the odd single error within the table.

(iii) Candidates found this part quite challenging with many not recognising the quadratic expression of n^2 gave the required formula. Common errors included $w + g$, and a variety of linear or purely numeric expressions.

(iv) In general this part was very well answered with the required working for this 'show that' question clearly shown. A rare error was to work out $0.5 \times 3 + 4$ giving an answer of 5.5. A significant number were unable to attempt this part.

(v) Candidates found this part quite challenging although a good number of candidates were able to gain full credit. A significant number did not appreciate that the earlier parts were useful. Those who recognised that $t = w + g$ from the table in **part (ii)** were often able to score one or two of the available part marks.

Question 7

(a) This part was generally answered well with the majority of candidates able to find the two required angles. Common errors included 48 and 48, 84 and 84 and answers such as 52 and 32 where the two angles added up to 84 (i.e. the isosceles property not recognised).

(b) This part proved to be a good discriminator. A large number of candidates demonstrated a good understanding of angles around a point and were able to set up a correct algebraic equation and solve it correctly to be awarded full marks. Less able candidates found the combination of geometry and algebra difficult to grasp. A significant number attempted to use a trial and improvement method, but this was rarely successful. Common errors included equating the sum of the four angles to 180, or equating the sum of $3x + 5x + 6x$ to 45.

(c) This part also proved to be a good discriminator**.** As the initial step, finding the sum of the interior angles, and finding an exterior angle, were equally popular approaches. Finding the exterior angle first generally proved a more successful method. Common errors included stopping after a correct first step of 18 or 3240 (although this did earn one of the method marks available), use of an incorrect formula to find the sum of the interior angles, and the incorrect use of 360 and/or 180.

(d) The majority of candidates realised that Pythagoras' theorem should be used and often went on to use it successfully. Common errors with this approach included inaccurate answers often due to premature approximation (7.7 was seen often), adding the two sides, and incorrect application of Pythagoras' theorem, often as $7.4^2 – 2.3^2$ (possibly due to the orientation of the given triangle). A small number attempted to use trigonometry, but this valid although less effective approach was rarely successful and often incomplete.

(e) The majority of candidates earned the first mark for recognising that the triangle was right-angled and finding the correct size of angle *b*, although common errors of 119, 58 and 59.5 were seen. Fully correct mathematical explanations, containing the three required key words of angle, semi-circle and 90° were rare. For many candidates trying to express what they knew, in an acceptable way, was challenging. Common errors included incomplete explanations such as 'it is in a semi-circle', 'angles in a triangle are 180', 'adds to 90', or mention of 'tangent', and purely numerical working such as 180 – 90 – 61 = 29.

Question 8

(a) (i) Many candidates found this part demanding and did not appear to recognise the possible use of the form $y = mx + c$. Common errors included (6, –3), (0, 3), (0, 6) and (3, –3).

(ii) Again, many candidates found this part demanding and did not appear to recognise the possible use of the form $y = mx + c$. Common errors included 6x, $y = x - 3$, $y = 6x + 3$.

(b) (i) This part was reasonably well answered although the common errors included drawing $y = -3$, $x = -3$, $x = -2$, or a diagonal line passing through (–3, –2).

(ii) This part was less successfully answered with few correct lines seen. The majority of the sloping lines did not go through the origin, and/or had an incorrect gradient, again suggesting that the use of $y = mx + c$ was not appreciated. The alternative and easier approach of using substituted values to obtain co-ordinates was rarely seen.

(c) Few candidates appreciated that the easiest way to solve these simultaneous equations was to use the substitution method giving a first line of working of $3x + 13 = 7x - 3$. The majority attempted to use the elimination method to solve their equations usually by attempting to equate the coefficients of x. Many numeric and algebraic errors were seen in the setting up of the equations such as use of $y = 21 + 91$, and in the solution of the equations such as $4x = -16$, $10y = 100$ and $10x = 10$. Less able candidates often managed to score one mark for two values satisfying one of the original equations.

Question 9

(a) Candidates found this question on bounds challenging and few correct answers were seen. Common errors included $23.45 \leqslant m < 23.55$, $23 \leqslant m < 24$, $23\,450 \leqslant m < 23\,550$, and $2395 \leqslant m < 23505$.

(b) This part was generally answered well although common errors included an incorrect initial step of 861 ÷ 11, or 861 ÷ 8, and leaving the answer as 2296 (the cost of hotels).

(c) This part was generally answered well with the majority of candidates appreciating the three calculations required to answer this multi-stage question. If full marks were not achieved, then two or three method marks were generally scored. Common errors included × 1.15 to convert euros into pounds, less often ÷ 0.88 to convert dollars into euros, rounding errors or premature approximations leading to an inaccurate answer, and using 45% rather than 55%.

MATHEMATICS 9-1

Paper 0980/42
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 and application of formulae and mathematical facts to apply in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions. Candidates must learn to hold accurate values in their calculators when possible and not to approximate during the working of a question. If they need to approximate, then they should use at least four figures.

General comments

Some questions allowed candidates to recall and demonstrate their skills and knowledge, others provided challenge where problem solving and reasoning skills were tested. Solutions were usually well-structured with clear methods shown in the space provided on the question paper.

Candidates had 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.

Most candidates followed the rubric instructions with respect to the values for π and three significant accuracy for answers. A few approximated values in the middle of a calculation in some parts and lost accuracy for the final answer as a result. Some did not show all of the required steps on questions where they were asked to establish a given result. Some candidates worked with numerical values correct to 2 significant figures. A minority of candidates need to take more care with the writing of their numerical digits and standard mathematical notation.

Candidates should show full working with their answers to ensure that method marks are considered where answers are incorrect. This also includes situations where candidates may show values on a diagram.

If candidates are using standard mathematical symbols they should make the use and location of the symbol very clear, for example when indicating a right-angle on a diagram.

The topics that were answered well included the equations of straight line graphs, calculation of values from a given formula, factorisation, drawing the graph of a function and a line, recall and use of the sine rule and cosine rule, arc length and area of a sector, finding the mean from a grouped frequency table, drawing and using a cumulative frequency diagram and observing patterns in diagrams to produce sequences.

The weaker topics included linking ratio to percentage, factorising a quadratic $ax^2 + bx + c$, manipulating the equation of a line to the form $y = mx + c$ to deduce gradient and y-intercept, finding the length of a line segment, use of the graph in an unfamiliar way, solving an equation with fractions and brackets, and more complex geometry where multiple approaches can be taken.

Comments on specific questions

Question 1

(a) Many candidates calculated from $\frac{1.13}{0.97}$ and converted to a suitable level of accuracy. The main error was to see division by 1.13.

(b) (i) Many candidates calculated the number of pages correctly. The most common error was the answer 84 which came from starting with 60 ÷ 5. Only a few candidates gave the number of news pages as their final answer.

(ii) Some candidates did not start with either a correct fraction or ratio. The answer 58.3 % coming from $\frac{7}{12}$ was common.

(c) This currency conversion question was a challenge for many candidates. The most efficient solution was to convert 2.25 euros to dollars by division. A large number of candidates did not show their intermediate working which sometimes cost marks when they could not correctly round to the nearest cent.

(d) A small number of candidates incorrectly wrote down $1\,763\,000 = 58\,000\left(1+\frac{x}{100}\right)^{21}$ as a first step and some others used the analogy of simple interest rather than compound interest**.** Those who had the correct first step usually went on to write down $\sqrt[21]{\frac{58\,000}{1\,763\,000}}$ as part of the working and were given credit for this. There were many correct answers but some candidates could not use the calculator to evaluate correctly and others gave an answer of –15%.

(e) Candidates usually knew how to find the two upper bounds and to multiply their answer. A common error was to see the calculation of the exact value followed by an attempt to find the upper bound of this value.

Question 2

(a) This part was answered well by a large proportion of candidates with minimal working. A small number of candidates in both parts of this question gave explanations which were not needed. The clearest answers included values correctly placed on the diagram. Many candidates showed working such as $\frac{180-26}{2}$ but did not indicate by the letters *ABC* which angle they had calculated. Candidates should present their work in a step-step style clearly stating which angle they are working out using the three letter or other unambiguous notation

(b) There were many fully correct answers seen in this part. Most candidates knew that the angle between the radius and tangent was 90° and calculated 32°. In a question like this where it is difficult to define the angles using the three letter convention, candidates should place their values clearly on the diagram. It is important that any symbols for right angles are used rather than the use of an arc which could represent any angle. A common error was to treat the triangle containing *y* with apex *P* as isosceles; this usually resulted in the incorrect answer 74. The values 58 at the circumference were rarely seen. The indication of a right angle on the diagram was frequently unclear.

Question 3

(a) Candidates usually gave the correct expression $1 - r$. A common error was to see $\frac{r}{2}$ which may have arisen from candidates regarding the probabilities for cycle and does not cycle as equal.

(b) (i) The majority of candidates correctly completed the two brackets or followed through their expression from **part (a)**. A small number of candidates changed this equation by an attempt to multiply by 10.

(ii) The best solutions showed expansion of the brackets and then terms collected and equated to 0.4. It is important that once candidates are working with an equation that they ensure that each line of their working is still an equation with no missing values. Some candidates made an error with one term and then compounded this error by trying to match an incorrect line of working to the correct equation.

(iii) When correct, the factorisation was usually done in one stage with the two brackets then used to reach the solutions. A significant number of candidates reached $5r(2r - 1) - 9(2r - 1)$ (or the similar factorisation) and then correctly equated the two brackets to zero. Many candidates used the quadratic equation formula instead of the method asked for in the question and although this led to correct solutions, they couldn't score full marks.

(iv) Candidates who had correctly completed **part (b)(iii)** usually took the valid solution and obtained 0.8.

Question 4

(a) (i) The gradient was often correctly stated as many candidates realised that the equation needed to be divided by 2. A considerable number of candidates did overlook this however and gave an answer 3. A few candidates gave the answer $\frac{3x}{2}$.

(ii) There was a strong correlation between candidates who succeeded here and those who had a correct answer to **part (a)(i)**. The candidates who had the answer of 3 in **part (a)(i)** usually had the answer (0, 4) in this part. A few candidates found the co-ordinates of the intersection with the x-axis.

(b) (i) This question was well answered and met with more success than **part (a)**. Most candidates earned at least two marks with three-term equations with either a correct gradient or a correct y – intercept.

(ii) The perpendicular line was more challenging. There were many correct answers from candidates demonstrating full knowledge of gradient and the use of a point on the line. A few candidates used the same gradient as the line in **part (b)(i)** and a few only changed the sign of the gradient in **part (b)(i)**. The substitution of (9, 3) was usually correctly carried out although occasionally (3, 9) or co-ordinates of another point were used. A few sign errors were seen following a correct substitution of (9, 3).

(c) (i) This length of a line met with mixed results. There many correct answers, almost always from using a formula. Very few candidates chose to use a sketch to find the x and y values. Another error from correct calculations was to give an answer of 12.7, presumably from 12.649... = 12.65 leading to 12.7. The candidates who first gave the more accurate answer gained full marks. Several incorrect formulae were seen involving variations of Pythagoras' theorem where candidates had tried to learn a set technique. A few candidates calculated the gradient of the line.

(ii) The co-ordinates of the midpoint were generally successfully given.

Question 5

(a) Nearly all candidates scored full marks here. The only common error was to give the co-ordinates to 1 decimal place instead of 2 decimal places.

(b) Due to an issue with this question, careful consideration was given to its treatment in marking in order to ensure that no candidates were disadvantaged. The published question paper has been amended. Most candidates plotted the points accurately and drew the curve well. Some errors resulting from the use of an incorrect scale for some points were seen, such as plotting (0.15, 3.30) at (0.15, 3.15). There were some who used large 'blobs' to mark the points and there were examples of candidates drawing a very thick line for the curve.

(c) Some candidates were able to rearrange the given equation and identify that the required line was $y = 2 - x$. These candidates usually drew the line correctly and reached the correct solutions. In many cases working was unclear, and candidates did not identify the equation of the line they had drawn. It was common to see a line with y-intercept 2 drawn from a partially correct rearrangement or simply from the constant of 2 in the given equation, but the gradient of the line drawn was often incorrect. Candidates who had added a line to their graph usually read the x-values of the intersections correctly.

(d) Many found this part challenging and either did not attempt it or just gave a value for $\sqrt{2}$. The majority of those who were able to make an attempt identified $y = 0$ or substituted $\sqrt{2}$ into the given equation to earn a method mark. Very few were able to make further progress however. Some candidates gave $\frac{2-x^2}{4x}$ or more usually $\frac{4-2x^2}{8x}$ and a few equated this to 0 and went on to reach $x = \sqrt{2}$. The most common error was to replace y with $\sqrt{2}$ and then attempt to solve the resulting equation.

Question 6

(a) Candidates expanded the brackets well. Most candidates wrote down the four individual terms from the multiplication and then correctly combined the x terms for the solution. There were a few errors with the sign of the $4x$ or **–** 21. Sometimes candidates seem a little unclear about what 'simplify' meant and went back to a factorised form so that the answer was identical to the question.

(b) (i) This was answered correctly by the majority of candidates. Sometimes small errors were seen, such as swapping a p and q when transferring to the answer line. Where 1 mark was gained this was usually for taking out a factor of $5q$ rather than for the other part factorisations. A common error was to try and take out pq as a factor.

(ii) Most candidates identified the correct method of pairing up the terms. Many made a sign error at the first step, a typical example being to give $2f(2g - 1) + 3h(2g - 1)$. Others did not have the content of the two brackets the same at the first step, usually $(2g - 1)$ in one bracket and $(1 - 2g)$ in the other. There were a number of candidates who dealt with the negative signs correctly and earned both marks

(iii) Many candidates were familiar with the difference of two squares. Where candidates did not gain full marks, they often showed that they had identified the two squared terms by re-writing as $(9k)^2 - m^2$. Sometimes this then was translated into $(9k - m)^2$.

(c) Many candidates arrived at the correct answer, but for others any error was mainly due to an incorrect removal of the fraction in the equation. It was common to only multiply the fraction and the right-hand side of the equation by 5. Some candidates tried to do two steps at a time and made an error in one of the steps. Advice would be to work vertically and show one step for each line of working.

Question 7

(a) This question was usually well answered with candidates showing a full method leading to the angle of 108°. The most common method was to calculate $(5-2)\times 180 \div 5$, although some candidates omitted the brackets around the subtraction. A minority of candidates showed $3\times 180 \div 5$ without identifying why 3 was used. Candidates who found the exterior angle using $360 \div 5$ usually reached the correct result. Some candidates stated that the sum of angles in a pentagon was 540° or worked back from 108° neither of which were sufficient to show a complete method.

(b) (i) Candidates who identified that there was a right angle at *M* and that angle *OBC* was half of the interior angle of the pentagon often reached the correct answer. Some used an incorrect trigonometric ratio and found *OM* rather than *BM*. Candidates who used the cosine rule in triangle *OAB* and then halved the length of *AB* to find *BM* often lost accuracy due to premature rounding of *AB*. It was very common for candidates to assume that triangle *OAB* was equilateral and give an answer of 6 cm.

(ii)(a) The most straightforward approach in this part was to use the right-angled triangle *BMX* and their value for *BM* to find *BX* and candidates using this approach were often successful. Candidates who used triangle *OAX* to find *AX* and then subtracted *AB* to find *BX* were less successful: incorrect angles were often used, values were rounded prematurely or there was confusion in which sides were being found. A significant number of candidates did not attempt this part.

(ii)(b) This part was found very challenging and many candidates were unable to identify the correct sides and angles to use in their area calculation once they had quoted the formula for the area of a triangle. Some candidates calculated a correct partial area, often the area of triangle *OAB* or *OBX* but methods were often unclear with no indication of which triangle was being considered. Some showed extensive working to find different lengths in the shape, but errors were often made and it was unclear which length they were attempting to find. Few candidates realised that the lengths found in the previous two parts together with the angle of 54° could be used to find the required area.

Question 8

(a) (i) Most candidates identified that the cosine rule was required in this part and reached the correct answer. Having shown a correct substitution, some worked in stages and did not combine the terms correctly. A small number quoted the formula incorrectly, usually adding rather than subtracting the final term. A small number of candidates used the sine rule or Pythagoras' theorem.

(ii) Most candidates identified angle *BCD* as 32° and used the sine rule correctly to find *BC* or *DC*. In some cases, an incorrect combination of angles and sides was used in the sine rule. Many were then able to identify the right-angled triangle required to find the shortest distance and reached the correct answer. Some used an incorrect trigonometric ratio in their calculation. A small number of candidates gave the answer as either the length *BC* or *DC*.

(b) (i) This question was well answered. The most common errors were to use the formula for area of a sector rather than arc length or to round values prematurely or to truncate their answer to 116.0 giving an answer out of the acceptable range.

(ii) This part was also well answered and those candidates who had not reached a correct angle in **part (b)(i)** usually showed a correct method using their previous answer. A small number of candidates used an incorrect formula, usually either the arc length formula or including $\times 2$ in the area formula.

Question 9

(a) This part was well answered by most candidates. Errors that were seen included adding up the midpoints and dividing by 5 or 100, using the width of the interval instead of the midpoint before finding the sum of these products with the frequencies. Just a few candidates made numerical errors when the method shown was correct.

(b) This part was almost always correctly answered.

(c) The cumulative frequency graphs in this part were generally very well drawn with points plotted at the upper end of the interval and at the correct heights. Only very occasionally was a block graph seen and when this did occur candidates struggled to access the marks in **part (d)**.

(d) (i) The median was often correct although a significant number gave the answer 10 when it should have been clear that the answer was less than 10.

(ii) The interquartile range was usually sufficiently accurate although a few candidates experienced some confusion with the scale of the graph, reading their values at 70 and 30 instead of 75 and 25.

(iii) This was a well answered question with almost all candidates giving an integer value within the required range. Some forgot to subtract from 100 and others read the scale of the graph incorrectly.

Question 10

(a) This question was generally well answered. Almost all candidates earned two marks for the two respective volumes. A few candidates found the surface area of the cylinder. The conversion of cubic centimetres was not very successful, with some candidates not attempting a conversion and others not using the correct factor of 1000.

(b) Candidates who worked out the volume of the cuboid in cm^3 by converting the length to cm first were generally more successful than those who tried to convert m^3 to cm^3 as many incorrectly multiplied by 100 or 1000. Other common errors were to multiply the volume by the rate of flow or to divide the rate of flow by the volume. Most candidates who reached 16 200 seconds were able to convert to hours and minutes successfully.

(c) A number of fully correct answers were seen in this part. However, a significant number of candidates didn't appreciate that they needed to square root the scale factor for the areas and so 9.19 cm was a common incorrect answer. A small number of candidates lost marks through premature rounding.

Question 11

(a) Most candidates completed all four values correctly. Some used the pattern in the values in the table to continue the sequence and others drew the next pattern and counted lines and dots.

(b) Many candidates found the second differences and identified that the sequence was quadratic, often going on to reach the correct expression. Some substituted values into formulae for the terms of a quadratic sequence which sometimes led to the correct expression.

(c) Candidates who had reached the correct expression in **part (b)** often reached the correct answer in this part. Some made errors in using the quadratic formula when factorisation might have been more straightforward. Some gained a method mark for equating their algebraic expression from **part (b)** with 10 300, but many omitted this part. A small number substituted 10 300 into their expression from **part (b)**.

(d) Candidates who attempted this part often reached the correct answer. Some formed two simultaneous equations by substituting $n = 1$ and $n = 2$ which they solved to find a and b. However some equated these to 0 rather than to the appropriate term of the sequence. Other candidates identified the second difference of 1 and sometimes went on to reach the correct values for a and b.