MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed with this paper, candidates need to have completed the full Core syllabus. Candidates are reminded of the need to read the questions carefully, focussing on instructions and key words. Candidates also need to check that their answers are accurate, are in the correct form and make sense in the context.

General comments

There were a considerable number of questions that were standard processes and these questions proved to be generally well understood and, in most cases, there did not seem to be confusion about what was being asked. Other questions were more testing, for example the problem-solving aspect of questions such as **Questions 3**, **10** and **21**. Many candidates showed some working with the more able candidates setting their work out clearly and neatly. Some candidates did not show any working before they gave an answer.

When calculations of two or more steps are needed, it is best if each step is shown separately for candidates' checking their own work and for method marks to be awarded. This is particularly important with problem-solving questions and vital for those that explicitly say to show all your working.

The questions that presented least difficulty were **Questions 1**, **2(a)**, **3**, **15** and **25(a)**. Those that proved to be the most challenging were **Questions 4** name a specific shape, **12(a)** give a geometric reason, **18** find limits of length and **24(b)** understanding set notation.

Comments on specific questions

Question 1

This opening question was the best answered question on the paper. A very small number of candidates gave their answer as 72 or 120 months in 5 years.

Question 2

(a) Many candidates gave a correct answer. Some gave their answer as 52 or 3700 which is a truncation or 3800, the number corrected to the nearest 100. A few changed the position of the decimal point to give answers such as 37.52.

(b) This question was slightly less well answered with answers of 752 or 3700 (a truncation again) given.

Question 3

This was a slightly different way to ask a question with candidates being required to fill the spaces with numbers and many were successful. Some wrote 4.4 which in this context of number of magazines is not correct. Many candidates who gave incorrect answers of 3 or 6 knew that this first number had to be an integer. The money left over had to be less than $3.40 or one more magazine could be bought. Many who wrote 4 magazines also calculated the change correctly.

Question 4

This question required the candidates to visualise 4-sided shapes to work out which one fitted the given criteria. It would have been a good idea to sketch out some shapes to check for symmetry – not many diagrams were seen. Some gave names of other quadrilaterals (including quadrilateral itself) as well as 3D shapes (cube) and other polygons (pentagon or hexagon). The difficulty level of this question was raised as candidates were not given names of quadrilaterals to choose from.

Question 5

This question was generally well answered with other candidates giving the mode (8), the median (19) or the middle of the unordered list (3). Some added all the numbers and correctly got to 180 but then divided by 2 instead of 9. A few made arithmetic errors when adding. Writing + signs between the digits then ÷ 9 is not enough for the method mark without brackets around the numbers to be added.

Question 6

Often the correct method was seen in logical working. Sometimes there were arithmetic slips in dealing with the fact that the journey finished the next day so answers of 5:15 am or 7:15 am were seen. Others left their answer as 29 75 without going further. Occasionally, the correct time was seen then the candidate gave either 6:15 pm or 18 15 as the answer. The workings for a few candidates seem to infer that they thought there are 100 minutes in one hour.

Question 7

This ordering question had two numbers very close to one another and frequently candidates did not check to enough digits to determine the order; $\frac{15}{213}$ has to be written to at least 0.0704… to be able to write it in the correct place. Many candidates were able to gain credit for writing 3 of the numbers in the correct places relative to each other. Many chose 7% as the largest number rather than the smallest.

Question 8

Most candidates cancelled the fraction by 2 or 6. This was not far enough to write the fraction in its simplest form. A few candidates gave a decimal answer.

Question 9

This was answered reasonably well with many gaining partial or full credit. The term $-11b$ was found more challenging (this was often give as $-1b$) than the first term. Most problems stemmed from misunderstanding that subtraction signs only affect the number that immediately follows. Some candidates chose to combine these terms together into one, or, occasionally, the terms became squared.

Question 10

Only the candidates who showed their workings clearly and logically reached the correct answer as many gave an incorrect number of hours without any working to support it. Only if candidates substituted 36.5 correctly and made the correct first step in solving this equation, could they access the method mark. Many added together all 3 numbers (52) or just added 12 and 3.5 and ignored the 36.5 entirely.

Question 11

This was a 2-stage vector question that was generally not well answered. One difficulty was that to start working this out, first **b** had to be multiplied by 2 then subtracted from **a**, using the order of operation for numbers and algebra.

Question 12

(a) Candidates found it challenging to give the correct geometric reason. Many knew that *x* did in fact equal 52° but gave a partly correct reason or chose an incorrect reason. Z angles is not accepted as this is the shape that is made with the parallel lines and not the proper reason – alternate angles. Others gave corresponding angles, which is a geometric reason but not for this situation or gave parallel angles which is not a geometric reason. It is important that the reasons are learnt along with suitable diagrams.

(b) Many correctly gave the value of *y*. Some made arithmetic slips when performing the calculation. The incorrect reasons often included a comment about there being 360° in a circle or angles sum to 360° instead of, angles at a point sum to 360°. Some gave 16° as they subtracted 180° and gave angles on a straight line add to 180° as their reason.

Question 13

Only a minority of candidates gave a correct answer. Some substituted the diameter given in the question instead of the radius. Some multiplied the diameter value by 2 before substituting. Others rounded $\frac{4}{3}$ to 1.3 before putting the calculation into their calculators. Others did not include the fraction in the calculation and so gave 43.4 as their answer even though they had correctly written the full calculation down.

Question 14

This is a question that many misunderstood even though this sort of question has been asked before. The instruction to round each number correct to 1 significant figure was frequently ignored as candidates put the given numbers into their calculators and rounded the final answer to 1 significant figure. All stages of the calculation had to be seen before credit could be awarded.

Question 15

Many candidates correctly added all the probabilities in the table and most went on to work out the final entry for the probability of yellow paint. A few treated this as a sequence so answers of 0.135 or 0.23 were seen. Some, when adding, used 0.03 instead of 0.3 and so gave 0.49 as the answer. A few made arithmetic slips but if they showed their working, they could be awarded a method mark. A very small number gave an answer greater then 1 showing that they had not understood the context of the question.

Question 16

Many candidates partially factorised the expression correctly. To gain full credit all factors needed to be in front of the correct bracket. Some correctly factorised then went on to do further work. Some combined the terms to give answers such as $-12x$ or $160x^3$.

Question 17

(a) There were some fully correct answers and others had two of the three terms correct. Some started with $n = 0$, (10, 9, 6). Others did not know what should be substituted for *n*. Answers such as 2, 4, 6 or 10, 20, 30 or 20, 30, 40 or 10, 100, 1000 were given.

(b) Finding the *n*th term of a linear sequence is a more familiar question than that of **part (a)**. Some candidates can find this syllabus content challenging. Some may have felt that this was connected with the previous non-linear sequence and felt they did not know where to start, as there were many blank responses for this question, or they gave answers including n^2. Some found the common difference but were unsure what to do next; answers of 3, $3n$, $3n + 7$ were all seen. A few candidates thought the *n*th term meant 9th term so gave 31 as their answer.

Question 18

This area of the syllabus is often found to be challenging for many candidates. Also the length of piece of wood, *l*, was given in metres but the extra information to find the limits was given in centimetres. The answer line used *l*, so the limits were expected to be in metres not centimetres. There were two types of incorrect answers, those who did not understand the notation of limits and so gave answers such as $3.6 \leqslant l < 10$ and those who tried to find a lower and upper figure that made some sense in the scenario, for example, $3.1 \leqslant l < 4.1$ or $3.5 \leqslant l < 3.7$.

Question 19

Many candidates gave 15625, the value on the calculator display, as their final answer. This needed to be written in standard form and often this second stage was not attempted. Of those that did try to change the form, some had more that one figure before the decimal point or rounded the digits instead of giving all five.

Question 20

Two steps had to be taken to get fractions in a form to multiply. The mixed number must be turned into an improper fraction and the second inverted to give a multiplication sum. Once the single fraction result is found, this needed turning into a mixed number. Many candidates had difficulties with one or more of these stages, with many omitting the last stage. All working had to be clearly shown for marks to be awarded. Often workings were not set out in a logical manner or had numbers and mathematical operators overwritten. Workings and answers must be fractions and not converted to decimals.

Question 21

This problem-solving question combined geometry and algebra. There was one piece of information that was not explicitly given to candidates, that the angles of a triangle add to 180°. The question gave the instruction to write down an equation. Some did this then went on to show clear working to find *x* correctly. Candidates often did not do this and chose values for *x* to find the two angles by trial and error and some did find that *x* equalled 13. Candidates that used this method to get 13 without first showing an equation were awarded only partial credit as they did not follow the instructions. Candidates should check whether they are asked to find the angles of the triangle or the unknown value.

Question 22

In general, this question was not answered particularly well. Some gave answers showing no working or working that did not involve trigonometry. Some used Pythagoras' theorem to find the hypotenuse and then did not go on to find the value for *y*. Those that did use tangent were invariably totally correct.

Question 23

This question needed a correct proportion statement about the sides in the two triangles. The frequent incorrect response was 6.5 from finding the difference between 8.1 and 7.2 and adding that to 5.6 for *h*. Looking at the triangles, *h* needs to be larger than 5.6 and smaller than 8.1 so if candidates had thought about the context they should have realised that answers of 9.7 or 4.48 were incorrect.

Question 24

(a) Many candidates correctly answered this part or only made a small error so that they still could be awarded partial credit. Others wrote letters only in the crescent shaped parts of the diagram instead of putting the a and c in the intersection of the two sets. Some were correct with the elements of sets *F* and *B* (and the intersection) but also wrote all the letters in the outer area.

(b) Many candidates were unsure of the meaning of this set notation as many answer lines were left blank. If this question was attempted, the candidates gave lists of elements, for example, f, a, c, e, b, k or a, c.

Question 25

(a) This part was well answered by a large majority of candidates. Some gave the answer 7*ac*, showing a misunderstanding about combining like terms. Also, this answer shows a lack of thought about the context of the question.

(b) Some candidates used the example given in the previous part to write $6a + 5c$ with or without '= 65'.

(c) Those who correctly answered the first two parts understood what to do in this part and went on to find the value of *a* and *c*. Some found the correct values for *a* and *c* by using trials rather than solving simultaneous equations. To eliminate one variable, the quickest method is to multiply the first equation by 2 then *a* can be eliminated. There are other methods that all work if candidates are careful with their manipulation. There is a way to check the answers are correct by substituting the values in the equation that they did not use to find the second value – this is rarely done but it might make some go over their work to find where they had made any errors. Candidates needed to keep the scenario in mind. The letters *a* and *c* stand for a numerical value of the cost of tickets to the cinema so both values must be positive – the occasional negative answer was seen.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/12
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 0580/13
Paper 13 (Core)

Key messages

It is vital to cover the whole syllabus in the preparation of candidates for the examination.

Premature rounding in calculations should be avoided.

Work should be presented clearly and logically, making it clear which is the final answer.

General comments

While many candidates did attempt to answer the given questions, a significant number did not read the questions carefully. When a question asks for the answer as a decimal, credit is not given for a fractional answer.

Some candidates did not show working.

Some candidates did not show any, or clear, use of rulers where necessary. The need to use a pencil for diagrams should be emphasised.

Comments on specific questions

Question 1

Many correct answers were seen. Of those who did not write the correct number, common answers were 30, 92 or 920.

Question 2

Many candidates were able to give an equivalent fraction to $\frac{7}{9}$ although several gave the reciprocal.

Question 3

Most candidates answered this question correctly. 6 was a common incorrect answer from an incorrect order of operations.

Question 4

This was generally well answered by most candidates although some wrote $\frac{23}{30}$ or $\frac{7}{30}$. Some did not write a frequency or had counted the tallies incorrectly.

Question 5

(a) Many correct answers were seen. The common errors were answers of 1 or 4.

(b) Many candidates were able to draw the correct lines and gain full credit. Several incorrectly drew 4 lines of symmetry (diagonals with a vertical and horizontal line), whilst some drew no lines of symmetry at all. Some candidates shaded extra squares or drew vertical and horizontal lines of symmetry only. A small number of candidates drew just one diagonal gaining partial credit.

Question 6

This question was answered well by the most able candidates, but many incorrect answers were seen. The most common answer not gaining credit was $\frac{1}{16}$ as the candidate had not written their answer as a decimal. Some candidates wrote 0.16, others square rooted and gave 4 as their answer.

Question 7

(a) Most candidates answered this question correctly. Common errors were 14 out of 30 rather than 21.

(b) Most candidates answered this question correctly. However, incorrect answers were seen where candidates were unable to link the stem and the leaf correctly, and just had single digit answers. Some wrote 57 – 16 without working out the value of 41.

(c) Some candidates were not able to locate the median correctly from the stem-and-leaf diagram, giving answers of 38 or 39.5 from their 2 middle values.

Question 8

Many fully correct answers were seen. Some candidates calculated the volume of the cuboid, whilst others thought that the cuboid had two faces that were 3 by 5, and four of 8 by 5 giving 190 cm² as the total surface area. Many candidates who were unable to correctly work out the total surface area gained partial credit from working out the area of one or more faces correctly, whilst some worked out the area of the three different faces correctly but did not double their answer, giving 79 cm² instead.

Question 9

Many candidates drew a correct net. A common error was a net drawn of three 4 by 2 rectangles with two isosceles triangles of height 4 cm instead of equilateral triangles of side 4 cm. Some candidates drew separate faces and did not understand the concept of a net, whilst others drew a 3D representation of the prism.

Question 10

Many candidates gave a correct reason. Some said no but did not give a valid reason, the most common of which was simply writing out the definition of a prime number without stating 3 or 29. A significant number of candidates wrote yes, thinking 87 was indeed a prime number.

Question 11

Many correct answers were seen, with most being written in the 24-hour clock. Some wrote 08 15 without stating pm. Crossing the hour by taking away the 50 minutes did confuse some and 21.55 and 20.55 were common incorrect answers.

Question 12

Many candidates were able to give the correct answer. The most common error was to just subtract 38 from 180.

Question 13

Fully correct answers were seen, but these were in the minority. Common errors included the rounding of 10.6 to 11 not to 10 as one significant figure. Many worked out the exact answer, with some then rounding this. A few candidates had trailing zeros seen but the most common answer was $\frac{7 \times 11}{3-1} = 38.5$.

Question 14

(a) The correct answer, positive, was often seen. Some of the incorrect answers were describing the trend of the line such as 'increasing', whilst a few 'negative correlation' responses were also seen.

(b) Many candidates were able to give a sensible correct relationship.

(c) Although several candidates were able to draw a ruled line within the tolerances allowed, several had their line of best fit outside the tolerance allowed on the question. A common error was a line of best fit through the origin. Whilst some lines were within tolerance at one end, the other end of their line was then outside the allowed tolerance.

Question 15

This was generally answered well. Common incorrect answers were d^4 and d^{10}.

Question 16

Many correct answers were seen from using the correct method. The main error was to multiply 4000 by 0.913 and give the answer $3652.

Question 17

This was answered well by more able candidates. A significant number worked out the LCM, 480, or wrote 2 or 4 as the HCF.

Question 18

The majority gave the correct answer. Some worked out how many times Tom was not late as they had not read the question carefully.

Question 19

Several candidates were able to gain full credit on this question. Of those who were unable to expand two brackets correctly or were unable to simplify their expression once they had expanded the brackets, some did gain partial credit for three correct terms in their expansion.

Question 20

(a) Correct answers were seen in the majority of cases. Incorrect answers were often the names of parts of a circle, just not the one required.

(b) 58° was seen often, but very few candidates were able to give the correct geometrical reason. Most knew *ACB* was a right-angle, but not the wording of the circle theorem. Many just showed the calculation to arrive at 58, showing that they knew the angles in a triangle add up to 180°.

Question 21

(a) Most candidates answered this question correctly. Several gained partial credit for working out 0.89.

(b) This part was not answered as well as **part (a)**, but many fully correct answers were still seen. Some candidates divided 0.46 by 5, others stated a colour or added 0.16 and 0.3 incorrectly to give 0.19.

Question 22

Many correct answers were seen. Some showed correct working but did not round their answer to the nearest dollar. A significant number of candidates calculated simple interest or were unable to calculate compound interest correctly. A small number subtracted the principal to calculate the total interest rather than the total value. Candidates should be encouraged to use the formula rather than a year-on-year approach where rounding errors often occur.

Question 23

(a) Most candidates were able to recognise the transformation as a rotation, and many also included 90º clockwise; some omitted the direction or wrote 'right' instead of clockwise. Fewer candidates were able to identify the centre of rotation. Common incorrect centres were (0, 0) or (–2, 3) or (3, –3). Some candidates described how each point moved from one coordinate to the next.

(b) Many fully correct answers were seen. Some candidates did not know 'translation' and wrote various other words for this. Writing the vector was a problem for others who described the movement in words or wrote coordinates rather than a vector.

Question 24

Many candidates showed correct working and gained full credit on this question. Most changed their fractions to improper fractions, and then used either 12 or 48 as a common denominator. If successful with this, many were able to simplify to $8\frac{1}{6}$. A common error was not simplifying fully or not changing their improper fraction back to a mixed number. Some candidates did not know how to add fractions correctly, whilst others changed the question to $\frac{71}{12}+\frac{9}{4}$ and then appeared to use their calculator from there. A few candidates chose to add the whole numbers and fractions separately with differing success. Candidates should check their work for arithmetic errors.

Question 25

Setting up the initial equation correctly was challenging for most candidates. $10x – 12 = 2x + 3$ was more commonly seen as the equation or $3(10x – 12) = 2x + 3$. There were unsuccessful attempts at trial and error, or answers from incorrect starting points. Many candidates were unclear that one equation was needed. Some tried solving them simultaneously or just worked with $10x – 12$ and $2x + 3$ separately.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/21
Paper 21 (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. There were many good scripts with candidates demonstrating an expertise with areas of the subject content and proficient mathematical skills. Very few candidates were unable to cope with the overall demand of this paper. Some candidates omitted questions or parts of questions, but this appeared to be a consequence of a lack of knowledge or familiarity with a topic rather than any timing issue.

Candidates showed particular success with the basic skills assessed in **Questions 1**, **2**, **5**, **6**, **8, 9** and **10**. The more challenging problems were **Questions 13**, **16**, **18, 20c** and **21**. All candidates need to take care to read the specific demand in each question. This particularly applies to the demands to ‘show all your working’ (**Question 10**) and to ‘describe the **single** transformation’ (**Question 11**).

In general, candidates were very good at showing their working, which made it easier to award method marks when answers were not correct or were inaccurate. However, a small number of candidates appeared to be crossing out all of their workings, even where correct. This is not advisable, as an inaccurate answer that does not score could then lead to correct but crossed-out workings gaining no credit. In addition, marks were sometimes missed by candidates not being careful with accuracy. For example, intermediate results were sometimes rounded prior to the final answer, which could distort the accuracy of the solution.

Comments on specific questions

Question 1

For many candidates this was a comfortable first question, with the correct answer being most common. Some correctly found the fourth angle in the given quadrilateral, using angle sum, but neglected to find the required exterior angle. For less successful candidates it was common to see them incorrectly assuming that some lines were parallel, with incorrect answers of 56° and 71° being seen often. A small number of candidates seemed to be measuring despite the clear labelling that the diagram was not to scale.

Question 2

Whilst there were many correct answers most errors came from poor addition of times, with the incorrect 05:15 being offered quite often, apparently forgetting to ‘carry’ an hour when adding the 43 to 32 minutes. Some working ignored that there are 60 minutes in an hour rather than 100. Whilst alternative formats for the time (such as 6.16 a.m.) were acceptable a small number incorrectly gave their answer as a duration (e.g. 6 hours 15 min) and so did not score.

Question 3

The correct values for *a* and *b* were most usually found but the quality of reasoning varied greatly. Candidates must understand the demand to ‘give a geometrical reason’ means the use of correct vocabulary is expected, rather than descriptions in non-mathematical language. Reasoning for angle *a* was more commonly given credit with reference made to 'opposite angles being equal' but some candidates introduced doubt with additional reference to other geometrical properties such as 'angles on a straight line' which is not appropriate here. Sometimes there was inadequate reasoning, e.g. referring to 'vertical angles'.

Acceptable vocabulary in reasoning for *b* was less common although those gaining credit usually did so by referring to the 'interior angles', or better still that 'co-interior angles sum to 180°'. There were candidates who attempted reasoning in stages, which is trickier as each part needs to have correct reasoning vocabulary. Some gave or described calculations, which does not count as 'geometrical reasoning'.

Question 4

There was a significant minority who did not address the demand to write each number in the given calculation to 1 significant figure. These candidates took much longer to answer the question and could not gain any marks. Had the rounding been done the calculation became straightforward, simplifying to $\frac{14}{14} = 1$. For those who did round, the most common error was to leave 18 unchanged instead of rounding to 20, meaning full marks was not possible. Some incorrectly added a trailing zero in their calculations, e.g. by changing 6.7 to 7.0 instead of 7.

Question 5

The vast majority of candidates scored both marks on this probability question with very few arithmetic errors in evidence.

Question 6

With the necessary formula given in the question most candidates fared well here. The most common error seen was failing to halve the stated diameter to use radius in the formula. Other errors by a smaller number were using r^2 rather than r^3, doubling the diameter, or using $\frac{3}{4}$ rather than $\frac{4}{3}$. Some introduced inaccuracies when the value of $(2.4)^3$ and/or $\frac{4}{3}$ were rounded prior to multiplying.

Question 7

Whilst most knew they should multiply by the map scale, a large number were unable to address the conversion between centimetres and kilometres. The more successful candidates often tackled this part in two stages, first changing to metres, but many stopped there. Few started by converting the scale to reach 1 cm: 1.25 km, which might have been more successful for some candidates.

Question 8

Only a small number were unable to use the given *n*th term in **part (a)**. A few gained just 1 mark by giving the 'zero-term' of 10 first, then missing the 3rd term of 1.

In **part (b)** arithmetic sequences were a familiar situation to most candidates with the correct answer, or at least including $3n$, being very common. There were however some who were unsure how to use the common difference, with the incorrect answer $n+3$ being seen a number of times. Some of those using a formulaic approach left their answer unsimplified, e.g. as $7+3(n-1)$, although this was condoned. A small number appeared to find the common difference and 'zero-term' but gave their answer as $4n+3$ in error. Some checking by candidates, using substitution, may have helped identify any error.

Question 9

Many candidates were able to correctly use the scale factor between the two triangles to reach the correct answer, but some worked in stages rounding intermediate values and hence lost an accuracy mark. The most common error made here was to add 0.9, the difference seen in the given corresponding sides, giving the wrong answer of 6.5. As the triangles were right-angled some thought they needed to use Pythagoras Theorem or trigonometry; whilst such an approach could have worked if done correctly, these attempts were usually unsuccessful.

Question 10

A large majority were able to re-write $2\frac{1}{7}$ as an improper fraction, with most of the successful candidates on the question then taking a standard approach of multiplying by the reciprocal of $\frac{5}{9}$. Candidates are instructed to show all their working so the multiplication step needed to be explicit. Some wrote the division using 'double-decker' fractions $\left(\text{i.e.}\ \dfrac{15/7}{5/9}\right)$ leading to $\frac{135}{35}$ without making the products involved explicit and so were unable to gain the method mark. A small number 'flipped' the wrong or both fractions before multiplying. The approach of re-writing the division of fractions with a common denominator was seen less often but was usually successful. A number of candidates were able to gain the method marks but neglected to cancel to a mixed number as instructed.

Question 11

As in previous series a number of candidates in both **parts (a)** and **(b)** failed to follow the instruction to describe using a **single** transformation, and hence did not gain marks. They should also note that correct vocabulary is required, rather than a description such as 'it doubles in size' for **part (a)** which could not score for either 'enlargement' nor 'scale factor of 2'. Some considered the transformation in the wrong direction, giving a scale factor of $\frac{1}{2}$. The most commonly omitted property for the transformation was the centre of enlargement. A very small number of candidates gave a vector for the centre of enlargement rather than coordinates; this was only acceptable if referenced as a *position vector* for the centre.

Again in **part (b)** correct vocabulary ('rotation' rather than e.g. 'turn') was needed, with most recognizing the appropriate transformation. Pleasingly most candidates who gave the angle of rotation also stated 'clockwise', which was necessary. The centre of rotation was the most common error or omission.

Question 12

There was an error in Question 12(a), in which sides AB and AC were incorrectly identified as equal, rather than sides AB and BC. This has been corrected in the published version of the paper. Please note that due to this issue with the question, full marks have been awarded to all candidates to make sure that no candidates were disadvantaged.

In **part (b)**, the correct answer of 42° for angle *QSR* could most quickly be reached using the Alternate Segment Theorem. As *QS* was clearly a diameter many candidates instead subtracted 42° from the right angle at *Q*, but 48° was then often incorrectly given as the answer for angle *QSR*. The mark for angle *PQS* was often still earned as follow through for recognising it should be the same as their angle *QSR*. Candidates were least successful in finding angle *POS*, and this was left blank by some, although again the mark could still be earned as follow through for recognising it should be double their angle *PQS*.

Angles simply written on the diagram were insufficient to score marks as the question required candidates to demonstrate an understanding of the notation 'angle *QSR*' etc.

Question 13

This question on compound interest proved challenging for a significant number of candidates. One common error was to treat the problem as simple interest. For those trying a compound interest approach many attempted to set up an equation, but a very common error was to work with the interest ($621.70) rather than with the value of the investment at the end of the eight years ($6621.70). Such a crucial error in setting up the original equation meant no marks were possible. For those with an appropriate equation there were often errors in the rearrangement, applying steps in an incorrect order.

Question 14

Whilst there were many fully correct solutions seen to this problem, commonly errors were due to not reading the demand carefully enough by: **(i)** attempting linear proportion, **(ii)** attempting inverse proportion, or **(iii)** using square root rather than square. It was also common to see attempts without using a constant of proportionality and so failing to score.

Question 15

Most recognised the need to start off with $\frac{5}{13}$ for the probability of a first button being green, which earned a first method mark. Many fewer were able to use this correctly in a product with $\frac{8}{12}$ for a second button being non-green to score the next mark. Some made more work of it by considering blue and white separately rather than non-green. Only the stronger candidates realised that they also needed to double the result of the product to account for the possibility of green being the second button, and were then able to score full marks. Some found a tree diagram helpful to organise the outcomes, but if they had separate branches for blue and white rather than one for non-green this became harder for them to manage. A common error made by candidates who recognised the need to find a product was to miss that the question stated that the buttons were taken out 'without replacement'.

Question 16

Only a minority of candidates understood what was required of them to find the magnitude of the vector in **part (a)**, with the elements instead combined in various different incorrect calculations. Of those realising that Pythagoras' Theorem was needed many used -4^2 rather than $(-4)^2$ and so did not score.

In **part (b)**, only a minority of candidates were able to correctly find the required vector $\overrightarrow{CB}$ in terms of **x** and **y**. There were a range of incorrect answers seen, some of which were incorrect combinations of the two vectors, but others were not actually vectors in that candidates had squared, square rooted, multiplied or in other ways tried to process the given vectors in an incorrect way.

Question 17

There were a reasonable number of fully correct responses offered demonstrating that many candidates understood the principles of simplifying with indices. A common error seen however was applying the power of $\frac{3}{4}$ to only the x^{12} or (less often) to only the 81 but not to both. Also seen was adding the indices in error, or treating the power of $\frac{3}{4}$ as a factor to work out $\frac{3}{4}\times 81$ giving an answer with coefficient 60.75

Question 18

In this problem-solving question candidates needed to realise they had to first find an acute angle in the triangle before applying their knowledge of bearings. A number wrongly assumed the triangle was isosceles and often then also were unable to deduce a bearing from their angle *UWV*. The error of finding the angle anticlockwise from north was not uncommon. Those with little idea of what to do simply subtracted 125° from 360° to give an answer of 235°.

Only a minority realised they could use the sine rule, having a known pair of side and opposite angle. (Some unsuccessfully attempted to use the cosine rule.) Those using the sine rule usually found the required angle *UWV*, but most commonly could not then reach the required bearing. Some found the bearing in the wrong direction (giving answer 056°), but there were also a number of fully correct solutions seen.

Question 19

The quality of sketched cosine graphs in **part (a)** was very mixed, showing that this is a skill much in need of practising. Whilst some were very good, a large number gave a poor indication that there were turning points at 0° and 360° (sometimes appearing almost parabolic), were often very linear, or demonstrated no idea of symmetry. Most did show a realisation that it should be a wave shape but often either not starting at (0, 1), or otherwise starting correctly at (0, 1) but cutting the x-axis at 180° (and often then again at 360°). Labelling of the axis was not required but if candidates decided to label then the axis crossing points (90° and 270° in this case) needed to be correct.

In solving the trigonometric equation in **part (b)** it was not uncommon for candidates to find one correct angle, but a second correct answer was often not given or not attempted. Those not reaching a correct angle sometimes gained a mark for the correct rearrangement to $\cos x = -\frac{3}{5}$, but this was not always managed. (The incorrect $\cos x = +\frac{3}{5}$ was not uncommon.) A special case (SC) mark was then available however if they gave two angles with a sum of 360° (using the symmetry in the graph). Candidates should consider how the sketch in **part (a)** can help in finding the location of further roots of the trigonometric equation.

Question 20

Whilst correct y-values were often found in **part (a)** there was a greater problem finding the value at $x = -0.5$, with the most common incorrect answer of -0.75 coming from a sign error when squaring.

There were a good number of fully correct graphs drawn for **part (b)**. Points were usually plotted accurately with only a few incorrectly reading the scale. Following errors in **part (a)**, plotting points that do not join to form a standard parabola shape for the quadratic function should prompt candidates to reconsider their values in **(a)**; also there were some with a correct curve who did not re-visit their incorrect value(s) in **part (a)**. Candidates will benefit from practice drawing smooth curves through plotted points – these need to be a single curve without breaks that do not miss the points plotted. It is not appropriate for a polynomial graph to join points with straight lines as was seen a number of times.

In **part (c)** only the strongest candidates knew how to rearrange the given equation to deduce the correct straight line needed to solve it using the graph from **part (b)**. A common incorrect line, when one was attempted, was $y = -x - 1$. Often a line was not attempted, as required by the question, with instead an attempt made using the quadratic formula. This was condoned for 1 mark provided candidates gave only the root within the stated range of x. A number of candidates were successful in this respect.

Question 21

Only a minority of candidates realised that **part (a)** required them to find the gradient function and so try differentiation. Often, unhelpful attempts were instead made by substituting values into the equation of the curve and trying some form of linear gradient calculation. Those who did differentiate commonly did so correctly (although not always with correct notation, sometimes instead writing the gradient function as $y = \ldots$), and went on to find the correct gradient.

A small number of candidates were able to find at least one of the turning points in **part (b)** but this was not always by use of the gradient function. Instead an empirical approach with tables of values for y at different x-values was often seen. Candidates need to understand that equating the gradient function to zero is the expected method, and that had the turning points not been at integer x-values they would have had greater difficulty in using an empirical approach. Many who took the expected approach and obtained the correct equation ($3x^2 - 12 = 0$), then struggled to solve it, with incorrect factorisation attempts being seen and even some resorting to use of the quadratic formula. The correct x-values were sometimes found but the corresponding y-values were not always forthcoming.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/22
Paper 22 (Extended)

Key messages

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

General comments

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 $2\times32=64$. 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 (WITHOUT COURSEWORK)

Paper 0580/23
Paper 23 (Extended)

Key messages

It is important for candidates to read the questions carefully. In many cases, the answer was correct and accurate, but it was not given in the form requested. For example, in **Question 8** where we required a single transformation, **Question 10** on fractions, the answer should have been given as a mixed number in its simplest form, **Question 12** where we needed proof that the number was correct to 1 decimal place, **Question 14** required the answer in its simplest form, **Question 15** is to the nearest integer, **Question 19** answers to 2 decimal places, **Question 20(a)** is in its simplest form and **Question 23** is in hours and minutes.

General comments

With truncation of numbers, it is important to keep track of significant figures throughout multiple calculations. This will help to ensure that the final answer is accurate to the required number of decimal places.

The question on proportionality was misread by many. It may be helpful to read the question carefully and to ask for clarification if anything is unclear. It is essential that candidates show all their working steps clearly. This will make it easier for the marker to follow their reasoning and to identify any errors. It is also helpful to have their working organized in a clear and logical order and to avoid writing loosely all over the page.

It is important to take care when manipulating algebraic expressions. Some errors were caused by poor writing and some by not applying the laws of algebra correctly. Candidates should carefully review their work before submitting. It is often helpful for candidates to pursue their original idea when solving a problem. Those who changed their strategy midway, often adopted an incorrect method. It is often best to follow through with the initial approach and to avoid making unnecessary changes that might result in having the wrong answer.

Comments on specific questions

Question 1

Both parts were not well completed, indeed quite a few candidates left these parts blank, which was not reflective of candidate engagement with the paper as a whole.

(a) The common incorrect responses were $\frac{1}{3}$, 1, 3, 4, 180 degrees, angles and diagonal.

(b) The common errors were to just give one correct line of symmetry or to also include a vertical and horizontal line of symmetry thus giving four lines of symmetry.

Question 2

Many candidates gave the correct answer. A common incorrect answer was 8 15 without the ‘pm’ which was necessary. The other main error was that some candidates subtracted the 2 hours giving 21 and then they subtracted the minutes giving 15 so they wrote 21 15 omitting to reduce the hour by one.

Question 3

The responses to this question were very mixed. Many did give the correct answer, a few gave half the answer, 79. The most common error was to multiply all three numbers to get the volume. A few thought there were four sides measuring 8 cm by 3 cm and two sides measuring 3 cm by 5 cm.

Question 4

This was well answered. The most common misconception was not following the correct order of operations. Some candidates missed the negative sign from the 7, so they worked out 4 – 9.8 × 7. The other problem was not dealing with the double negative in the middle.

Question 5

This was usually answered correctly, some wrote d^4 and others gave an un-simplified version d^{8-2}.

Question 6

Many candidates found this question quite challenging, most multiplied $12 \times \frac{3}{13}$. The correct method followed by some of them was to do $12 \div \frac{3}{13}$. A few used $\frac{10}{13}$ so they attempted 12 ÷ 3 = 4 then 4 × 10 = 40.

Question 7

(a) Most candidates gave the correct answer, the most common error was to write 0.89.

(b) The majority of those who gave the wrong answer did so by multiplying 0.3 and 0.16. Some candidates used addition but gave the answer as 0.19.

Question 8

This question was answered well, some candidates did not include the centre with their answer and others did not include the direction of the angle. It was also common for some to use vector notation for the centre. The question does ask for a single transformation and despite that many answered with a combined transformation, often a translation was included. Some used incorrect terms such as 'turn'.

Question 9

(a) The correct method was to attempt 65 ÷ 2 which many did. Some candidates tried to find the two speeds for the two parts of the journey and find the average of them.

(b) Many candidates were close to the correct line but not close enough suggesting that they were inaccurate. The correct method was to calculate that at 13 00 they will be 65 – 50 = 15 away so draw a line from (12 00, 65) to (13 00, 15) and extend to the base line.

Question 10

Most candidates realised they needed a common denominator and it was usually 12. Some just added the fractions as they were. A common error was to give the answer as $\frac{49}{6}$, or similar such as $\frac{98}{12}$ or $8\frac{2}{12}$, even though they were asked to give the answer in its simplest form and as a mixed number. A few used decimals.

Question 11

(a) This question was answered well by the majority of candidates giving three fully correct regions. It was very common that candidates used commas to separate the letters. Some candidates wrote all the letters again outside the circles. Some included letters 'g', 'e' or 'r', which should have been in the intersection, in the other parts of each circle. Some had 2 of each of these letters. A few wrote the number of elements in each part rather than the elements themselves.

(b) This was again well answered. The common errors were to shade everything not in A or to shade all of B.

Question 12

The correct method was to work out $\begin{pmatrix}5\\3\end{pmatrix} - \begin{pmatrix}4\\8\end{pmatrix} = \begin{pmatrix}1\\-5\end{pmatrix}$ then use Pythagoras' Theorem, $\sqrt{1^2 + (-5)^2}$ to reach $\sqrt{26}$. Now $\sqrt{26}$ = 5.099…. so we needed them to give at least two decimal places, 5.09… to show it rounds to 5.1. Some did reach the first vector, many candidates did use Pythagoras' Theorem but some did not show the numbers inside the square root correctly. Finally many candidates wrote $\sqrt{26}$ as 5.1 which does not show that it rounds to 5.1.

Question 13

There were signs of truncating the square root too early but most candidates gave a correct answer, a few gave an answer of 8 or 8.0.

Question 14

Most candidates gained credit on this question. The most common method was to label the number x and the work out $100x$ and subtract. Other combinations worked such as $10000x - 100x$. There were a lot of different correct methods though. Some of these methods used a formula they have learned and others used sequences. Many candidates gave the correct answer without any working or very little working and they did not get full marks. The most common errors were to write the fraction as 0.581581… or to attempt a subtraction such as $100x - 10x$ where the recurring digits do not cancel out.

Question 15

The best and most efficient method was to write the percentage as a multiplier such as $1-\frac{1.75}{100}$ or similar, 0.9825. It was then 980 multiplied by this multiplier to the power 11. Some tried to do it year by year but small numerical errors crept in. Other candidates increased the amount giving an answer comfortably over 1000.

Question 16

The greatest loss of marks was due to candidates not giving answers to an appropriate degree of accuracy with 6.99 being a common error that was sometimes followed by 7 or 7.0 on the answer line. Another error was the use of an incorrect formula: $V = \pi rh$, $V = \frac{1}{3}\pi r^2 h$ and $V = \pi r^2 h + 2\pi r$.

The way answers were set out was sometimes not clear and also candidates often showed one line leading to the answer which was not always correct, a more methodical approach would ensure that candidates would get more method marks.

Question 17

Almost every candidate was able to multiply by m to remove the fractions and also to expand the brackets. The main problem was to unite the terms in m on one side and put the other terms on the other side of the equation. We would see a lot of solutions with a term in m in their answer. The other errors included not multiplying the second term by the factor outside the brackets. Those who kept the fractions, struggled with the manipulation. Some tried to complete two steps in one and often made an error.

Question 18

This was answered well. The common errors were mainly concerned with the initial equation. Some wrote it as directly proportional to the cube root of $(x + 5)$ whilst others inversely proportional to just $(x + 5)$.

Question 19

This was answered very well, the largest error was writing down an incorrect quadratic formula. This included not having the $-b$ term correct, not substituting -7 for c and then division by an incorrect number.

Candidates needed to show all their working in the quadratic formula. There were too often cases when candidates were not showing any manipulation in the discriminant and they would write 53 without any working. A large proportion of candidates answered using the method of completing the square, however these candidates would often give their answers in exact form despite 2 decimal places being requested in the question.

Question 20

(a) The most common error was to work out $6x + 2 - 7$ giving the answer $6x - 5$. Some expanded the brackets incorrectly by not multiplying the second term by the factor outside. Other candidates reached $6x + 12 - 7$ then simplified to $6x - 5$.

(b) The most successful method was to switch x and y and then rearrange the formula to make y the subject. Some switched the x and y when they had reached the answer. A few gave the correct expression with y in the place of x. Another common error was to give the reciprocal of f(x). Some candidates made an error in rearranging the formula and finished with the numerator as $x - 7$ instead of $x + 7$.

(c) Many candidates found the correct answer. Many more wrote $x^{-3} = 125$ and then gave the answer as 125^3 or 125^{-3}. Some started with 6(22) – 7 but did not realise what this was equal to.

Question 21

Generally this question was well attempted, better than in previous years. The biggest error was not being able to factorise the expression $2x^2 + 5x - 12$, some candidates left it in an unfactorised form, whilst others factorised it incorrectly. A few candidates did not realise that the denominator was the difference of two squares.

Question 22

All methods involved forming equations and solving them. The most straightforward one was to substitute $n = 1$ and $n = 2$ into the expression and equate them to 2.75 and 6. Solving them gave the values of a and b. Some found the differences and equated them to learned expressions but they were for the expression $an^3 + bn^2 + cn + d$. They usually found the value of *their* a was $\frac{1}{4}$ which they were told in the question and so they went on to find the values of b, c and d. They would get the question correct if they gave the values of *their* b and *their* c.

Question 23

The simplest response was 220 ÷ 125 but these did not take into account the bounds required for both numbers. Some gave the correct bounds but selected the wrong one(s). For 220 some chose 225 or 230 instead of 220.5 and for 125 they chose 120 or 130 instead of 122.5. Most were able to change the decimal hour to minutes but some could not.

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

To do well in this paper, candidates need to demonstrate that they have a good understanding of all topics in the syllabus, remember necessary formulae, and use a suitable level of accuracy. In addition, candidates need to ensure that they read the questions carefully and ensure that they are answering the question asked.

It is generally expected that candidates show some mathematical workings. This is particularly important if they make an error as without workings, they are usually unable to score any method marks.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Overall, there were some excellent responses. Most candidates completed the paper in the time available although there were a significant number of parts that were not attempted. 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 paid to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) The majority of candidates answered this question correctly. Common errors were 4033, 40 330 and 4 000 033.

(b) Again, a majority of candidates could answer this correctly. Common errors seen were 27, 243 and 81.

(c) Candidates found this question very challenging. The most common error was to evaluate $\frac{7}{9}$ as a decimal. Some candidates did not know the meaning of 'reciprocal' whilst others gave the correct reciprocal as a fraction but did not give their answer as a decimal, or attempted to round the correct fraction to 3 decimal places but made errors.

(d) The majority of candidates answered this question on calculating indices correctly, although the common error was to attempt to write the answer in index form (2^1) rather than calculating the value of each term and then dividing.

(e) Most candidates answered this question correctly.

(f) (i) Nearly all candidates answered this question correctly. The common error was to work from left to right and not to consider the order of operations in the sum.

(ii) Again, nearly all candidates answered this question correctly. Most errors were slips when using their calculators.

(g) Candidates found this question on finding the irrational number very challenging. All possible answers were seen with the most common incorrect answers of 3.142 and $\sqrt{49}$.

(h) (i) Around half of the candidates correctly identified 312 as the LCM of 24 and 104. Successful solutions generally involved drawing two correct factor trees or tables. Some candidates attempted to write out a full list of multiples but often made errors with their list of the multiples of 24. Common errors included 8 and 2496.

(ii) A similar number of candidates identified 8 as the HCF of 24 and 104, again most using the factor trees or tables drawn in **part (h)(i)**. Many candidates attempted to write a full list of factors but often went wrong with the list of the factors of 104. Common errors included 312 and 2 or 4.

Question 2

(a) This part was generally well answered although the common error was to write a particular 4-sided shape, such as trapezium, rather than giving the general name of all 4-sided shapes. As with many of the questions which required a worded answer, a large proportion of weaker candidates did not attempt this question.

(b) (i) This part was answered reasonably well with most candidates able to identify the given transformation as a rotation, although fewer 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. The angle of rotation was commonly given but with no direction. A significant number gave a double transformation or used non-mathematical descriptions.

(ii) Fewer candidates were able to identify the given transformation as an enlargement and very few 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. The scale factor also proved challenging with 2 and –2 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 for an enlargement.

(c) A significant number of candidates omitted this part.

(i) This part was answered reasonably well with many of the candidates able to draw the given translation. Common errors included drawing only one of the vector components correctly or drawing a shape which was a different size to the original shape.

(ii) This part was again answered reasonably well with many of the candidates able to draw the given reflection. Common errors included reflecting in the *x*-axis, *y*-axis or drawing a shape which was a different size to the original shape.

Question 3

(a) The stem-and-leaf diagram was generally completed well with most candidates gaining full credit. A common error was not splitting the units from the tens and writing the 2-digit numbers in the leaf part of the diagram and therefore scoring no marks. Some candidates gave an unordered list for each stem and therefore only gained a part mark.

(b) The majority of candidates answered this question correctly. Many candidates used the original list, or re-wrote the list to identify the mode.

(c) Fewer candidates were able to identify the median. Candidates who made errors in their stem-and-leaf diagram often gave the incorrect answer of 32 or 34. A significant number of candidates wrote out the original list in numerical order to identify the median.

(d) Candidates were more successful at identifying the range. A common error was giving the extreme values of 45 and 9 but not calculating the difference.

(e) Completing the bar chart was very well answered with the majority of candidates gaining full credit. Very few candidates attempted to draw the bars with a different width to the one given. Many candidates were able to earn the follow through from an incorrect stem-and-leaf diagram.

(f) Most candidates were able to correctly work out the percentage of students with test scores of 40 or more. Candidates who had made an error in the last row of their stem-and-leaf diagram found this more challenging as the percentages were 18.75% or 31.25%. Common errors were 4 or $\frac{4}{16}$.

Question 4

(a) (i) This part was well answered with the majority of candidates identifying the correct point. Common incorrect answers were *C* or *L*.

(ii) This question was found challenging by many candidates although some correct and complete answers were seen. Successful solutions showed each part of the net calculated and then added together. Candidates often were able to calculate the areas of the rectangles (often showing these on the net). However, the area of the trapezium proved challenging to all but the strongest of candidates. Very few formulae were seen and the most common attempts at the trapezium was to count the squares or split into triangles and a rectangle, with mixed success. Other common errors included, adding the lengths of all the sides of the net, not including all rectangles and trapezia and errors in multiplication. Many weaker candidates did not attempt this part of the question.

(iii) Completing the statement was very challenging to all candidates, with very few candidates gaining full credit. Prism was rarely seen, with cuboid, pyramid or trapezoid being common incorrect answers. Similarly, trapezium was rarely seen, with trapezoid, rectangle, or octagon being common. Many candidates did not attempt this question.

(iv) This part was answered reasonably well with about half of the candidates able to draw a sketch which resembled the solid. A common error was to draw a two-dimensional shape, including a trapezium, octagon, or rectangle. Again, a number of candidates did not attempt this part of the question.

(b) This part was generally answered well with the majority of candidates able to find the value of *x*. Candidates often found the answer using the formula for the volume of a cuboid, although rarely quoting it. $6 \times 6 \times 15 = 540$ was often seen rather than $540 \div (6 \times 6)$ followed by the correct answer on the answer line and therefore gaining full credit. However, some candidates gave the correct sum in the working but wrote 560 on the answer line. Candidates should be reminded to reread the question after answering it to check their answer makes sense. Some candidates used 540 as the surface area and calculated *x*, a much more challenging question but gained no credit. Some common errors were 22.5, 504 and 516.

Question 5

(a) Only a minority of candidates gained full credit on this question. 'Show that' questions need further attention by all candidates. It is important that all elements of the solution are shown. Many candidates used 62.5% in their solution without showing that $\frac{5}{8}$ = 62.5% and therefore gained no credit. However, most candidates were unable to gain any credit on this question as they started with the 144 000 and showed that it was $\frac{5}{8}$ of 384 000. Candidates should be reminded that in a 'show that' question they should not use the value they are being asked to show. Another common error was to find $\frac{5}{8}$ of 240 000 and attempt to find 144 000 using this figure.

(b) All three parts of this ratios question were answered reasonably well.

(i) (a) Some candidates found it difficult to understand which values to use, many using the 240 000 or 384 000 found in **part (a)**. Recognising this as a ratios question, many candidates attempted it as a standard division into a ratio question and thought that the 144 000 was the total. Therefore, a very common error was to divide 144 000 by 22 and then multiply by 5.

(i) (b) Candidates repeated the same correct or incorrect method used in **part (a)** in this part and the success rate was similar.

(ii) Candidates were more successful in calculating the amount Antonio had left as they were able to follow through their incorrect answers from **parts (a)** and **(b)**. The best solutions included the complete subtraction. A significant number of candidates did not attempt this part.

(c) A number of candidates did not attempt this question. Many candidates gained part marks for calculating the simple interest but did not then calculate the total amount. Common errors included calculating compound interest and $762 000 (multiplying all values together).

(d) Candidates found this part even more challenging. Correct solutions showed all parts of the calculation but most candidates gained no credit as they divided by the new number of customers instead of the original number of customers. A common error was to attempt to find the percentage by trial and improvement, with many candidates concluding that 17% of 560 was 96 or 117% of 560 was 656. Many candidates did not gain full credit because they rounded their final answer to two significant figures without showing a more accurate answer first.

Question 6

(a) The table was generally completed well with the majority of candidates giving 5 correct values. The common error was with the substitution of $x = -2$. Candidates should be encouraged to look at the general shapes of different groups of graphs as the majority followed through their error to plotting, not realising that this could not possibly be the correct point for this quadratic graph.

(b) Many curves were well drawn with very little feathering or double lines seen. Many candidates also joined some or all of their points with straight lines which meant they could not gain full credit. Most candidates who made errors in their table followed them through correctly. Some candidates recognised the symmetry of the curve and did not follow through the incorrect values in their table and plotted a correct curve to gain full credit.

(c) Few candidates were able to find the equation of the line of symmetry of the graph, with a significant number of candidates not attempting this part. Common errors were $y = 1.5$ and just giving 1.5.

(d) (i) The table was generally completed very well with the majority of candidates giving three correct values. The common error was in substituting $x = -1$ into the given equation.

(ii) Most plotted the three points from the table correctly but did not extend the line to be long enough to be used and therefore did not gain the mark. The question said that the graph had to be for values $-2 \leqslant x \leqslant 5$. Many candidates joined up points from the quadratic graph and the straight line graph therefore ending up with an incorrect line.

(e) Finding the coordinates of the two points of intersection was challenging to most candidates, with many not attempting this question. A follow through was available for incorrect curves and lines from previous parts, which some candidates were able to benefit from. Generally candidates found reading the scale on the y-axis more complex and often used 1 square to equal 0.1 rather than 0.2. Other common errors were to write down the coordinates where the curve or straight line crossed the x-axis or to write coordinates in the wrong order.

Question 7

(a) (i) (a) Around half the candidates correctly identified the line *BOD* as diameter. Common errors were chord, radius, tangent, circumference and straight line.

(i) (b) Fewer candidates correctly identified the line *ABC* as tangent. Common errors were straight line and triangle. Around a quarter of the candidates did not attempt this question.

(ii) Giving the two geometrical reasons proved to be the most challenging question of the whole paper, with a significant proportion of candidates not attempting this question. Most candidates who attempted the question recognised that angle *AOB* was part of a triangle and that the angles in a triangle add up to 180 degrees. However most did not gain a mark as they did not give a geometrical reason. It is important that candidates use the correct terminology. Common incorrect answers included the sums to justify the angle of 62 rather than the reasons; for example, *ABO* = 90 so *BOD* = 180 – (90 + 28) = 62.

(iii) Candidates were slightly more successful at giving the geometrical reason why angle *DOE* is 62. The correct responses included the word 'opposite'. Common unacceptable answers were 'alternative angles', 'corresponding angles', 'angles in parallel lines', 'angles in a circle add up to 360', 'equal to *DOE*' with no reason.

(iv)(a) This, and the other two parts of **(a)(iv)**, were challenging to all but the strongest candidates and a large proportion of candidates did not attempt any part of it. About half of the candidates identified angle *DEB* as 90. Common incorrect answers were 59, 62 and 56.

(iv)(b) Fewer candidates were able to find angle *ODE*. Again the most common incorrect answers were 62 and 56.

(iv)(c) A similar number of candidates were able to find angle *BEF*. Successful candidates often marked angles on the diagram as they were found, to aid finding the angles asked for. Most correct answers were found in stages. In all three parts some candidates used a protractor to measure the angles. Candidates should be reminded that diagrams are 'not to scale' and measuring will not give the correct answers.

(b) Many candidates did not attempt this question. To be successful answers had to show understanding that a regular polygon has 'equal sides' and 'equal angles'. Many candidates were able to gain one of the two marks but it was rare for candidates to gain full credit. There was a wide range of incorrect answers given, many described symmetrical properties, sum of exterior or interior angles, a polygon needs more than 3 sides or only 2 sides are equal.

(c) Again, this part was found very difficult. Many candidates found the exterior angle. Another common error was to find the sum of all interior angles but not divide by 10 to find one interior angle.

Question 8

(a) This question was found challenging by many candidates. Those who used the distance, time, speed equation were usually able to correctly find Diego's speed in metres per minute (6 ÷ 40) but could not then convert it to km per hour. Other common errors included dividing by the time of day, multiplying distance and time or rounding prematurely before multiplying by 60.

(b) (i) Drawing the line representing the time spent at the swimming pool was the most successfully answered part of this question. Most candidates drew an accurate ruled line to 1220.

(ii) Around half of the candidates correctly found that Diego spent 1 hour 40 minutes at the swimming pool. Common incorrect answers were 1 hour 45 mins, 2 hours 40 mins and 2 hours 20 mins.

(c) Candidates found drawing Javier's journey to the swimming pool very challenging. The best solutions were drawn with a ruler and accompanied by working out calculating that the journey took 40 minutes. The most common errors were starting Javier's journey from Diego's house or starting at 10 15 but arriving at the swimming pool at the same time as Diego.

(d) Candidates were more successful at drawing the journey back from the swimming pool. The most common error was to draw both lines to the horizontal axis (Diego's house).

Question 9

(a) Explaining why the probability that the spinner lands on a prime number is $\frac{4}{7}$ was challenging to all candidates. Most candidates were able to identify that 4 of the numbers were prime but they needed to identify the 4 prime numbers to gain credit for their comment. Another common error was including 1 as one of their prime numbers.

(b) (i) Candidates were more successful at completing the tree diagram. However, it was rare to see a completely correct diagram. The majority of candidates correctly identified the first branch for 'not prime' as $\frac{3}{7}$ but many used probability without replacement for the second set of branches. Many candidates did not use fractions as the probabilities and just gave frequencies.

(ii) Few candidates were able to calculate the probability that the spinner lands on a prime number both times. Many candidates added the probabilities on the two 'prime' branches or gave the common incorrect answer of $\frac{4}{7}$.

Question 10

(a) This question was found challenging by many candidates, although some correct and complete answers were seen. Candidates should realise that in a multi-level problem solving question such as this the working needs to be clearly and comprehensively set out. The majority of candidates sensibly attempted to answer this question in stages. Common errors in finding the area of the semi-circle included incorrect formulas used, omission of dividing by 2, use of 9 instead of 4.5, and simply using 4.5×4.5. The most common errors in finding the area of the right-angled triangle was not dividing by 2 (base $\times$ height only) or using Pythagoras Theorem to find the hypotenuse and then multiplying the wrong sides. Many candidates gave an inaccurate answer due to premature rounding. The majority of candidates were able to give the correct units of cm^2, the most common wrong answers were cm, cm^3 or no units given.

(b) Candidates who recognised that to find *AB* they needed to use Pythagoras' Theorem were generally successful and full workings out were seen. Common errors when using Pythagoras' theorem was to forget to square root or rounding before square rooting. Candidates who did not recognise it was a Pythagoras' Theorem question were unable to find the answer. Although possible to solve using trigonometry this was only seen a few times although each one was completed correctly.

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. 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 $y = -1$, $x = \text{k}$ 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, $x = 2 - 20$, $x = \frac{20}{-2}$ or $x = \frac{20}{8}$.

(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 $\frac{p-3}{5}$ 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 $\frac{p}{5} = t - 3$. 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 (WITHOUT COURSEWORK)

Paper 0580/33
Paper 33 (Core)

Key messages

To do well in this paper, candidates need to demonstrate that they have a good understanding of all topics in the syllabus, remember necessary formulae, and use a suitable level of accuracy. In addition, candidates need to ensure that they read the questions carefully and ensure that they are answering the question asked.

It is generally expected that candidates show some mathematical workings. This is particularly important if they make an error as without workings, they are usually unable to score any method marks.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Overall, there were some excellent responses. Most candidates completed the paper in the time available although there were a significant number of parts that were not attempted. 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 paid to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) (i) The majority of candidates gave the correct answer. A common incorrect answer was 90°.

(ii) The majority gave the correct fraction in its simplest form. Some gave an equivalent fraction and a few converted it to a decimal or percentage, although some candidates did not include the % sign leaving an incorrect answer of 62.5.

(iii) It was common to see answers that were only partially cancelled or written as equivalent fractions or decimals. Candidates need to take care they write the ratios in the same order as the question asks.

(iv) Very few correct explanations were given in this part. Incorrect answers usually referred to 90 or $\frac{1}{4}$ being even numbers. A significant number of candidates did not attempt this part.

(v) A slight minority of answers were correct. Various incorrect methods were seen, often with no working. Common incorrect responses were finding the total number of candidates or finding the sector for Physics as a percentage of the whole pie chart.

(b) (i) The majority of answers were correct. A common incorrect answer was 24, given by candidates who did not include the students who studied neither subject.

(ii) Many answers were correct. Some candidates gave the answer 5 for those candidates who only study geography, or 9 for the intersection of the sets, or listed 5 and 9 without adding them.

(iii) This part was answered well by many candidates. Common incorrect answers were 9 or $\frac{9}{24}$ (omitting the 4 candidates who studied neither subject). The answer $\frac{9}{24}$ was sometimes given even when the correct total number of candidates, 28, had been given in the previous part.

(iv) A minority of candidates gave the correct answer. Many subtracted 1 candidate from the intersection but often did not know to add it to the candidates studying only geography. Many different incorrect diagrams were seen.

Question 2

(a) This part was answered correctly by a large majority of candidates, usually with clear working shown.

(b) Many correct answers were given in this part. A very common incorrect answer was $15.12 from finding 90% of $16.80. A few subtracted $10 or $0.10 from $16.80.

(c) A large majority of candidates gave the correct answer. The most common error seen was to find the amount of the increase but omitting to add this to the original price. A few candidates just wrote the increase as 27 on the answer line which is taken to be $27 and some added 0.15 to $1.80.

(d) (i) This part was answered correctly by many with clear working shown. A few candidates got into difficulty after adding 5 and 1.5, misunderstanding the multiplier of 1.5 per kilometre. A significant number of candidates did not attempt this question.

(ii) The majority of graphs were drawn from (0, 0) to (10, 20) rather than (0, 5) to (10, 20). Many others were only awarded partial credit for correctly plotting the point (10, 20); common errors were drawing a horizontal and/or vertical line to (10, 20). Other graphs consisted of two joined line segments that were horizontal from (0, 0) or (0, 5) then sloping to (10, 20). Candidates should note that line graphs need to be ruled.

(e) This part was answered correctly by a large majority of candidates. Some started with a correct division $20 ÷ 1.55 = 12.9 but did not know how to calculate the amount of change due. A few rounded up to 13 which was incorrect in the context of this question, or just subtracted $1.55 from $20.

(f) Candidates found this part challenging with few finding the correct answer. Those candidates who recognised the answer was the LCM of 12 and 50 were nearly always successful. Others multiplied 12 × 50 = 600 but did not realise this was not the LCM. The most common method was to divide 50 by 12 leading to the final answers 4, 4.1, 4.16 or 4 × 12 = 48 or 50 – 48 = 2. Candidates did not know how to proceed from this initial step.

(g) This question was answered well by many candidates showing clear working and with answers given to a sufficient degree of accuracy to allow correct comparisons of the bottles. Most of the successful candidates opted to compare the cost per litre, cost per 2 litres, cost per 6 litres or the number of litres per dollar, although other equally valid methods were seen. A common misunderstanding was to choose bottle B following 2.6, 2.66.., 2.625 for the cost per litre, thinking the biggest number gave the best value. A similar error, in reverse, was often made when the number of litres per dollar was compared. Some answers were not given to sufficient accuracy. A common incorrect method was to multiply the cost by the number of litres for each bottle.

Question 3

(a) Many candidates were able to give the correct area. A common incorrect answer was 12 from 6 × 2; otherwise many different incorrect answers were given.

(b) The majority of candidates found the correct answer. A common error was to find the area.

(c) Many candidates gave the correct answer. It was very common for candidates to divide the area by 4 or, less commonly, to divide the area by 2.

(d) (i) Many candidates were able to give the correct volume. Many different incorrect answers were given, often resulting from attempts to find the surface area of the cuboid or the area of various combinations of the faces.

(ii) A minority of candidates were able to give a correct answer. A very common error was to give the same dimensions as the original cuboid. Others gave three numbers which did not multiply to 48.

(e) Many correct answers were given. Candidates often gave the answer in decimal form rather than in terms of π as required. Some used the incorrect formula $2\pi r$ and a few subtracted the area of only one small circle from the area of the large circle.

(f) (i) Many candidates found the correct angle. A few gave the total sum of the interior angles. Other incorrect answers often seen were 180° or 360° or resulted from random incorrect methods.

(ii) This question was found challenging by many candidates. A few candidates who did not score in **part (f)(i)** restarted the process and gained full credit. A significant number successfully found the interior angle of the pentagon, 108°, and a few subtracted this from 140° but forgot to halve the answer. Some candidates thought the interior angle could be found from 360° ÷ 5 = 72º. Most candidates were unable to relate the previous answer from **(f)(i)** to the diagram in this part.

Question 4

(a) (i) A large majority of candidates gave the correct answer. Some read the scale as 10 25 or 10 29.

(ii) A large majority of candidates gave the correct answer.

(iii) Candidates found this part challenging. Many candidates were able to draw the line to represent the boat being stationary for 20 minutes but could not complete the graph correctly. Some just joined this line to the top corner of the grid at (13 00, 18) without calculating where it should reach. Others joined it to an incorrect location not always reaching *C* or omitted the rest of the journey altogether.

(iv) Whilst many candidates showed a good understanding of how to calculate speed, this question proved challenging to the majority of candidates, with many struggling with the conversion of a time in hours and minutes to a time in hours in decimal form. Some candidates either omitted the 20 minutes spent stationary from the total time or calculated two separate speeds for each of the respective segments and proceeded to average them.

(b) (i) Many correct responses for measuring the bearing were given. A common error was to measure the distance from *X* to *Y* either in centimetres or converted to kilometres.

(ii) Many candidates plotted the position of point *B* accurately. Many others were awarded partial credit. It was quite common for candidates to plot *B* on the coastline usually at an incorrect distance from both *X* and *Y.*

(iii) Only a minority of correct answers were given in this part. A common incorrect answer was 76° from 360° – 284°. A sketch diagram showing the location of *S* from *X* would have helped more candidates to calculate the exact answer. Some did use the given diagram to plot the position of *S* by measuring its bearing of 284° from *X* and then measured the reverse bearing. This often led to inaccurate answers of 103° or 105°. A significant minority did not attempt this part.

Question 5

(a) Nearly all candidates drew the correct diagram.

(b) Nearly all candidates completed the table correctly.

(c) (i) This part was answered well. Some knew the expression involved $4n$ but could not complete the constant term correctly. Some incorrect expressions such as $n + 4$ were given.

(ii) Many correct answers were given showing clear and correct working. A few substituted 73 into the expression $4n + 1$ rather than solving $4n + 1 = 73$.

(d) (i) The majority of candidates answered this part correctly showing 5 + 9 + 13 = 27.

(ii) A minority of responses were correct. Some substituted $k = 1$, $k = 2$ and $k = 3$ into the expression without realising they only needed to substitute $k = 3$ and a few incorrectly thought they needed to add these three answers together. Some equated $2k^2 + 3k = 27$ and tried to solve this equation, making no progress. A significant minority did not attempt this part.

(iii) This question was found challenging by many candidates. The most common incorrect answer was 10, resulting from subtracting the sum of the first 10 terms from 240. Other incorrect methods were very common and varied, including adding the first 7 terms or subtracting the number of sticks in diagram 10 from 240. A small number of candidates made some arithmetic errors in calculating the terms of the sequence in otherwise fully correct methods.

Question 6

(a) Many candidates gave the correct equation. Many equations had either the correct gradient or intercept. Common errors were $y = 2x + 3$ and $y = 3$.

(b) (i) Many candidates completed the table of values correctly. A common error was to calculate (–2, – 1) from not using brackets on a calculator when carrying out the substitution.

(ii) Many fully correct curves were drawn and a large majority of other graphs were awarded partial credit. Sometimes this was because the minimum point was not below the line $y = -5$. Candidates who made the error in part **(b)(i)** should have checked the shape of their graph and realised it should be symmetrical for a quadratic function. A few candidates had ruled sections or plotted the points but did not join them with a curve.

(c) (i) This part was not answered well. Candidates did not use the values in the table to realise the line of symmetry of the graph was when $x = 1.5$, nor did they use the graph accurately to determine this. Hence, they did not use $x = 1.5$ as a coordinate for the minimum point. Incorrect answers included (1, –5), (2, –5) or x values of 1.4 or 1.6 which were off centre.

(ii) This part was not answered well. Candidates who had realised the minimum point was when $x = 1.5$ in the previous part usually drew the line $x = 1.5$ long enough to show the symmetry of the graph. Some managed to draw this line even if they did not score in the previous part. Many omitted this part or drew inaccurate lines.

(iii) Few correct equations were given in this part.

(d) Those candidates who had drawn the curve in **(b)(ii)** often gave the correct coordinates for positive x. Some incorrectly gave the point of intersection when x was negative or both points. A few gave the answer as (0, 3), where the curve crossed the y-axis.

Question 7

(a) (i) Many answers were correct. The most common incorrect answers were acute and triangle.

(ii) A large majority gave the correct answer.

(iii) A large majority gave the correct answer.

(b) Many candidates omitted this part. A minority showed the required working 180° ÷ 3 = 60° as a general case. Candidates often added the angles in the diagram from **(a)(i)** and divided by 3 to reach 60° as a specific example. Some multiplied 60° × 3 = 180° which was not accepted as candidates should not use the value they are expected to show within their workings.

(c) Many candidates recognised they needed to use trigonometry in this part but only a minority gave the correct solution to the required accuracy. It was common for answers to be given to 2 significant figures, 9.8, and were sometimes given as 9.76 rather than 9.77 or 9.766… A common error was to start with a correct equation $\cos 35 = \frac{8}{h}$ but then rearrange it incorrectly to $8\cos(35)$. Others used $8\tan(35)$ to find the vertical height 5.6, but made no further progress.

(d) (i) This part on similar triangles was answered very well. Less able candidates made the common error of finding the difference between the corresponding base sides and then adding this to the length *AC* while others applied Pythagoras' theorem even though the triangle was not right-angled.

(ii) This part was very similar to the previous part.

(e) Most candidates used Pythagoras' theorem correctly to find the missing side. Many did not add this to the given sides to find the perimeter. Some used Pythagoras' theorem incorrectly by adding $26^2 + 24^2$ while others just added the two given sides of the triangle.

Question 8

(a) Candidates found this question challenging. Some candidates found one correct bound, some wrote their answers in centimetres and a few gave the answers in reverse. A common incorrect upper bound was 18.74. Other errors included adding and subtracting 5, 0.5, 0.1 or 1.

(b) Although some candidates displayed an efficient method which led to full marks, this question proved challenging for many. Some were able to show a conversion between kilograms and grams. Others had some idea of the method and were awarded partial credit even if the units were inconsistent. Quite often inaccurate rounding was seen in the final answer.

(c) Answers to this part were split fairly evenly between those who gained full marks and those who were awarded the method mark for the correct multiplication 2.7×6000. A few gained partial credit for writing their answer correctly in standard form following incorrect working.

(d) This part proved challenging to many candidates with fully correct and accurate working quite rare. Many candidates who used the correct method only gave their answer to 2 significant figures. A common error was to calculate $\frac{12}{12.017} \times 100$ then subtract the answer from 100. A significant number had an idea of how to start but wrote down an incomplete method, $12.017 - 12 = 0.017$, or gave the answer as 1.7 or 17.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/41
Paper 41 (Extended)

Key messages

Candidates sitting this paper need to have a thorough understanding of all the topics on the extended syllabus. Some candidates did not respond to many parts of the questions, while others missed out whole questions entirely. This suggests that they may not have fully prepared for the exam.

Candidates were generally able to show their working well, but it is important to show the methods that were used. In some cases, incorrect answers were written on the answer line without any working. If these answers had included working, it may have been possible to award method marks. Other candidates crossed out all of their working, which should have been left to support their responses.

General comments

There were some excellent scores on this paper with a good number of candidates demonstrating that they had a clear understanding across the wide range of topics examined.

It is important for candidates to read the questions carefully and make sure they understand what is being asked. For example, in **Question 1(a)(iii)**, the question asks for the mean mass of pear trees, not all the trees. In **1(b)(ii)**, the amount needed is in dollars for one pear, not Euros for 12 pears. By carefully reading the questions, candidates can avoid making common mistakes and ensure that they are answering the questions correctly.

Questions that involve drawing within their solution should be clear and easy to follow with straight lines being drawn using a ruler when appropriate. On this paper, the box-and-whisker plot (**Question 5(a)(ii)(a)**), the histogram **(5(b)**) and the lines representing the inequalities **(8(b))** should all be ruled as those drawn freehand were often inaccurate.

Many candidates show multiple attempts when answering questions. However, it would be helpful for candidates to indicate which of their attempts they would like to be marked when answering questions. This is because if none of the attempts leads to the correct answer, the attempt with the lowest mark will be used to calculate the candidate's score. This can sometimes have a negative impact on the candidate's score, as was the case with **Questions 1(b)(ii)**, **7(b)**, and **7(d)**.

When answering questions that ask candidates to 'show' results, it is important to start with the given information and arrive at the value or result that is asked to be shown, ensuring that every step is explicitly shown. For instance, in **Question 2(a)** candidates were expected to arrive at 32.0(0) in order to be able to conclude that the angle was approximately 32. Many started by assuming that the angle was 32, and then, using subsequent parts came back full circle to the intended value. Such an approach will not score full marks. The commonest case was the candidate who used 32 to find the length EA = 3.4 (as asked for in **part (b)**) and then used EA = 3.4 to show that angle $EBA = 32$ in **part (a)**.

Comments on specific questions

Question 1

(a) (i) Almost all candidates answered this question correctly. Some scored one mark for correctly finding one part as 50 but proceeding no further. The most common incorrect method seen was to divide 1250 by 12, without using the fact that there were 25 parts in total.

(ii) Almost all candidates answered this question correctly though some scored just one mark for finding the total mass as 80 000 kg but did not convert to tonnes. Others divided by 64 rather than multiplying.by 64 whilst a small number of candidates did not read the question carefully enough and tried to find the mass of just the apple trees.

(iii) A good number of candidates answered this part correctly, recognising this as a reverse percentage question. The common errors were answers of either 59.4 or 48.6 from either increasing or decreasing 54 by 10 per cent. A small number of candidates first worked out the total mass of pears from the 450 trees as 24300 and worked with this number, some were successful but others made the same common errors as stated earlier.

(iv) Almost all candidates answered this part correctly. Some scored one mark for finding the number of trees lost as 250 but not going on to give the number remaining. The most common incorrect method was $1250 - \frac{1}{5} = 1249.8$ without appreciating the need to find one fifth of the trees.

(b) (i) It was rare for candidates not to answer this part correctly. The most common error was to find the cost but not go on to calculate the change.

(ii) Whist a small number of candidates answered this part correctly many did not score any marks at all. A wide range of different errors were seen, including multiplying by the conversion rate rather than dividing, subtracting values in different currencies, such as 0.54 – 0.51, rounding prematurely or using 1 – 0.826, Many chose to work with 12 pears, and were able to earn one method mark or two special case marks if they correctly reached $0.93 for the extra cost in dollars of 12 pears.

Question 2

(a) Very few candidates were able to clearly show that angle *EBA* = 32. In questions involving showing or proving a result, candidates should not be starting with that given result, but should be working towards it, as though it had not been given. Some recognised that to start the question they needed to use the volume and length to find the area of the triangle. From here, candidates were required to clearly show their method by setting up a calculation, showing all the rearrangement as well as a more accurate value such as 32.0 before giving 32. Common wrong methods used the 32 to find a value, usually the cosine rule to find *EA* = 3.4, and then used this in reverse to get back to the 32.

(b) A number of candidates answered this correctly recognising that the cosine rule should be used whilst others were successful in using longer alternative methods, usually by finding the perpendicular height of the triangle, as required for **part (c)** and using Pythagoras' theorem twice. Some made errors with the cosine formula and others tried to use the sine rule but found they had not got enough information to make progress. Some candidates assumed the triangle was isosceles, often giving the answer of 5.7 or splitting the base into equal lengths of 3.2.

(c) A number of candidates also answered this correctly. However, whilst a good number of candidates evidenced, by drawing a right angle in the correct place on the diagram, that the shortest distance was perpendicular to *AB*, many, as in the previous part, wrongly assumed that this perpendicular would meet *AB* at its midpoint and 3.2 was frequently used incorrectly in a range of calculations.

(d) It was rare to see this part answered well with most candidates unable to visualise which angle was needed to be found with many attempting to find angle *FBD* or angle *FBC*. Frequently these candidates were awarded method marks for using Pythagoras to find a relevant length, usually, *BF* that could have been used in the evaluation of the required angle. Most of those using the correct method, scored full marks but some lost the last mark due to premature approximation within their work.

(e) Almost all candidates scored at least one mark on this question. However, few managed to use both of the correct unit conversions to find the correct number of grams. Whilst the majority used 1000 g = 1 kg only a minority used 1,000,000 cm^3 = 1 m^3. Candidates not scoring had usually divided rather than multiplied the two values.

Question 3

(a) (i) Most candidates were able to accurately find the mean though some errors were made with the midpoints or later, slips with the arithmetic. However, clear evidence of method meant that most candidates were able to gain some, if not all, of the method marks. A minority of candidates found the mean of the four frequencies as 250. It was not uncommon to see candidates using the class widths instead of the midpoints.

(ii) This part was answered well with many candidates scoring full marks. The most common errors were either not simplifying the fraction, or giving it as a percentage. Other errors usually came from not including the 200 or adding in the 520.

(b) (i) A good proportion of candidates answered this correctly though incorrect answers included 25, 24 000 and 24 700, as well as some no responses.

(ii) A good proportion of candidates were able to correctly write 24 730 in standard form. Common errors included having more than one number in front of the decimal point or having the incorrect power, usually 3, 5 or –4. Candidates who converted their previous answer in to standard form did not score.

(c) (i) A small proportion of candidates answered this part correctly. Candidates could score full marks by either considering the data as continuous, $505 \times 330 = 166{,}650$ or as discrete, $504 \times 329 = 165{,}816$. Candidates who did not score full marks frequently picked up method marks for using one or more correct values. Common errors included adding/subtracting 10 and 20 rather than 5 and 10, merely calculating 500×320, or choosing an incorrect operation such as divide or subtract.

(ii) Candidates who were successful in the previous part were often successful in this part. The most common incorrect answer was 295 from 790 – 495. However there were again candidates who used the wrong bound adjustments or gave the answer of 300, with no bound adjustment from 800 – 500.

Question 4

(a) (i) This part was answered very well. The few errors seen included omitting the division by 2 or calculation errors.

(ii) This part was also invariably answered correctly. The most common errors seen included giving angle Q as 90, choosing the incorrect trigonometrical function, or rounding, for example $\frac{8}{24}$ to 0.33 or 0.3 before applying the inverse tan function. It was not uncommon for candidates to be successful using the much longer method of Pythagoras to find the hypotenuse and then either sine or cosine, but, as before, some lost the accuracy mark from premature approximation.

(b) Many candidates found the volume accurately though some lost a mark for either premature approximation within their working or for using an inaccurate value of pi, such as 3.14. There were others who only got as far as finding the area of a semi-circle or who found the volume of the whole cylinder. Other errors included using an incorrect formula for the area of a circle or for answers which came from multiplying various multiples of 6, 11 and pi together.

(c) (i) A good number of candidates answered this part very well. Working was usually set out clearly and it was almost always easy to follow the methods being used with most answers accurate, with very few errors given to premature approximation. Other candidates found it hard to work out the exact area to take away from the rectangle but they, more often than not, were able to earn method marks, one for each of the area of the rectangle and the area of the circle. A minority of candidates did not use the correct formula for the area of a circle.

(ii) This part was also answered well, with clear working and methods evidenced. Again, many candidates were able to earn a method mark for either the circular or straight part of the perimeter, even if they could not work out the total perimeter correctly. Common errors included working out the total perimeter of the rectangle without subtracting the two missing lengths of 4 units, subtracting rather than adding the arc length, finding either the whole or wrong fraction of the circle or using an incorrect formula for the perimeter of the circle.

Question 5

(a) (i) (a) Most candidates gave the correct median. The most common incorrect answer was 35, this being the the middle of the age range. Some candidates gave answers over 100 years old, without thought that this might be too old.

(b) Most candidates gave the correct lower quartile. A few candidates gave the answer 40, probably arising from $160 \div 4$.

(c) This part was also answered very well though some candidates, having scored one mark for 148, as the number of people aged 50 or less, then omitted to subtract this from 160. Another common error usually involved an incorrect reading of the scale as 144.

(d) This part was answered well with many correct answers given. Others often scored one mark for 104 seen.

(ii) (a) This part was answered well by a minority of candidates and these candidates drew box-and-whisker plots that were ruled and carefully drawn. It was evident however, that many candidates were not completely clear about what a box and whisker diagram should look like and that it has a specific layout. Many candidates were unclear as to which values to plot, and how to represent them. Other candidates plotted their values inaccurately and few evidenced 34 as the upper quartile value.

(b) A good number of candidates answered this correctly. There were a wide range of responses, including calculations, that demonstrated that many candidates did not understand that the median represents the value of the middle piece of data.

(b) Only a few candidates scored full marks on this and the histograms were expected to be accurate and ideally ruled and with no gaps between the bars. Many candidates drew bars with heights 1.85, 1.2 and 3 from dividing all of the frequencies by 20, taking no account of the different interval widths and these candidates often just scored one mark for the correct bar with height 1.2. Other candidates seemed to draw bars of various heights, which came from various sums, differences, products and divisions of the numbers given in the question.

Question 6

(a) Almost every candidate started their answer to this question by correctly plotting points *A* and *B* on the grid. A minority of candidates then completed the square on the diagram to score full marks. Of those who completed the expected square, many lost marks by inaccuracy in their plotting, costing them some or all of the other marks. Some tried to find the equation of the line joining *A* and *B*, and hence of *BC* or *AD* but this was an almost too complicated and too long a method for them to be successful. The majority of answers were incorrect and did not have squares drawn, usually a rectangle *ACBD* with coordinates (1, 1) and (–2, 5) or a rhombus with *ABCD* and coordinates (4, 1) and (1, –3).

(b) (i) Most candidates answered this question correctly with many candidates using the grid to draw *P* and *Q* to help them. For those not using the grid, the main errors arose from arithmetic errors, sign errors, or finding the mean of the difference, rather than of the sum, of the coordinates.

(ii) A good number of candidates were able to obtain the length of *PQ* to the required accuracy by calculation. Common errors included adding the coordinates rather than subtracting them or not squaring the differences and arithmetic errors. Those who used the grid and counted the squares and found $\sqrt{14^2 + 2^2}$ did not score, nor did those who measured the length as they could not give the length to the required 3 significant figure accuracy.

(iii) Many candidates gave the correct gradient for the line either from calculation or from points *P* and *Q* on the grid. The most common errors came from arithmetic slips, errors with signs or using ''rise over run'' upside down.

(iv) Whilst some candidates found the correct line, there were a wide range of errors seen. These included not using their gradient from **part (b)(iii)** or using the reciprocal of the gradient from **part**

(b)(iii). Whilst some used (2,0) to find the value of c, others used (0,2) or *P* or *Q* or the midpoint of *PQ*, none of which were on the line. Again, there were arithmetic slips and sign errors. Candidates omitting the ''y='' or giving an inexact equation, with rounded decimals rather than exact fractions, could score a maximum of 2 out of 3 marks.

Question 7

(a) (i) Some candidates factorised the expression completely. Some scored two marks for factorising the expression into two brackets, without taking out the 3. Most candidates were able to score just 1 mark by simply taking out a factor of 3 but not able to factorise further as they did not recognise that $9y^2 - 1$ was the difference of two squares. Others were unable to make any progress with this question and candidates should be advised to look for any common factor, whether numerical or algebraic as a first step.

(ii) Many candidates factorised the expression correctly and demonstrated a clear technique to do so. Some scored one mark for getting as far as $m(2-p)+k(2-p)$ or any equivalent useful step but then could not complete the solution. Other candidates gave two brackets with different signs such as $k(2-p)-m(p-2)$ but could make no further progress. Some candidates were not sure how to factorise this type of expression.

(b) Very few candidates scored full marks on this question. Most were able to correctly write the common denominator as $(x-1)(x+1)$ and many gave the numerator correctly as $(x-1)(x-1)-6(x+1)$. However few candidates were able to expand and simplify the numerator correctly with a variety of numerical and sign errors, such as $-6x+6$ often seen. In addition there were a variety of cancelling errors, for example, $\frac{(x-1)(x-1)-6(x+1)}{(x-1)(x+1)}$ wrongly cancelling to $\frac{(x-1)-6(x+1)}{(x+1)}$ or $\frac{x^2-8x-5}{x^2-1}$ wrongly reducing to $\frac{-8x-5}{-1}$.

(c) Most candidates recognised that the quadratic formula needed to be used for this question and many showed precise substitution into the formula evaluating the two solutions carefully to the required degree of accuracy. Common errors included stating the formula incorrectly, dealing with the $-b$ as -3 rather than $-(-3)$ or writing b^2 as -3^2 rather than $(-3)^2$, having short fraction lines or short square root signs which did not cover the relevant parts of the sum as well as arithmetic errors and answers rounded to the wrong number of decimal places.

(d) There were some excellent answers to this question with candidates showing excellent algebraic manipulation. However, there were many conceptual errors seen. Common examples included, not using brackets or multiplying both sides by *m* incorrectly as $k = 4 + kp \times m$ rather than $k = (4+kp)m$, error signs when collecting terms in *k* on one side, and factorising $k - kpm$ to $k(pm)$. Some candidates did not understand that they needed to manipulate the equation so that *k* was on only one side of the equation with a common incorrect final answer being $k = 4m + kpm$.

Question 8

(a) Some candidates wrote down the three inequalities correctly. Most other candidates offered a response but there were frequently errors with both the direction and the type of inequality sign chosen. Other candidates had little knowledge of what was intended and wrote expressions which did not make any mathematical sense.

(b) A minority of candidates completed this correctly and they often used ruled, carefully drawn dashed or solid lines with clear shading and a defined region. Other candidates demonstrated a fair understanding of the approach needed but lost marks because they either used dashed or solid lines incorrectly, drew inaccurate lines, or shaded the wrong side of one or more of the lines. A significant number of candidates only scored 1 or 2 marks usually for drawing either $x = 4$ or

$y = 7$. In addition, there were a number of candidates who did not offer a response or whose lines had no relevance to the problem.

(c) Candidates with the correct diagram were frequently able to give the correct answer. Some others were able to give the correct answer simply by considering the given information.

(d) Although few candidates were able to give the correct answer, many scored one mark for evaluating the profit for a point in their region. Candidates who evaluated profit for a point outside of their region or who attempted an evaluation for non-integer values of shirts or dresses, or who gave a profit without workings (other than the special cases) did not score.

Question 9

(a) (i) It was rare for a candidate not to list the elements of *X* correctly. The most common incorrect answer was to list only *r* and *l.*

(ii) Most candidates recognised that *r* and *l* were the elements not in *Y,* but only those that gave the number of elements, namely 2, as their answer scored, as listing the elements did not score.

(b) Although some candidates shaded both diagrams correctly, it was more usual for one of the two diagrams to be incorrect and although most candidates offered a response, many showed little understanding of union or intersection, seemingly shading regions at random.

(c) (i) Whilst there were some correct answers, there were many answers which showed little knowledge of Venn diagrams such as placing the same number in multiple regions rather than in just the intersection of the sets. Another significant error was to either omit numbers, usually the 11, or to include extra values, usually 0 or 13.

(ii) This was a difficult region to locate and only a minority of candidates were able to evidence that they knew exactly which regions it included. It was even rarer to see the correct answer, even with follow through, as candidates frequently either listed the elements or found the total of the elements in the regions rather than giving the number of elements as required. °.

Question 10

(a) (i) The majority of candidates understood the function notation and gave the correct answer.

(ii) Many candidates were able to correctly find the inverse function. Most candidates started by swapping the *x* and *y* in the function to $x = 2y + 5$ and then rearranging. Common errors were not dividing every term by 2 or moving the +5 to the other side with the wrong sign. Other errors included just reversing the signs in *g*(*x*) giving $g^{-1}(x) = -2x - 5$ or confusing the inverse function with reciprocal resulting in $g^{-1}(x) = \dfrac{1}{2x+5}$, or by writing $x - 5/2$ rather than $\dfrac{x-5}{2}$ or leaving *y* in the answer rather than changing to *x*.

(iii) Some of the candidates who set up the combined expression correctly scored full marks. Common errors included expanding $(x-4)^2$ as $x^2 - 16$, writing the combined expression without brackets as $x - 4 \times 2x + 5 \times x - 4$ or trying to expand the 3 brackets altogether rather than expanding two to start with. Other errors included slips with signs, slips combining like terms and slips with arithmetic. In addition, a significant number of candidates appeared to misread the question and tried to evaluate $\mathrm{f}(x) \times \mathrm{g}(x) \times \mathrm{h}(x)$. These candidates scored a maximum of one mark for 3 terms correct out 4 from $2x^2 + 5x - 8x - 20$.

(b) A fair number of candidates answered this part correctly. Many others were able to score one mark for just appreciating it involved g(–2), evaluating g(–2), finding an algebraic expression for g(f(*x*)) or writing $3^x = 1$. Common errors included finding f(g(*x*)) or g(*x*)f(*x*), evaluating 3^1 as well as arithmetic errors.

MATHEMATICS

Paper 0580/42
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 60th 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 60th 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.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/43
Paper 43 (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 intermediate values written to at least four significant figures with only the final answer rounded to the appropriate level of accuracy.

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

There were some very good scripts in which candidates demonstrated a clear knowledge of the wide range of topics tested. However, there were also some poorer scripts in which a lack of expertise was evident. Coincidentally, a lack of familiarity with some of the topics resulted in high numbers of no responses. The majority of candidates attempted nearly all of the later questions, suggesting that they were not short of time.

The standard of presentation was generally good, however there were occasions when a lack of clear working made it difficult to award some method marks. Candidates should be aware that if they are directed to use a particular method in the question then credit for method is not given if an alternate method is used, as in **Question 10d**.

The topics that were found to be accessible were: Simple ratios, reverse percentage problem, mode and range of discrete data, mean of continuous data, forming and solving linear equation, area of triangles and compound shapes, drawing an exponential graph, distance between two points, differentiation.

In contrast, the more challenging topics included: Giving geometrical reasons, finding heights of blocks in a histogram, using a graph to solve a related equation, finding the equation of a perpendicular bisector, determining the turning points and their nature.

Comments on specific questions

Section A

Question 1

(a) (i) Almost all candidates found the correct percentage. Most errors were the result of either adding the three parts of the ratio incorrectly or slips when using a calculator.

(ii) Those that were successful in the previous part were usually successful in this part. Those that had errors in the addition of the parts of the ratio were able to use their value correctly. Calculating how much he received for the computer or the phone were the most common errors.

(iii) Calculating the selling price in order to achieve a 25 per cent profit or calculating the actual profit based on their answer to the previous part were the two most common methods. Those opting to calculate the actual profit tended to make more errors, usually basing the profit on the selling price and not the cost price. Candidates were asked to decide whether Tomas made a profit of 25 per cent and were therefore expected to write a conclusion such as 'No he did not'. A significant omitted their conclusion. Many candidates achieved a fully correct response but fewer than in the two previous parts.

(b) Many correct responses were seen. A significant minority used the formula for compound interest and some spoiled their answer by giving the balance of the investment rather than the interest earned.

(c) Most candidates demonstrated a good understanding of reverse percentage calculations and had no difficulty in obtaining the original price of the shoes. Calculating 24 per cent of the sale price and either adding it to or subtracting it from the sale price were the two most common errors.

Question 2

(a) (i) Most candidates were able to complete the stem-and-leaf diagram. In some cases, the leaves were not in rank order or candidates made a slip, usually omitting one of the values. Weaker candidates lacked understanding and often wrote the full values in the rows of the diagram. Completing the key correctly proved more challenging and mistakes were far more common. Errors usually involved listing one or more of the original numbers or giving an incomplete key such as 1 | 3 and no mention of what it represents.

(ii) Most responses gave the correct value for the median. Common errors included 4.5 from ignoring the stem, 22 and to a lesser extent 27.

(iii) Candidates were far more successful in identifying the mode. A few made no attempt at a response and some attempted to calculate the mean.

(iv) Again, most candidates were able to give the correct range. Some had a partial understanding and listed 13 and 38, forgetting the the difference was required. A few attempted other calculations such as the mean or listed the largest or smallest number.

(b) Most candidates obtained the correct probability. One common error involved replacement and $\frac{8}{12} \times \frac{8}{12}$ was often seen. Some had the correct product of probabilities but mistakenly doubled their answer.

Question 3

(a) (i) Many candidates gave a correct answer for angle *ABC*. The most common error involved reading from the wrong scale on the protractor and 62° was often seen. A small number gave the total length of the lines *AB* and *BC*.

(ii) Most candidates had no difficulty in marking the point *X* on the diagram. Most candidates did not show the calculation of the distance *BX*. A few candidates that did benefited when the position of *X* was slightly inaccurate.

(ii) Almost all candidates realised that division by five was needed but slightly more of them opted to give the answer 1:40, forgetting to change the 200 m into centimetres.

(b) This question was answered well with a small majority reaching the correct answer. Candidates usually opted to work with ratio of volumes with just a few working with ratio of masses. Most candidates calculated the volume and ratio of volumes correctly as did those working with masses. The crucial step was realising that the ratio of the heights was the cube root of the ratio of volumes. Most of those that did usually obtained the correct height for the model.

Question 4

(a) Many candidates gave a correct bearing. Most candidates were able to find the angles of the triangle and those that drew the north line at *C* were usually more successful, often giving the correct bearing. Without the north line many could go no further or stated an incorrect bearing. Some gave an anticlockwise bearing or the bearing of *A* from *C*. Several candidates used the working space for calculations of angles without identifying the angles they had found.

(b) (i) Many candidates were familiar with the alternate segment theorem and gave a correct angle for *PRS*. Common errors usually involved incorrect assumptions, often that triangle *PRS* was isosceles or that the two unmarked angles at *P* were equal. A small number gave the value of the angle *QRS* instead.

(ii) A large majority of candidates understood the angle property of a cyclic quadrilateral and gave a correct answer. A common wrong answer was 74.

(iii) Many correct answers were seen. Some opted to use the alternate segment theorem again while others opted to use angles on a line. Some of those with an error in an earlier part often earned partial credit for a correct method.

(c) This question proved challenging for almost all candidates and the award of a high number of marks was very rare. Many candidates had vague ideas of the answers but were unable to express themselves clearly using correct mathematical terms. For some parts, candidates opted to show their calculations which are not acceptable as reasons.

In order, candidates need to refer to the radius and the tangent. Quite often one of these terms was missing, instead referring to *OA* or *OB* instead of radius or *AT* and *BT* instead of tangent.

Many candidates referred to tangents but rarely mentioned that they were from the same point. Some referred to the triangles being congruent triangles.

All possible congruency conditions were given but few gave RHS.

The angle was often correct but many failed to give an acceptable reason. Partially correct reasons e.g. a straight line = 180 or *CA* is a line were common as well as some showing their calculations.

The angle was often correct but attempts at reasons rarely mentioned isosceles triangles.

In the final part it was common to see an alternate or corresponding pair of angles with many not giving the correct reason. Others gave the correct reason without the correct pair of matching angles.

Question 5

(a) (i) Most candidates recognised that the cosine rule was needed. Those starting with the expression for AB^2 were more successful than those that started with the expression for cos20.4. Many were successful but both methods produced some errors following a correct start. For the first option some calculated $(4.8^2 + 5.6^2 - 2 \times 4.8 \times 5.6)\cos 20.4$ whereas the second option tended to produce more errors with the rearrangement. Many of the incorrect responses assumed that angle *ABC* was a right angle and the use of Pythagoras was a common error. Some candidates used less efficient methods by drawing perpendiculars, such as from *A* to *BC* and then using a combination of Pythagoras and trigonometry. These less efficient methods tended to produce answers that were outside of the acceptable range.

(ii) Many correct answers were seen with the tangent ratio proving a more popular method than the sine rule. Some less efficient methods were seen such as calculating the side *BX* as the first step.

(iii) The vast majority of candidates had no difficulty in calculating the area. A few opted to use the formula ½*ab*sin*C* to calculate the area.

(b) This question was answered well with many finding the correct length of *PQ*. Most applied the sine rule in triangle *PRM* to find the length of *PM* and then doubled its length. Some forgot that *M* was the midpoint and often made incorrect assumptions about triangle *MQR* to try and find the length of *MQ*. Some candidates with a completely correct method approximated the length of *PM* so that when doubled the final answer was not in the acceptable range. Some alternative methods were seen, usually involving dropping a perpendicular from *R* to *PQ*, or similar, and then applying a combination of trigonometry, sine or cosine rule and Pythagoras. Some weaker candidates assumed that angle *PRQ* was a right angle.

Question 6

(a) (i) Most candidates had a good understanding of this topic and drew some very good cumulative frequency diagrams. Almost all diagrams had points plotted at the upper bounds of intervals with just a few using the midpoint or lower bound of the interval. Common errors usually involved the incorrect vertical plotting of one or more of the points. Some candidates drew blocks instead of a curve or polygon.

(ii)(a) Those with a correct curve usually obtained an acceptable value for the median. Errors usually resulted from misreading one of the scales.

(b) Although many correct values for the interquartile range were seen, candidates tended to fare less well on this part. Giving only the lower quartile or upper quartile value was a common error as well as the usual misreading of the scale. A small number gave the answer as 150 – 50 instead of using the readings for these values.

(c) Most candidates were able to interpret their cumulative frequency diagram correctly and many correct solutions were seen. Some gave a correct reading from their graph but then did not subtract this from 200.

(b) (i) Most candidates were able to set out their calculations clearly and went on to obtain the correct value of the mean. Occasionally some candidates made slips, either with a midpoint or with the numeracy work. Some candidates mistakenly use the interval boundaries or the interval widths in an otherwise correct method.

(ii) If candidates understood what was required then all marks were usually awarded, otherwise no marks were awarded. Many saw the height of 6 cm as being half of the frequency 12 and just halved the other frequencies to get 7.5, 8, 3.5. There were some good solutions seen. In these cases, many candidates found the correct frequency densities. If these were kept as fractions, rather than as decimals, then candidates tended to be more successful as inaccuracies due to premature rounding were usually avoided.

Question 7

(a) Most candidates identified the curve as a cubic. A sizeable minority seemed unaware of the different shapes produced by different equations. All four incorrect options were frequently seen and, in some cases, more than one of the options was offered. A few used all the options as labels for different parts of the graph.

(b) (i) Most candidates had some idea of the shape of the curve and many drew acceptable sketches. Some interpreted sketch to mean draw and a significant number of candidates attempted to plot points. Due to the lack of a scale this method often resulted in curves that were not smooth and asymptotic in nature. A common issue was for the curve to bend away from the axes for large values of x and/or y. A small number drew the curve in only one quadrant, others chose both incorrect quadrants and some drew straight lines or parabolas. A higher-than-average proportion of candidates made no attempt at a response

(ii) Many candidates had no difficulty in solving the equation, usually rearranging it to either $4x^2 = 1$ or to $4x^2 - 1 = 0$ and using the difference of two squares. Some only found the positive solution and then struggled to find a second solution. Rearranging the equation to $4x = 1$ was a common error.

(c) (i) Many correct sketches were seen. Some curves had the correct shape but the turning points were significantly above $y = 1$ or below $y = -1$. A few drew a sine curve with a different period and some drew curves that did not start at the origin.

(ii) Only a small majority found the two correct solutions. Some went wrong with the rearrangement, losing the negative sign which led to the common answers of 19.47 and 160.53. Some of those with a correct value for $\sin x$ obtained one correct value along with –19.5. It was clear that many candidates did not use their sketch graph as a check for their solutions nor did they check the sine values of their answers on a calculator.

Question 8

(a) Most candidates were able to form and solve the equation correctly. Common errors usually involve an answer rounded to 16.3 or giving the cost of four shirts.

(b) Many candidates demonstrated a clear understanding of the topic and had no difficulty in reaching the correct values of x and y. Almost all attempted to eliminate y to obtain a quadratic in x. Weaker responses often contained errors either with the substitution or with the collection of terms. As candidate were asked to show all working, they were expected to show the method for solving the quadratic. Some used factorisation, others used the quadratic formula but several just gave the solutions without any method. If the quadratic was solved correctly then the remaining two values of y were usually correct. A small number attempted to eliminate x and obtain a quadratic in y but this proved more difficult and few correct quadratics were seen.

(c) Most candidates knew the correct method for finding the total surface area of a cylinder. In some responses, one or both ends of the cylinder were omitted and in a few the volume was calculated. Once the correct initial equation had been set up candidates usually proceeded to the correct solution with only a few making errors in the collection or cancelling of the terms. Some candidates struggled to differentiate between the variable x and the multiplication sign in their working which sometimes led to incorrect answers. A higher-than-average proportion of candidates made no attempt at a response.

Question 9

(a) (i) Almost all candidates demonstrated a good understanding of area of a composite shape with most using the correct formulae. Apart from occasional arithmetic slips the most likely error was the omission of one of the two quadrants.

(ii) Almost all candidates demonstrated a good understanding of circumference of a shape with most using the correct formula for circumference. As in the previous part, occasional arithmetic slips were seen. Common errors included finding the circumference of a circle and then forgetting to halve the value or either including *AD* and *BC* in with the perimeter or forgetting to include *AM* and *CN*.

(b) Most candidates recognised the require angle and were usually able to calculate it correctly. Many used one of the two most efficient methods, either finding *AC* and using the tangent ratio or finding *AG* and then using the sine ratio. In some responses both *AC* and *AG* were found followed by either simple trigonometry or sine and cosine rules. Premature rounding frequently led to final answers that were outside the acceptable range.

Question 10

(a) Completing the table was almost always correct.

(b) Many candidates plotted the points correctly and drew smooth curves through their points. Occasionally some points were plotted incorrectly, usually the points at $x = 0.5$, 1.5 or 2.5. For some of the graphs the points were joined with straight line segments.

(c) If a correct graph was seen then the solution to the given equation was usually correct.

(d) The question asked candidates to solve an equation by drawing an appropriate line. This proved to be a challenging question and only a minority of candidates were able to determine the equation of the line and daw it successfully. Some responses had slips in the rearrangement of the equation and could only earn partial credit. Most of those that found the correct equation for the line drew it accurately but in some responses a lack of accuracy resulted in inaccurate solutions. A high proportion of candidates made no attempt at a response.

Question 11

(a) Many fully correct responses were seen. Incorrect answers were the result of errors in finding the differences in the coordinates, failing to square the differences, subtracting the square terms instead of adding or arithmetic slips.

(b) Many correct answers were seen with errors usually resulting from using horizontal distance divided by vertical distance or slips with the signs.

(c) Most candidates appeared to understand the method for finding the gradient of a perpendicular line. Unfortunately, a significant number of these appeared to have missed the importance of bisector and many simply used the coordinates of either *M* or *N* and did not find the midpoint. Some of those who attempted to find the midpoint were not successful, usually making a slip with the signs. Some candidates found the equation of *MN* correctly then simply swapped the gradient of 4/3 with 3/4, and retaining the intercept. A high proportion of candidates made no attempt at a response.

Question 12

(a) Most candidates gave a correct derivative. Incorrect responses usually involved an error with one of the two terms and in a few cases the constant term +5 was included. A higher-than-average proportion of candidates made no attempt at a response.

(b) Many candidates had a good understanding of the required method, appreciated that they needed to set dy/dx = 0 and solved the equation leading to the correct three turning points. The question required candidates to show all working but a significant number simply gave the solutions to their equation without showing any method. Some candidates then made errors when calculating the corresponding *y*-coordinates. A high proportion of candidates made no attempt at a response.

(c) While this part proved challenging for some, others showed a variety of methods. Often the second derivative was stated and values substituted to determine the negative result required for the maximum turning point. Others drew annotated sketches of the graph from –2 to +2 identifying the maximum at (0, 5). Less common were the methods of evaluating values of *y*, or gradients, on either side of points. Most errors were seen when substituting values into the second derivative. A few showed correct working but did not give any conclusion. A very high proportion of candidates made no attempt at a response.