MATHEMATICS (WITHOUT COURSEWORK)

Paper 0980/12
Paper 12 (Core)

Key messages

Non-exact answers should be rounded to 3 significant figures. All the digits of a number should be written down for exact answers.

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.

General comments

Many candidates showed a strong understanding of the content of the syllabus and demonstrated proficient mathematical skills. The standard of presentation and the detail in the working shown was generally good, however centres should continue to encourage candidates to show formulae used, substitutions made, and calculations performed. Candidates are reminded of the need to write clearly and should not write over any working, but rather cross these out and write alongside. Candidates should also be encouraged to read questions once completed to ensure the solutions they give are in the required format and answer the question set.

Comments on specific questions

Question 1

(a) Many good responses were seen to this part. Some responses omitted a 1 or 18, or gave an incorrect factor such as 4 or 8. Some responses offered prime factors or product of primes. Some responses listed the factor pairs of 1 × 18, 2 × 9 and 3 × 6 but did not consolidate these results into a list.

(b) Many good responses were seen to this part. Most responses expressed the reciprocal as a fraction, rather than as a decimal. Some common incorrect responses seen were -8, 4, $\frac{8}{1}$ or $\sqrt{8}$.

Question 2

(a) Most responses showed a line perpendicular to *AB*, drawn to an appropriate degree of accuracy. Some responses showed a construction with arcs, which was not essential for this question. A common mistake seen was to draw a parallel line, rather than a perpendicular one.

(b) Most candidates successfully measured the length of the line, giving the answer in centimetres as requested. This required a decimal point, which was not always immediately clear in some responses. Some responses suggested that candidates measured from the end of the ruler rather than the start of the scale since 7.9 cm was a common error.

Question 3

Many fully correct responses were seen to this part. There were some responses where two squares were shaded of which one of the squares was correct. In some cases more than two squares were shaded, or attempts were made to show line rather than rotational symmetry.

Question 4

(a) Most responses involved a straight division by 4. The best responses wrote the answer exactly, either as a decimal or fraction. In some cases, the answer was given having rounded or truncated to 3 figures, without working shown.

(b) This part was answered well by many candidates. It was common to see Ava's longer part worked from the answer to **part (a)** of the question instead of the 57 cm long piece of wood they each had to start with. An incorrect initial step often seen here was division by 2, as the question said two parts, before working out the fraction of that length.

Question 5

The best responses clearly stated and then used the properties of angles in a triangle and angles on a straight line. Some who made an error in one angle often gained a mark for both angles adding to 180°. Some responses gave values for x and y which added to 90°. Candidates are reminded to check the appropriateness of their answer, using the sketch to support this judgement.

Question 6

Many correct answers were seen to this part. A common error seen was to omit the minus sign in the final answer. Another common response seen was the value 3, suggesting an incorrect calculation using the numbers 8 and −5.

Question 7

Selection of prime numbers from a list and adding these was done successfully by most candidates. The best responses identified the two prime numbers and added these values. Many responses recognised the two primes but did not show the final step of summing these.

Question 8

(a) There was a good response to the stem-and-leaf diagram question by many candidates. The best responses listed all values involved, with the leaves in the correct order. A common mistake was to list the full number in the table, rather than separating out the tens and units in line with the key.

(b) Many good responses were seen to this part, some using the list to determine the median and others using the diagram. Some responses gave the mode and others worked out the mean. The two middle numbers, 5 and 8, were identified by many but then incorrect steps to the answer were often evident.

Question 9

Many good responses were seen to this part, with measurements stated within the accuracy required. A common error seen was to measure the angle in the anticlockwise direction, giving a reflex angle of 225°. Some responses stated the length of a line, rather than a bearing.

Question 10

Nets were well constructed by most candidates with ruled lines and the correct number of added rectangles and triangles. Some responses omitted one of the rectangular sides, others gave all sides correctly drawn but the triangles positioned such that the sides would not align with the corresponding rectangular side. Other responses showed one correct rectangle. Others showed both triangles having the correct dimensions, but with incorrect rectangles (often both 6 cm by 3 cm).

Question 11

The vast majority of candidates realised that 3.5 needed to be multiplied by the scale. Better responses reached the figures 875, correctly included a step converting units to get an appropriate answer, and gave the correct answer in kilometres. Many responses showed a value of 250 000 cm but did not convert the units as requested. In some cases, a scale factor of 3 was used, rather than 3.5.

Question 12

The probability question was answered well by many candidates. Some responses showed an incorrect step of adding the given probabilities, rather than subtracting these from 1. Some incorrect responses were not supported by working and so the method to reach these answers was not clear.

Question 13

(a) Most candidates could list the members of set *M*. A common incorrect response was to list the elements, rather than stating the number of elements in the set.

(b) Few fully correct responses were seen to this part. Responses which included 5 or 15 were common, as were responses which included just one of the two elements.

Question 14

Many good responses were seen for this question. Most responses correctly converted the mixed number to an improper fraction and many went on to show the correct method for the division of fractions. Some responses confused the two methods of invert and multiply and division with a common denominator. Some who had a fully correct method did not simplify their answer.

Question 15

(a) Multiplying a vector by a whole number was done very well by most candidates. Common errors seen were due to incorrect multiplication, missing the minus sign in front of the second component or adding 3 to the vector. Some responses included the 3 in front of the vector without showing the multiplication. A common mistake here was to include a fraction line in the vectors.

(b) A similar level of success was apparent in this part as in **part (a)**. The main error was incorrect addition of directed numbers.

(c) The best responses here added the components of the vector to the appropriate coordinates of the point and included a diagram to support the working.

Question 16

A significant number of candidates correctly listed all possible values of *x*. Some responses showed incorrect interpretation of the inequality symbols and were missing the –3 or including the 3. Some responses missed the zero and others did not give integer values for *x*.

Question 17

Many good responses were seen for this question. A number of different, valid methods were seen, many with fully correct arithmetical working. Some responses gave the exterior angle as the answer rather than the interior angle**.**

Question 18

(a) Many fully correct answers were seen for this question. In some responses, the answer was in the form of a number written in words. Only a small number of responses gave an incorrect exponent, while others omitted the decimal point.

(b) Few fully correct answers were seen for this part. Some responses gave an answer as a whole number while others gave an answer in the form $a \times 10^b$, where a was greater than 10.

Question 19

Many correct answers were seen for this question. Dividing the indices instead of subtracting them was the main error, although not all divided 18 by 3 correctly, and often 15 from subtraction was seen. Some responses showed an attempt at factorisation.

Question 20

The best responses used the method of finding the LCM of 28 and 48, giving the answer in terms of either the 12-hour or 24-hour clock. An alternative method was to list the times of the buses leaving the station, but it was rare for the lists of both buses to lead to the correct time. Those using factor trees or tables started well but not many then correctly worked out the required time of day. Some answers were written in 12-hour clock but omitted the ‘pm’, or were written in 24-hour clock and included a ‘pm’.

Question 21

There were many correct answers to the proportion question. A common error was to add rather than multiply by the scale factor. Candidates are encouraged to look at the diagram and check the appropriateness of their answer, using the diagram to support this judgement.

Question 22

(a) Some good responses were seen for this part. The best responses used sine ratio, correctly moved from an implicit to an explicit form of the formula and gave the answer to the required degree of accuracy (3 significant figures). In some responses, premature approximation resulted in a final answer that was not correct to the accuracy required.

(b) Few fully correct answers were seen to this part. Most responses began with a method to calculate *PS*. The diagram indicated that *PS* had to be less than 23.8 cm, but some methods added the square of the lengths rather than subtracted leading to answers greater than the length of the hypotenuse. Some responses started by first adding *QS* and *RS*. Attempts that included many steps to reach an answer often did not maintain the accuracy required.

Question 23

(a) Many responses added and subtracted 5 from 350 and reached the correct inequality. Some responses added and subtracted 10, or reversed the correct limits. Some values of 354 for the upper limit were seen.

(b) Few fully correct responses were seen for this part. Some responses gave the inequality statement for object *B* but did not also reference object *A*.

MATHEMATICS (WITHOUT COURSEWORK)

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

This examination provided candidates with many opportunities to demonstrate their skills. Many high-scoring scripts were seen, and there was no evidence that the examination was too long.

Some candidates omitted questions or parts of questions, but this was likely due to a lack of knowledge rather than time constraints. It would have been helpful if candidates had written their numbers more clearly, as some of them were difficult to distinguish, particularly 4s and 9s, and 1s and 7s. Some candidates' handwriting was not as legible as others, which may have contributed to the errors in their work.

There were some questions where candidates rounded to an unsuitable level part way through calculations, this was particularly evident in **Questions 11** and **17**. Candidates need to be mindful that completing working in one line when they should use several lines (see **Question 18**) means that they can miss the opportunity for method marks.

Few candidates were unable to cope with the demands of the paper. However, candidates need to take care to read and understand the specific requirements of each question. Not following these requirements often led to marks being lost. For example, not giving an answer in its simplest form in Questions 7 and 16, or not reading the information about values a and b in Question 12.

In general, candidates showed a good amount of working in most questions. However, occasionally this was insufficient, as was evident in questions that demanded that all work be shown (Questions 7 and 16).

Comments on specific questions

Question 1

Most of the candidates answered this correctly. A small minority subtracted –5 from 8 or added –5 to 8 instead of subtracting 8 from –5. Consequently 3 and 13 were common incorrect answers.

Question 2

Many candidates correctly found the sum of the prime numbers 47 and 61, which is 108. However, a few candidates only found the two numbers without summing them. When the correct pair of numbers were selected, some candidates found the difference, product and less frequently the mean. A small number of candidates did not provide any supporting work for their answers, and if their answers were incorrect, they did not receive any part marks. Some candidates seemed unaware of the divisibility rule for 3, as they chose 27, 57, or 93 as one of the prime numbers. These candidates could improve their scores by reviewing the divisibility rule for 3 and practicing finding prime numbers.

Question 3

Part (a) was well answered by the candidates and the majority correctly completed the stem and leaf diagram in order with clear presentation. For those who did not gain 2 marks the majority obtained 1 mark for completing an unordered diagram, especially swapping the 4 and a 5 in the first row and the 1 and 2 in the second or they missed out one of the 5s in the first row. For those did not obtain any marks the main error was to include the tens digits in the 'leaf' section of the diagram, especially in the second two rows, e.g. 23, 24 instead of just 3, 4. In some cases numbers were crossed out to find the median for the second part of the question. It was sometimes difficult to distinguish between what was crossed out to find the median and what was an error. Candidates are advised that instead of crossing out they could use a different method such as underlining numbers so as not to spoil the stem and leaf diagram. It was rare for a candidate to offer no response.

Part (b) was less well answered than **part (a)**. Whilst many candidates did obtain the correct answer of 6.5 about a third of candidates gave an incorrect answer. Errors arose from various methods, most commonly giving the mean 9.6 or the mode 5. Also very common was where one of the 5s was missed out in the stem-and-leaf diagram giving a frequent incorrect answer of 8 or 9.5. The error of 8 was where the candidate just used the 5^{th} result. Some realised, because the text in the question stated that results were recorded for ten days, that they needed to average the 5^{th} and 6^{th} results, but when the 5 was missed out these were 8 and 11 giving the answer of 9.5. Another common error was to give an answer of 13 from adding 5 and 8 and forgetting to divide by 2. It was also common to see 13.5 from using the original unordered data set and taking the average of the two middle values. Some gave the answer 5.5 which is the position of the median. This question was rarely left blank.

Question 4

Although the figures of 875 were generally arrived at there was a large range of answers seen in addition to the correct answer of 8.75 most commonly 0.875, 87.5, 875 or 875 000. Changing the units to kilometres was the main problem encountered by the candidates. Some candidates multiplied 3.5 by $250\,000^2$ instead of just 250 000. Some divided 3.5 by 250 000 or divided the other way round.

Question 5

Nearly everyone gained at least 1 mark with most gaining 2 marks. Almost all gave their answer in decimal form, very occasionally candidates converted to fractions and often this caused problems or if they converted to percentages, they often missed out the crucial percentage signs. More frequently candidates did not show any working, so the method mark was not awarded that often. The most common wrong answer was 0.6 obtained from adding the given probabilities but forgetting to subtract from 1. Another common error, after finding 0.6 was to divide it by 4 to reach 0.15.

Question 6

Whilst candidates often scored well on this question it was evident that many were unfamiliar with some of the set notation.

Part (a) was the worst answered part with just over half of the candidates answering it correctly. It was common to see the elements of set M listed (usually correctly) as the answer, rather than giving the number of elements as denoted by the n(M) notation in the demand. Some spoiled their answer by writing it as {4} which is incorrect. A small number of candidates added the elements of the set or confused multiples with factors so thinking $M = \{1, 5\}$.

The intersection notation in **part (b)** appeared to be more familiar to candidates with the correct two elements being given by the majority. Candidates are advised that the question asked for elements in the sets and many gave the answer using set brackets e.g. {10, 20}, this was condoned. A common error was to state just one of the two required elements, usually 10 so perhaps misreading the inequality sign in the given universal set. Some gave the number of elements in the intersection instead of listing them, consequently 2 was a common incorrect answer.

Most candidates were able to score the mark in **part (c)**, usually by recognising that an odd number would be appropriate and gave one in range, often 3 or 1. Some unnecessarily decided to list all the odd numbers in the universal set, sometimes in set brackets. Whilst this was condoned if the given values were all possible for y, candidates should take care to follow the demand of the question. Very few decided to give a decimal or mixed number in the range, which would have been acceptable as the universal set was not restricted to integers. Common incorrect answers were an integer out of range, often 21, an even number, or a decimal less than 1 often $\frac{1}{20}$.

Question 7

Most candidates gained full marks on this question. Of the two methods on the mark scheme, the majority used the method of multiplication by the reciprocal i.e. $\frac{4}{7} \times \frac{21}{26}$ which was the most successful of the two methods. Occasionally the use of common denominators was seen i.e. $\frac{12}{21} \div \frac{26}{21}$. However it was more common for there to be a conceptual error when this method was attempted e.g. to write $\frac{12 \div 26}{21}$. It was also common for $\frac{12}{21} \div \frac{26}{21}$ to be followed by conversion into multiplication anyway e.g., $\frac{12}{21} \div \frac{26}{21} = \frac{12}{21} \times \frac{21}{26} = \frac{252}{546} = \frac{6}{13}$. Those reaching $\frac{252}{546}$ often had cancelling errors or arithmetic errors in the multiplying when they did not cancel before multiplying. Of those who did not get full marks, some did not convert correctly to an improper fraction with $\frac{26}{5}$ and $\frac{5}{21}$ both seen quite often. Another, less frequent, error was to write the reciprocal of the wrong fraction giving $\frac{7}{4} \times \frac{26}{21}$. Some gained full method marks but did not simplify correctly at the end with un-simplified fractions sometimes seen as the final answer. A very small number treated $\frac{6}{13}$ as $\frac{13}{6}$ and converted the correct answer into $2\frac{1}{6}$ and a few candidates converted the answer into decimals and lost the final accuracy mark. Only a very small minority showed no working.

Question 8

Part (a) was one of the most successful questions on the paper with nearly all candidates getting the correct answer. Some showed working but most did not need to. The most common approach when working was seen was $30 = 6x$ followed by $\frac{30}{6} = x$. The most common incorrect answer was $x = 180$ where they multiplied 6 and 30 together. A very small number of candidates gave $\frac{1}{5}$ as their final answer.

In **part (b)** the most common mark was 3 scored by about two-thirds of the candidates. The most common and successful approach was to follow the method:

$$11x - 3 \geqslant 2(2x + 9)$$
$$11x - 3 \geqslant 4x + 18$$
$$11x - 4x \geqslant 18 + 3$$
$$7x \geqslant 21$$
$$x \geqslant 3$$

The less successful method was to collect the x terms on the right-hand side i.e. $-21 \geqslant -7x$ as instead of following this with $3 \leqslant x$ it was more often followed by $3 \geqslant x$. Other common errors seen were an answer of $x = 3$ or 3 alone it often followed from solving as an equation, $11x - 3 = 2(2x + 9)$ and not reinstating the inequality sign. Some candidates had the correct inequality answer in their working but spoilt it by writing $x = 3$ or just 3 as the answer or they gave positive integer solutions such as '0,1, 2, 3' if they found $x \leqslant 3$ or '3, 4, 5, ….' if they found $x \geqslant 3$. Consequently about a fifth of candidates scored 2 marks. Several candidates made errors in expanding the bracket. This was most often forgetting to multiply the second term of 9 by 2 as well as the $2x$. Often they still gained a method mark for successfully collecting their x terms on one side of their inequality and their number terms on the other side. A few candidates left their final answer as $7x \geqslant 21$. Some candidates having expanded the bracket correctly were not able to successfully collect their x terms on one side of their inequality or equation and their number terms on the other side, this was usually due to sign errors in the rearranging rather than arithmetic errors.

Question 9

Parts (a) and **(b)** were extremely well executed with nearly all candidates gaining both marks. There were a few arithmetic errors in each part as well as errors involving the negative signs and sometimes the negative signs were omitted. Sometimes vectors contained an incorrect fraction line and occasionally candidates treated their vectors as if they were fractions and 'simplified' their answer by dividing both parts by the same value, particularly in **part (b)** where $\begin{pmatrix} -1 \\ 8 \end{pmatrix}$ was sometimes seen following the correct answer of $\begin{pmatrix} -4 \\ 32 \end{pmatrix}$. **Part (c)** was less well attempted with fewer than half the candidates scoring any marks. Although weaker candidates demonstrated that they could multiply and add vectors in the previous parts, they did not understand the meaning of a vector, i.e. that the point *G* could be found by adding 8 to the *x*-coordinate of *F* and adding –3 to the *y*-coordinate of *F*. Common incorrect coordinates were (7, 1) where the difference was found, (7, –1), from a subtraction and (–7, 9) from mixing up the coordinates. Stronger candidates were more successful in **part (d)** as this question was a good discriminator. Many understood that they needed to use Pythagoras' theorem but candidates need to be aware of the difference between -12^2 and $(-12)^2$ as misinterpreting this led to the very common wrong answer of 32.9. Weaker candidates did not understand the word magnitude as there was a very high level of non-response in this question.

Question 10

In **part (a)** most candidates identified reflection with many of these also gaining the second mark for $y = 2$; $y = 2$ was variously described as a line, point, mirror or axis. A few incorrectly identified rotation or translation, and a small minority had a combination of transformations rather than the single transformation that was asked for. The incorrect response seen most often was $x = 2$ for the line of reflection and identifying reflection but giving properties of rotation such as 180/90 clockwise or centre (3, 2).

In **part (b)** there were fewer but still a lot of correct responses with most using a ruler and pencil to draw their answer. Many other candidates gained one mark for a correctly orientated shape in the wrong place or, more rarely, an anticlockwise rotation of 90° about the correct centre. It was evident that some candidates used tracing paper to help with this as often there were slight inaccuracies in the position of the vertices. Tracing paper is permitted but candidates need to be aware that this is to assist them in finding the correct position of the vertices and they should check if their vertices fall between gridlines.

Part (c) was the least successful with only about a third of candidates scoring 2 marks. Many did not attempt to answer the question, did not use the correct centre of enlargement or used an incorrect scale factor. There were also a significant number of shapes in the grid that were not mathematically similar to shape *A*. Images were most often smaller than shape *A*, it was particularly common to see an enlargement with scale factor $\frac{1}{2}$, indicating that confusions were mostly caused by the scale factor being negative. Many diagrams were unclear because they included heavy/bold rays passing through (2, 0). Often there were rays drawn but no attempt to draw the enlargement.

Question 11

This question was a good discriminator. The most common method, often successful used $\frac{140}{360} \times \pi r^2$ for each sector then subtracted and equated to $k\pi$. Very few went straight to the more efficient method of $\frac{140}{360} \times 5.8^2 - \frac{140}{360} \times 3.2^2$ although about a third of the candidates still managed to obtain 3 marks on this question. Many found the area of just one of the sectors or found both, but added them together so a mark of 1 was as common as a mark of 3. Candidates were told that the area of the shape was $k\pi$, so there was no need to include a value for π in their calculations. Of those including π in their initial calculations when dividing by π at the end this often resulted in an inexact value that was either slightly lower or higher than 9.1 depending how they rounded. This resulted in many losing the accuracy mark but still gaining 2 method marks. Many performed correct calculations but did not use their calculator efficiently or rounded their figures prematurely, and so lost accuracy in their final answer that way. A few candidates calculated the area of a sector using a radius 2.6 cm, which demonstrated a lack of understanding. Some calculated the arc length of a sector rather than the area, and a minority of candidates did not use the sector angle of 140° at all, and just used the formula for the area of a circle.

Question 12

In **part (a)** most candidates gained at least 1 mark for the $64a + b = 181$ or equivalent. Just under half of the candidates went on to correctly use a trial and improvement method to realise they needed to substitute 2 to get the final answer of 53. Many candidates struggled to spot the importance of the second line of the question despite the text being in bold. Often they stopped after writing down a correct equation, because it had two unknowns not realising that they did in fact have enough information to answer the question. Sometimes incorrect rearranging was an issue when trying to make b the subject, e.g. the incorrect starting points of $a + b = 181 \div 8^2$ or $a + b = 181 - 64$ were often seen. The most common incorrect answer was 117 arising from picking a value of a that was not greater than 1 but was in fact equal to 1. The final answer was often non-numerical usually the correct rearrangement $b = 181 - 64a$. $x = \sqrt{\left(\frac{181 - b}{a}\right)}$ was sometimes seen as the answer. Another common incorrect answer was 2.83 arising from $181 \div 64$.

Part (b) had a the most non-responses on the paper, approximately a fifth of candidates made no attempt to answer this question. It also had the fewest number of candidates scoring marks on the paper. Of those who obtained the mark available there was a high number with no working out and it was clear these candidates realised that all was expected was them to use the negative value of the 8 already given in **part (a)**. There were a large number responses with a great deal of incorrect methods demonstrated, including trying to solve an equation in x using the quadratic formula or factorising.

Question 13

This was generally answered correctly with very few candidates scoring no marks. As with all solutions it is sensible to show some working in case an arithmetic slip arises later, which was sometimes the case. A common incorrect answer was $180 - 32 = 148$ or just $2 \times 32 = 64$. An incorrect answer still regularly scored 1 mark usually for 32 shown correctly on the diagram.

Question 14

Most candidates were very familiar with the method to find the inverse function and were able to score 2 marks. A small number of candidates gave their answer in terms of y. The most common error was to add 2 rather than subtracting 2 when rearranging, leading to the common incorrect answer of $\frac{x+2}{5}$. Those candidates who made this error but had used $x = 5y + 2$ as their first step gained the method mark for a correct first step. A common misconception was to confuse the inverse function with the reciprocal so $(f(x))^{-1}$ was sometimes found. Some candidates formed and solved the equation $5x + 2 = 0$. Candidates sometimes made sign errors in their rearranging, the two most common being following the correct starting point of $-5x = 2 - y$ by $x = \frac{2 - y}{5}$, or having the incorrect starting point of $5x = 2 - y$.

Question 15

In **part (a)** the correct midpoint was by far the most common response with very few arithmetic errors. Among the few incorrect responses a common error was to find half the difference of the x-values and y-values, without adding on to the first point, so resulting in an incorrect answer of (4, 8). A small number wrote unevaluated expressions or gave the coordinates in the incorrect order.

Candidates were again mostly correct in finding the gradient in **part (b)** with only a small number dividing the wrong way up to reach $\frac{1}{2}$ instead of 2. Very few candidates did not understand what was required, although sometimes the answer was incorrectly given as $2x$. A small number had trouble subtracting –1 from 15, or attempted a formula for something other than gradient. A few subtracted the x-coordinates one way and the y-coordinates the opposite way causing a sign error in their gradient.

Part (c) was the least successful part of this question. Whilst most realised that they needed to change the gradient for the perpendicular line, usually correctly, it was quite common for them not to realise this needed to be used along with the midpoint to find the perpendicular bisector. Instead, one of the given points was very often used in the substitution. Those using the correct gradient and midpoint generally scored full marks. A few candidates used the same gradient as found in **part (b)** so were unable to score any marks in this part. There were a high number of non-responses in this question.

Question 16

Less than half of the candidates answered this question correctly. The most common starting point for those who scored was to multiply the decimal by successive powers of 10. Having done so, many candidates went on to score full marks. Of those who did not, the majority did not choose an appropriate pair of decimals to subtract in order to cancel the recurring digits. Quite a few others did select an appropriate pair but failed to subtract successfully. In many cases this could have been avoided if the work had been set out neatly with the decimals lining up beneath one another. Another subtraction error came when the recurrence was overlooked giving subtractions such as 62.121 – 0.6212 = 61.4998. This earned a method mark but usually went no further. Other fairly common wrong responses include ignoring the recurring nature of the decimal giving an answer of $\frac{621}{1000}$ or not recognising that only two digits recurred leading to $0.621621621 = \frac{621}{999} = \frac{23}{37}$. In a very small number, there was an error in multiplication by powers of 10 leading to, e.g. 62.111111. A small number of candidates used the alternative approach of splitting the decimal into separate fractions such as $\frac{6}{10} + \frac{2.1}{99}$. Those that did were generally successful. Despite the question telling candidates to show all of their working there were quite a few who gave the answer correctly with either no working, or no correct working.

Question 17

This question was answered well by the more able candidates. The most successful approach was the method $\frac{1}{2} \times 92.5x71xsinx = 2143$. Premature rounding of values was seen from some candidates, this led to an answer out of range due to the loss of accuracy. A common error seen was where candidates thought the triangle was right-angled and used incorrect trigonometry such as $\cos x = \frac{71}{92.5}$, or they used Pythagoras' theorem followed by the cosine rule. A few candidates omitted the $\frac{1}{2}$ in $\frac{1}{2}ab\sin x$, some used $\frac{1}{2}ab\cos x = 2143$ and others added 92.5 to 71 instead of multiplying.

Question 18

This question differentiated well between candidates. Strong candidates regularly gained all 4 marks showing a concise solution. Those making a single error, often a sign error were still able to gain subsequent marks for correct follow through processes usually scoring 3 marks. Some candidates often made a good start by multiplying by the denominator and multiplying out the brackets. They then often went on to collect the terms in *x*. Difficulties usually arose from this point onwards, with uncertainty regarding the necessary factorisation step and it was common to see *x* on both sides of the equation in the answer. Weaker candidates demonstrated a lack of understanding when manipulating algebra. The omission of brackets when multiplying by the denominator was a frequent error. It was common to see candidates trying to divide through by a term but not dividing the whole equation by this term. Selected parts of the numerator or denominator were often moved to the other side of the equation. Sometimes an *x* or a *c* variable was lost or changed so that no factorisation was necessary. Clarity of the working was an issue for those who struggled with the question with re-starts and scribbled out working making it very difficult for Examiners to follow. Many candidates tried to complete multiple steps in one line of working and when one of these steps went wrong they then missed the opportunity for method marks.

Question 19

Approximately two-thirds of candidates scored full marks in this question. It was rare to see partially correct responses but when they were seen, they often involved some slip in finding the value of their constant *k*, though subsequent correct use of their *k* could still earn a method mark. Sometimes a correct constant was substituted into an incorrect equation for example $m = \frac{16}{(8+3)^2}$ was occasionally seen instead of $m = \frac{16}{(8+2)^2}$. Common incorrect attempts began by misinterpreting 'the square of $t + 2$' leading to $m = \frac{k}{\sqrt{t+2}}$ or believing it was direct proportion $m = k(t+2)^2$ or not squaring at all i.e. $m = \frac{k}{t+2}$. Some attempted the whole question without converting their proportionality relationship to an equation which usually prevented method marks from being scored.

Question 20

Correct answers were seen in about half of the responses. Some candidates used the diagram for their working leaving a great deal of responses with untidy and confusing shading. The errors made were varied, the most common errors being to shade $A \cap B'$, $A \cap B' \cup C$, $(A \cup B)' \cap C$.

Question 21

In this question there was almost an even split between 0, 1, 2 and 3 marks. This question was the best discriminator on the paper with only the most able scoring 3 marks. Many candidates were only able to gain the first method mark for rearranging the equation to achieve $\sin x = -\frac{3}{5}$ making no further progress. About a quarter of candidates found one correct angle gaining 2 marks. A few candidates sketched a sine curve which helped them to realise that there are 2 reflex angles as solutions to the equation. Another common method was to use a diagram with axes and four quadrants (often called a CAST diagram). Without a diagram it was common to see either an acute or obtuse answer or just 1 reflex angle. The most common error was 143.1 from $-36.9 + 180$.

Question 22

Just over half of the candidates were able to combine the fractions using a correct common denominator and simplify to reach the correct answer. Most chose to combine the fractions into one as their first line of working. A good number of candidates gave their final answer with the correctly expanded denominator of $6x^2 + x - 2$ but other candidates spoilt an otherwise correct answer by expanding the brackets incorrectly with $6x^2 - x - 2$ as the most common error. In quite a few cases, candidates reached the correct answer and then attempted to cancel terms resulting in the loss of the final mark. Most candidates simplified the numerator correctly to $22x + 3$ after showing a correct step of $5(2x-1) + 4(3x+2)$. This was usually shown over the correct common denominator, although some candidates omitted the brackets in the denominator or added the two denominators. A common mistake was in one term in the numerator the first bracket might be expanded to e.g. $10x - 1$ or in the case of the second bracket e.g. $12x + 6$. The majority knew that the common denominator was $(3x+2)(2x-1)$. A few wrote $(3x+2)+(2x-1)$. This error is in decline compared to previous years. Weaker candidates added the top line of the fractions together and then added the bottom line together, consequently a common incorrect answer was $\frac{9}{5x+1}$.

Question 23

This question was well done by about a third of candidates but caused difficulties for most, more than half scored no marks. Part marks, especially 2 marks were rare. Of those who did not score 3 marks, many struggled with the first step and it was quite common to see $\frac{3}{5} + p = \frac{1}{10}$ either leading to a negative probability or more frequently solved incorrectly to give $p = \frac{1}{2}$. It would be helpful if candidates were able to annotate their work so that it is clear what they think each probability is. If they were to do this, stating that the probability that Ben picks yellow is $\frac{x}{y}$, then they are more likely to score the second method mark with the multiplication $\frac{2}{5}\times\left(1-\frac{x}{y}\right)$. Those that did the first step correctly sometimes continued by using $\frac{3}{5}$ as the probability of Anna picking red thus losing the second method mark. A common wrong method was based on the assumption that the probability of Ben picking yellow is $\frac{9}{10}$ giving an answer of $\frac{9}{25}$ (from $\frac{9}{10}\times\frac{2}{5}$). This may have been caused by misreading or misunderstanding and thinking that the probability of Anna and Ben each picking yellow is $\frac{1}{10}$. Another common incorrect starting point was $\frac{2}{5}\times p=\frac{1}{10}$ instead of $\frac{3}{5}\times p=\frac{1}{10}$ or thinking that probabilities needed to be doubled, e.g. $2\left(\frac{3}{5}\times p\right)=\frac{1}{10}$ Many candidates showed probabilities greater than 1 or occasionally less than 0 in their working or as their answer. Tree diagrams were seen sometimes and when used correctly seemed to help candidates in their analysis of the question.

MATHEMATICS

Paper 0980/32
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. The paper was quite demanding although most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown continues to improve and was generally good. Candidates should realise that in a multi-level problem solving question the working needs to be clearly and comprehensively set out, particularly when done in stages. Centres should also 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. 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. Candidates should also be reminded to write digits clearly and distinctly. Candidates should use correct time notation for answers involving time or a time interval.

Comments on specific questions

Question 1

(a) Most candidates answered this question correctly. Common errors included incorrect place values such as 30 003, 3 000 003, and the omission of the final 3.

(b) (i) Most candidates answered this question correctly. Common errors included 15 000, 15 900 and 16.

(ii) Most candidates answered this question correctly. Common errors included 16 000, 15 890 and 90.

(c) This part on estimation and rounding proved more difficult for many candidates. Few appreciated, or were unable to follow, the instruction given to write each number in the calculation correct to 1 significant figure, with the majority simply using a calculator to work out the exact answer, or rounding to 1 decimal place. Rounding errors included 29, 5.5 or 6, 0.4 or 0 or 1, and 0.9.

(d) . This part on use of a calculator and understanding mathematical notation was generally well answered. There were very few errors on **part (i)**, common errors on part **(ii)** included 5, 1, 0, 5^0, 5^{-1}, 5^1 and $\frac{1}{5}$. There were more errors on **part (iii)** with the two very common errors of 0.17 coming from $5\sin\frac{22}{11}$ and 1.77 coming from 5sin30 – 8 ÷ 11.

(e) (i) This part proved to be quite challenging for a number of candidates and proved to be a good discriminator. Whilst many candidates correctly used the relevant time/distance/speed formula many did not appreciate the different units given in the question. The most effective and successful method used was $\frac{5270}{8.5} = 620$ s, which was then usually correctly converted to the form required of 10 min 20 s. The most common method was $\frac{5.27}{8.5}$ which was rarely correctly converted. A significant number were unable to correctly convert a time in seconds to the required time in minutes and seconds, for example $\frac{620}{60}$ = 10.33 = 10 min 33 s.

(ii) This part on percentage increase also proved to be quite challenging for a good number of candidates. Common errors included $\frac{8.5}{10.2}$ leading to 83%, 10.2 – 8.5 leading to 1.7 or 17%, $\frac{1.7}{10.2}$ leading to 0.16 or 16%.

Question 2

(a) (i) This part on using the table and completing the bar chart was generally very well answered with a good number of candidates scoring full marks. Common errors included a variety of frequencies for 5 letters, possibly by not using the given value of 61, leaving this value blank, and incorrectly drawing the bar for 2 letters, often with a height of 14.

(ii) This part on finding the mode was generally answered very well. Common errors included 15, giving the median, the largest number, and calculating the mean value.

(b) (i) This part on finding the mean from a grouped frequency table caused more problems, although some excellent answers with full working were seen. Common method errors included 50 ÷ 6, 50 ÷ 21, 21 ÷ 6, 134 ÷ 6 and 134 ÷ 61.

(ii) This part on finding a probability was generally poorly answered with few correct answers seen. Common errors included $\frac{3}{6}$, $\frac{22}{50}$ and 13.

(c) (i) Common errors in this part included using the middle numbers of the unordered list, answers of 3 and 4, incorrect use of a calculator giving $\frac{3+4}{2} = 3 + \frac{4}{2} = 5$, and calculating the mean value.

(ii) This part on finding the range was generally answered very well.

Question 3

(a) (i) The majority plotted the correct points and joined them with a ruled line. However, a significant number did not realise they only needed to plot (0, 0) and (50, 540) to create a fit for purpose conversion graph, and found many intermediate points; some of which were plotted slightly inaccurately so the line became fragmented rather than a smooth straight line. Some of these plotted points were joined freehand or not joined at all. Other common errors included drawing a line joining two incorrect points plotted at (0, 540) and (50, 0), plotting the single point (50, 540) with no line or with a horizontal and/or vertical from the axes to it, and drawing a line towards (0, 0) but their line did not quite reach the origin.

(ii) The large majority of candidates used the given exchange rate to calculate the correct exact answer. Only a very few attempted to use their conversion graph were slightly out and gained partial credit. A few gave the incorrect answer of 27 from dividing 1350 by 50. Others did not think about whether they should be getting a lower number of dollars than rands with answers such as 14 580 from $1350 \times \frac{540}{50}$.

(b) (i) Although some candidates were able to find the correct time many others struggled with this question. Most candidates understood they needed to add 14 hours 15 minutes to the time 21 48 and many were able to reach the correct time of 12 03. Some were confused by the 8-hour time difference and added 8 hours to their arrival time instead of subtracting 8, resulting in a common incorrect answer of 20 03. Some candidates showed a clear method and were able to score a mark for this even if arithmetic errors were made. Some candidates did not write the time in a correct notation. Those who added 14 hours and 15 minutes to the departure time by adding the digits using the decimal system often reached 35 63 and did not know how to convert this to a correct time notation, with numbers such as 36.3 seen. Other errors included, being unable to recognise the units of their answer as seconds rather than minutes and were multiplying by 60 rather than dividing, for example, dealing with '0.62' seconds as 62 minutes. Many randomly subtracted 12 hours thinking it was the same time, for example, 2003 = 0803.

(ii) This part was answered very well with a large majority calculating the correct answer. A few found the number of children instead of the number of adults or just the value of one ratio part. Common errors included $\frac{315}{7}$ or $\frac{315}{8}$.

(iii) This part was answered very well with a large majority calculating the correct answer. The most common wrong answer was 42 from not reading the question carefully and giving the unoccupied seats.

Question 4

(a) The large majority plotted both points accurately. A few candidates plotted the point (85, 41) at (80, 41). A few did not plot either of the points and seemed to not see this part of the question, which obviously affected **part (e)**.

(b) Most candidates described the correlation correctly as positive. Incorrect answers included negative and no correlation or described the trend of the points as increasing. Others described the correlation as direct or described the relationship, such as, as the amount of water increases the height increases, which was not required.

(c) Nearly all candidates correctly identified the required point.

(d) (i) Many candidates were able to draw an accurate ruled line of best fit spanning the width of the points. A misconception seemed to be that the line needs to go through the origin and join to (100, 0). Some candidates drew a line with a roughly equal number of points each side but the line did not follow the trend of the points and was not acceptable. A few candidates drew two lines joined together; appearing as a 'bent' line. Some just joined the points in order, in a zig-zag fashion. Other errors, all relatively few, included lines that were too steep, lines that were too high and lines that did not cover a wide enough width of the graph.

(ii) A large majority of candidates were able to give a value within the acceptable range. Others who had a ruled line with a positive gradient were able to score by giving an accurate value from their line of best fit. Some of the few candidates without a line of best fit, were able to give an acceptable answer, within the range, by estimating from the lie of the points.

(e) Although many fully correct answers were seen, this part caused the most problems for candidates. Some candidates did not include both of the points they had plotted and gave a calculation using 6 or, more commonly, 7 out of 17. Some included the point from **part (d)(ii)** as an extra point. Others did not understand the requirement of this part and found $\frac{17}{24}$ as a percentage. The question asked for the answer to be rounded to 1 decimal place. Some ignored this requirement and gave the answer to the nearest integer.

Question 5

(a) This part proved to be quite challenging for a number of candidates and proved to be a good discriminator. The most common answer was the correct area of 72 cm^2 from 6×12 but an incorrect perimeter of 96 cm from 6×16. Many candidates did not appreciate that the length and width of the individual rectangle had to be found.

(b) This part on finding the area of a triangle was generally answered well. Common errors included a variety of incorrect formulas often omitting the $\frac{1}{2}$ or using the value of 11.7, simply adding or multiplying the three given values, and attempting to use Pythagoras.

(c) This part on finding the radius of a circle given the circumference was generally poorly answered. Common errors included using an area formula, $\frac{28}{2}$, $\frac{28}{4}$, 28π and 14π. A significant number lost the accuracy mark through premature approximation.

(d) This part on finding the surface area of a cube given the volume was generally reasonably answered. Common errors included starting by taking the square root of 125 rather than the cube root to find the side length, 125×6, $125 \div 6$, and 125^3.

Question 6

(a) (i) This part was generally reasonably well answered. Common errors included extra incorrect vertical and horizontal lines, and a variety of incorrect names for the shape, often parallelogram.

(ii) This part was generally better answered. Common errors included an extra incorrect horizontal line, and again a variety of incorrect names for the shape, often diamond.

(b) (i)(a) 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 enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (6, 4) and (1, 2) being common errors. The scale factor also proved challenging with 2, –3 and $\frac{1}{3}$ being the common errors. A significant number gave a double transformation, usually enlargement and translation, which results in no credit. Less able candidates often attempted to use non-mathematical descriptions.

(i)(b) 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 (1, 1), and (1, 2) being common errors. The angle of rotation was sometimes omitted with 90 (with no direction) and 180 being the common errors. Again, a smaller but significant number gave a double transformation, or used non-mathematical descriptions.

(ii) This part was generally answered well with many candidates able to draw the given reflection. Common errors included drawing reflections in $y = -1$, $x = k$ and drawing the correct shape but with a vertex at (–1, 0) or (0, –1)

Question 7

(a) (i) Many correctly identified the intercept. The gradient proved to be the most challenging with many using the formula instead of using the line by using rise/run. Those that used the straight line were more successful. There were a variety of incorrect responses including $y = -2x + 3$, $y = -2x + 1.3$, $y = 2x + 3$ and $y = \frac{2}{3}x - 2$. When an equation was not attempted, just a number or sum of two numbers with no x variable shown was seen.

(ii) Many ruled the correct line with some losing the mark for inaccuracy across some of the length or for a short line. There were a variety of incorrect responses including drawing $y = -1$, $x = 1$ or a diagonal line through (0, 1).

(iii) Many stated the correct intersection point or the correct follow through point from their incorrect line, although those that drew $x = 1$ often missed the negative in the y coordinate –0.5. Common errors included (1, 2), and giving the intersection of the graph with the y-axis or x-axis.

(b) (i) The table was generally completed very well with the majority of candidates giving three correct values. There were some arithmetic errors and a common error was in substituting $x = -2$ into the given quadratic, usually resulting in a y value of –14. Candidates should be encouraged to look at the general shapes of different groups of graphs as the majority followed through their errors to plotting, not realising that this could not possibly be the correct point for this quadratic graph.

(ii) Many curves were really well drawn with very little feathering or double lines seen. A few joined some or all of their points with straight lines or did not attempt to join their points in a curve. Some joined (0, –8) and (–1, –8) with a horizontal line rather than continuing the curve.

(iii) Identifying the equation of the line of symmetry was not well answered. Common errors included $y = 0.5$, $y = –0.5$, $x = 0.5$ and $y = mx + c$. Often an equation was not seen and just –0.5 alone was stated. Although not required, it may have helped candidates to draw the line of symmetry first.

(iv) This part on using the graph to solve the given equation was well answered with candidates reading the values off accurately from their curve, using the intercept values from the x-axis. Common errors included misreading of the scale, and omission of the negative sign. A significant number were unable to attempt this part. A small yet significant number of candidates tried to solve the equation algebraically, which was not the required method and is beyond the syllabus for core, and this was rarely successful.

Question 8

(a) . This was generally well answered with the majority gaining full credit. A common error was $56 + 38 = 94$, and there were a small number of arithmetic slips.

(b) This was a well answered question with the majority gaining full credit. One successful strategy often seen was to re-write the question, grouping the a values and b values together. Common errors included $5a – 11b$, $5a + 11b$, $a – 3b$, $a + 11b$, and $5a + –3b$, $10a^2b^2$, $6a^2 + 28b^2$ and $11b – a$.

(c) Generally well answered with the majority able to expand the given bracket correctly. Common errors included $–5x$, $10x – 6y$, $10x + 15y$, $25xy$, $10xy$, $10x–15$, $10–15y$, 40 and 10.

(d) Candidates demonstrated good algebra skills dealing with this equation with the majority able to make the correct first step of transposing the like terms to reach $2x = 20$. Common errors included incorrect first steps of $5x + 3x = 19 + 1$ and $5x – 3x = 19 – 1$, and incorrect second steps such as, $x = 2 – 20$, $x = \dfrac{20}{-2}$ or $x = \dfrac{20}{8}$.

(e) Although steps of working were often clearly set out, many candidates found this part a challenge. It was common for –3 to be dealt with incorrectly resulting in $\dfrac{p-3}{5}$ being a common answer. Some attempted to divide by 5 first but this was rarely successful. Other common errors included incorrect first steps of $5t = 3 – p$, $5t = –p – 3$ and $\dfrac{p}{5} = t – 3$. Some did not cope well with the required unknown being on the right-hand side of the equation and others attempted to find a numerical solution.

(f) The majority of candidates had the mathematical knowledge and skills to gain some credit with a significant number gaining full marks. Most were able to set up the correct two equations. A few missed a mark due to writing $3x + 5y = 23$ instead of 23.50 and the common follow through answer was $x = 6$ and $y = 1$. The most common and successful method was to equate one set of coefficients and then use the elimination method, and the majority showed full and clear working for this. It was less common to see a rearrangement and substitution method which is where more algebraic mistakes occur. Whilst many followed a correct elimination method some made numerical slips or mixed up addition and subtraction. The most common errors came from mistakes occurring when subtracting one equation from the other and when dealing with negative numbers.

Question 9

(a) (i) This part was generally answered very well with many candidates having no difficulty in giving the next term as 26.

(ii) This part was generally answered very well with many candidates able to give the correct term to term rule. Common errors included 6, $n + 6$ and $6n – 4$.

(iii) This part was generally answered very well with many candidates able to state the correct nth term. Common errors included $n + 6$, $6n + 2$, and $4n – 6$.

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(b) (i) Many candidates were able to give the correct three terms, a few only getting two out of three terms correct. Common errors included 5 10 15, 6 41 1686, and 9 69 201 by using the first 3 terms of the sequence in **part 9(a)**.

(ii) This part proved to be quite challenging for a number of candidates and proved to be a good discriminator. More able candidates attempted to use the method of differences but with limited success. Few appreciated the connection with the previous part which would give $n^2 + 5 + 1 = n^2 + 6$. Common errors included a variety of linear expressions, ‘next odd number’, with a significant number unable to attempt this part.

MATHEMATICS

Paper 0980/42
Paper 42 (Extended)

Key messages

To be successful in this paper, candidates should be prepared to demonstrate their knowledge of the extended syllabus. This includes the ability to recall and apply formulae and mathematical facts in a variety of situations, as well as the ability to interpret problem solving and unstructured questions. Candidates should also write their work clearly and concisely, with answers that are accurate to the appropriate level.

Candidates should write all numbers clearly and legibly. This is important because the Examiner may not be able to read illegible numbers, and therefore may not be able to give credit for the answer.

If a candidate wishes to amend an answer, it is best practice to clearly delete the first attempt and replace it completely. Overwriting one or more digits may make the answer even more difficult to read. Candidates should also show full working with their answers. This will help the Examiner to understand how the answer was arrived at, even if the answer is incorrect. This may result in method marks being awarded.

General comments

The paper was generally found to be more challenging than last year, with candidates scoring across the full mark range. This suggests that the paper was well-designed to test a wide range of skills and knowledge.

Many candidates demonstrated a strong understanding of the content and showed excellent problem-solving skills. Several of which scored more than 100 marks on the paper. A small number of candidates were inappropriately entered at extended tier and struggled to access some of the questions. However, the majority of candidates had the mathematical skills to cope with most of the demands of this paper.

The majority of solutions were well-structured and clear, with methods shown in the space provided. However, it is worth noting that some candidates did not provide full working. In most cases, correct answers will be sufficient to award method marks. However, if the answer is not correct to at least three significant figures, then the method must be shown in order to receive marks.

While most candidates appeared to have sufficient time to complete the paper, some omissions occurred. These were most likely due to lack of familiarity with the topic or difficulty with the question rather than a time constrain. To avoid losing unnecessary accuracy marks, it is important to keep track of significant figures and to avoid approximating values in the middle of a calculation.

The topics that were found to be accessible were: Working with ratio and percentages, compound interest, drawing a cumulative frequency curve, finding an estimate for the mean from a grouped frequency table, use of sine and cosine rules, solving simple geometry questions, expanding a set of three brackets and currency conversion.

In contrast, the more challenging topics included: Converting units of a volume, harder combined probability, completion of a calculus question and working with expressions involving fractional indices.

Comments on specific questions

Question 1

(a) This part was very well answered. There were two common errors. A very small number of candidates worked out 180 – 42 and stopped whilst a few processed this by correct division of 2 leaving their answer as 69°.

(b) This proved straightforward for most candidates with a clear linking of the correct ratio to 360°. A minority of candidates did not use 360° for the number of degrees at the point.

(c) The most common approach was for candidates to firstly work out the sum of the interior angles in the hexagon. There were some very concise solutions from this point with candidates stating d = 72, h = 120 then forming a correct fraction. A number of candidates did not simplify the fraction. For many candidates there were a number of common errors in working out the values of d and h, these included giving h as (6 – 2) × 180 = 720 or 360 ÷ 6 = 60 and giving d as 180 – (360 ÷ 5) = 108.

(d) A fully correct approach to this question was seen in a small number of responses. In order to prove that the quadrilateral was cyclic candidates needed to use all 4 angles in the given diagram to form an equation with a total of 360. This equation was usually solved correctly to get 55. At this point a significant proportion of candidates gained no further credit. Candidates who demonstrated that opposite angles added to 180 often did not state the geometrical property 'opposite angles sum to 180'. Many candidates formed one or sometimes two equations after assuming the quadrilateral was cyclic rather than showing that it was e.g. $x + 3x - 40 = 180$ and/or $x + 20 + 2x - 5 = 180$.

(e) The majority of candidates accurately substituted into a correct formula for arc length. Some candidates incorrectly used an area formula. A number found the arc length for the minor sector. Candidates should use either 3.142 or the value of π from their calculator to ensure that their answer falls into the required accuracy range.

Question 2

(a) The most common approach was for candidates to change $830 to euros and then subtract the 500 euro spending. Some candidates found it difficult to process the three given pieces of information. This question part required candidates to retain accuracy in their intermediate calculations which many did.

(b) (i) This part was done will although a significant proportion of candidates calculated the percentage of his earnings he did **not** spend on bills.

(ii) This question part was done well. Some just gave the percentage increase and a few gave an inaccurate final answer by rounding the correct value to three significant figures. In cases where the answer is an exact value then it should not be rounded.

(c) (i) The majority of candidates gave a correct method to work out the total amount after compound interest. The majority made the error not take the further step to calculate the interest that was required in the question. A very small number of candidates used simple interest or wrote 1.024 per cent in their method and then gave an inaccurate answer. To earn the method marks candidates either need to show a correct value to at least three significant figures leading from 1.024 per cent or to show an understanding of how to calculate with 1.024 per cent e.g. write $\frac{100 + 2.4}{100}$ within their written method. A few candidates used a year by year approach which is not efficient and usually leads to inaccuracies when rounding intermediate values.

(ii) This was well answered with candidates either going straight to the solution or showing a value associated with 15 or 16 years. Some candidates did not take account of the request to find the number of complete years and gave an answer of 15 years. A small number of candidates used a simple interest approach.

Question 3

(a) (i) Most candidates wrote down a correct expression for the area of the right-angled triangle, using $\frac{1}{2}$ × base × height, in terms of the given lengths. A few used $\frac{1}{2}ab\sin C$ with $C = 90°$ and, in both cases, virtually all candidates put their expression equal to 60. A few candidates started with an attempt to factorise the given equation. Almost all candidates multiplied out $(x + 3)(2x + 5)$ correctly but some omitted brackets giving $\frac{1}{2} \times 2x^2 + 6x + 5x + 15 = 60$ for example, and although this was usually corrected at the next step this was classed as an error/omission in the method. Candidates who cleared the fractions before this step almost always went on to complete the question correctly. A small number of candidates wrote down a line that was not an equation, usually by omitting = 0 and were not awarded full marks.

(ii) Many candidates attempted factorisation, as required, although a substantial number solved the equation using the quadratic formula and were not awarded method marks. Where factorisation was attempted, this was usually done correctly although in some cases candidates produced factors such as $(2x - 10)(x + 10.5)$. Some gave partial factors, usually $2x(x - 5) + 21(x - 5)$, as a first step, and generally went on the give the correct answers The expression $(x + 10.5)(x - 5)$ was not accepted as a genuine attempt at factorisation of the given equation.

(iii) Many candidates used the positive answer to the previous part to give the correct values for *AB* and *AC*. Most then used right-angled triangle trigonometry, usually with tan *ABC*, to find the required angle. A small number of candidates incorrectly gave tan *ABC* = . and other used Pythagoras' to calculate *BC* and then used this with either sin or cosine or occasionally the cosine rule, to complete the question. A few candidates did not pick up on the connection with the previous part and attempted to find angle *ABC* by using *AB* and *AC* in their algebraic form.

(b) (i) Some candidates round this quite difficult and quite a number did not offer a response. Those who used the answer to the previous part and the angle sum of a triangle usually gave a correct answer but a few did not give their answer to at least 1 decimal place. A small number used a similar method to the one that was used in the previous part such as tan $ABC = \frac{15}{8}$ and usually gave the correct answer. Many candidates thought that the angle in triangle *DEF* should be an enlargement of the angle in triangle *ABC* and attempted to use $\sqrt{\frac{93.75}{60}}$ or $\frac{93.75}{60}$ as a scale factor with the angle 28.1°.

(ii) Many candidates identified the correct area scale factor as $\sqrt{\frac{93.75}{60}}$ and went on to give the correct answer. Some used this factor incorrectly. The most common error was to use the linear scale factor, $\frac{93.75}{60}$ leading to an incorrect answer of 12.5. There were a number of candidates who did not offer a response.

Question 4

(a) (i) A small majority of candidates wrote down the correct interval containing the median. Many candidates assumed that the middle interval would contain the median and gave $1.5 < h \leqslant 1.65$. A very small number gave one of the other given intervals or 1.2 to 1.9.

(ii) Candidates usually scored full marks confidently working with midpoints and frequencies. A small proportion of candidates used the incorrect approach of multiplying the group widths by the frequencies and a few multiplied one the endpoints of the intervals by the frequencies. The midpoints of the intervals $1.5 < h \leqslant 1.65$ and $1.65 < h \leqslant 1.8$ were a little more difficult to calculate and some candidates only gave the rounded values for these two midpoints. A very small number of candidates added the midpoints. Most candidates set the work out carefully and carried out the calculations accurately.

(b) (i) Almost all candidates gave the correct probability A very small number of candidates used the first two intervals and gave an answer of $\frac{15}{80}$.

(ii) Candidates found this probability question very challenging with most unable to identify the correct intervals to use or to appreciate that the children could be chosen in either order. For many candidates the difficulty was in making the distinction between the 56 children up to 1.8 m and the 9 over 1.8 m, with 65 occurring as the most common wrong number in calculations. Many candidates wrote down one of the four probabilities involved in the solution; usually $\frac{9}{80}$ or $\frac{9}{79}$

(c) (i) Most candidates completed the cumulative frequency table correctly. A small number of candidates used the frequencies given in the table at the start of the question.

(ii) Some candidates incorrectly drew blocks but most candidates plotted the points correctly, using the right-hand ends of the intervals. A very small number plotted (1.4, 2) at (1.4, 4) or the point (1.65, 39) at (1.6, 39). Most candidates produced a reasonable curve or, in some cases, joined the points with line segments either of which is acceptable.

(d) (i) Many candidates used their graph to find accurate values for the upper and lower quartiles which were used to give the interquartile range. A few candidates used a cumulative frequency value of 40 and gave the median.

(ii) Many candidates used their graph to find the 60^{th} percentile Some candidates did not give the working to find 60 per cent of 80 and could not be given any credit for an inaccurate reading. Some candidates correctly calculated 60 per cent of 80 as 48 but did not give the value from the graph for the 60^{th} percentile but they gained partial credit for showing 48.

Question 5

(a) (i) This was well answered. The most common error was to use 8 cm as the radius in the volume formula for the cone. A small number used a value for π or 3.14 or $\frac{22}{7}$ and it should be noted that candidates who use these values will not score full marks as the final answer will be outside the acceptable range.

(ii) This proved more challenging as it required combining several areas of content and an initial step of using Pythagoras' to calculate the slant height of the cone. The most common error in finding the curved surface area of the cone was to use a slant height of 15 or 17 from $\sqrt{8^2+15^2}$. Other common errors included using 2 × π × 4 for the area of the circular base or losing accuracy by rounding the values before the percentage calculation.

(b) (i) Many candidates were able to gain partial credit by dividing the number of litres by the rate, but fewer were able to work in consistent units to get to 800 seconds. There were also issues for many when trying to convert 800 seconds to minutes and seconds with 13 mins 33 seconds being a common incorrect answer.

(ii) Candidates found this part very difficult and a minority were successful in gaining full marks. There were a number of errors the first of which was working with consistent units. A number used an incorrect formula for the volume of the cylinder when setting up an equation to find the height. Of those using a correct method, a significant number gave a two significant figure answer of 0.47 when at least three figures are required.

Question 6

(a) (i) This was generally very well answered. Most followed the requirement to give the terms as fractions. Common errors included giving decimal answer for which partial credit was available if they were given to at least three significant figures when not exact decimals and many did not give the degree of accuracy. Some were unable to substitute correctly into the expression given for the *n*th term of the sequence.

(ii) This was well-answered and most were able to set up the correct equation and solve it to find k. A few were able to show $\frac{k}{2k+3}=\frac{12}{25}$ but then made errors in solving the equation when removing the denominators. Some used trials and this was less successful.

(b) (i) Many were successful in recognising that the required expression was a cubic with almost all candidates using differences between the terms to establish this. Those that recognised a cubic sequence usually gave the correct answer. The most common error was to give a quadratic expression having used the difference approach e.g. $n^2 + 6$ or $6n^2$.

(ii) Many candidates recognised that this was a geometric sequence with a common ratio of $\frac{1}{2}$ And many were able to express the algebraic position to term relationship correctly there were a diverse number of correct acceptable answers seen here. Candidates who did not recognise the geometric nature of the sequence and who tried to work with a common difference approach were not successful in this part.

Question 7

(a) The most common method used to answer this question successfully was to identify angle *CAB* as 52° and then to use the sine rule to find angle *ABC*. The required angle *ACB* was then calculated using angles in a triangle. Many candidates who used the sine rule correctly used the 3 significant figure value of 32.9 to work out angle *ACB* as 95.1. To gain full credit they were required to use at least 4 significant figures leading to the more accurate answer of angle *ACB* = 95.08… which shows that 95.1° is correct to 1 decimal place. An alternative method that was also used successfully was to draw a perpendicular from *C* to *AB* to create two right-angled triangles with height 60 sin 52 which could then be used to find either angle in the right-hand triangle. Some candidates used the given angle of 95.1 to find *AB* and then used a circular argument to return to the given 95.1 which is not acceptable.

(b) Many candidates were able to use either the sine or cosine rule correctly to find the length *AB* leading to the correct total length of the journey of 257 km. Most candidates understood that they needed to divide the total distance by the total time to find the average speed, but not all used a correct value for the time. The time was given as 3 hours 20 minutes and an accurate value such as $\frac{10}{3}$ should be used in the speed calculation. The incorrect conversion of 3.20 was common or inaccurate conversions of 3.3 or 3.33 were often seen leading to an inaccurate final answer. Some candidates converted the time to 200 minutes to find a speed in km/min which was sometimes correctly converted to km/h as required by the question. Candidates who used the total distance as 60 + 87 = 147 did not gain any credit.

Question 8

(a) (i) Many candidates showed correct working in this part leading to the required result although some lost the accuracy mark due to slips in signs or omission of powers at some stage. They usually multiplied one pair of brackets out correctly and often simplified the result to a 3-term expression which simplified the second product. Terms were usually collected correctly. Work was sometimes poorly presented with missing brackets after the first stage, for example $x^2 + x - 4x - 4(x-2)$: despite this error, candidates usually multiplied all terms by $(x-2)$ and reached the correct result. A few candidates attempted to multiply all three brackets as a single step which was not successful.

(ii) When a question asks for a sketch graph, candidates are not expected to produce a table of results and plot points which a number attempted to do. The most successful responses were from those candidates that used **part (a)(i)** to identify the key points of the graph and who knew the shape of a positive cubic graph. The factorised equation given in **part (a)(i)** $y = (x-4)(x+1)(x-2)$ can be used to identify the *x*-intercepts as –1, 2 and 4. The expanded equation $y = x^3 - 5x^2 + 2x + 8$ can be used to identify the *y*-intercept as 8. A positive cubic graph can then be sketched passing through these points and the appropriate values marked on the axes. Many candidates were able to show a positive cubic graph, but often the intercepts were not labelled. In some cases, the curvature was incorrect usually curving back to indicate another maximum or minimum. Some candidates attempted to find the coordinates of the turning points in this part which was not required.

(b) Many candidates understood that they were required to differentiate the function and this was often done correctly. Those that then equated the derivative to 10 often went on to find the two required points which usually led to the correct two equations. Some candidates made errors when finding the constant for the second equation $y = 10x + \frac{292}{27}$ because of arithmetic or accuracy errors. A common error was to equate the derivative to 0 rather than to 10. Those candidates who understood that as the tangents had gradient 10, their final answer should be two equations of the form $y = 10x + c$ often gained the final B1 for an answer of this form even when the work leading to it had been incorrect.

Question 9

(a) (i) The majority of candidates found this part relatively straightforward and obtained all three marks. Some obtained partial marks by dealing correctly with the indices for x and y but frequently giving a coefficient 3 or 9. Other candidates added the indices for x and y rather than multiplying and scored 0.

(ii) This was a much more challenging indices question. Only the stronger candidates were able to succeed fully. Many candidates did earn one or two marks either by a correct first step or having parts of the answer correct e.g. $\frac{64^{-1}}{x^{-24}y^{-12}}$ scored two marks. A fraction with a negative fractional power was simply too challenging for many candidates.

(b) (i) Almost all candidates factorised correctly.

(ii) Where candidates were able to factorise in pairs they were able to complete this successfully. The candidates who only reached for example $2y(x – 3)+ 5(x – 3)$ and then cancelled out one of the brackets with the numerator thus leaving an answer of $\frac{(x+3)}{(2y(x-3)+5)}$ or similar were awarded one park for a correct partial factorisation. A few weaker candidates cancelled out individual terms before even trying to factorise.

(c) This quite challenging question was generally well done. Candidates were well practised in obtaining a quadratic equation in one variable by eliminating the other variable. In this case the most efficient approach was to eliminate y. The few candidates who eliminated x rarely obtained a correct equation in y. Most candidates showed correct use of the formula and went on to give correct solutions. Quite a number of candidates lost two method marks however by not showing their working simply giving answers to the quadratic from their calculator. There were a number of candidates that lost accuracy with answers and gave solutions correct to one decimal place.

Question 10

(a) Most candidates recognised the need to use Pythagoras' and many went on to score full marks showing a complete method usually in two stages. Most candidates gained a method mark for using Pythagoras with the values 28 cm and 20 cm, finding AC = 19.59 cm, and this was given as the final answer in many cases. Those who went on to consider the full method and obtained $2x^2 = 19.59^2$ often simplified it incorrectly to $2x = 19.59$ leading to a final answer of 9.8.

(b) A small number of candidates scored full marks in this part. An error made by some was to try to find the angle MRK. For those who attempted to find the required angle, a number attempted longer more complex trigonometrical methods than the concise method using sine. In particular, those who calculated the length RK and used the cosine formula made the question unnecessarily more complicated. The majority used a correct trigonometric method did not recognise the correct combination of the bounds that gave the lower bound of the required angle. The common error for those using sine was to use both lower bounds, $\frac{29.5}{36.5}$. Most gained partial credit for using a correct trig method with incorrect bounds or with the values given in the question.