MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus. Candidates should read the question carefully, focussing on key words and instructions and should also check their answers for sense, in the correct form and accuracy.

General comments

Candidates should pay attention to how a question is phrased, the command words used and what form the answer should take.

Candidates must show all their working to enable method marks to be awarded. Each step should be shown separately to maximise the chance of gaining marks.

The questions that presented least difficulty were **Questions 1**, **14(a)**, **16(a)** and **21(b)(i)**. Those that proved to be the most challenging were **Questions 10** (upper and lower bounds), **18** (distance, speed and time), **20(b)(ii)** (bearings), **22(b)** and **(c)** (gradient and equation of a line). The questions that were most likely to be left blank were **Questions 18**, **19(b)**, **20(b)(ii)**, **22(b)** and **(c)**. It is likely that the blank responses were due to the syllabus areas being tested rather than a lack of time.

Comments on specific questions

Question 1

Most candidates were successful with this first question and gave the correct answer. The few incorrect answers that were seen included 75, 75% and 0.8 – this last may have been an unnecessary rounding. Also seen a few times was 3.4 which did not show understanding of fractions.

Question 2

This question produced a variety of incorrect answers with the percentage given as 13.33 ($16 \div 1.2$), 19.2 (1.2×16), 1.2 or 0.012, showing a lack of understanding of this type of percentage calculation. Sometimes the answer was a power of 10 out, for example 75% or 0.075%.

Question 3

This question caused some confusion as candidates tried to combine the two unlike terms such as $1py^2$ or $5p - 30$. With factorising questions like these, it is not correct to give an answer such as $5(y - 1.2py)$ as decimals must not be used inside the brackets.

Question 4

(a) This question was well answered in general. Often questions like this give the probability as a fraction but candidates need to be able to be familiar with probabilities given as decimals or percentages as well. Some gave the probability as 0.38, the same as for green balls, while others gave 50%, maybe from the wrong assumption that if there were only two colours of balls in the bag, the probability of red was half. There was no instruction as to the form of the answer so 62% and $\frac{31}{50}$ were both acceptable.

(b) In this part, candidates were more successful, perhaps realising that it did not matter what the form of the probability was as there were no blue balls so the answer was 0 or zero although some gave 0.38 again.

Question 5

(a) A very small number of candidates found dealing with the directed numbers challenging, giving answers such as 1, 6, 8 and −12 (from multiplying the temperatures).

(b) The common incorrect answers to this part included 5 or 3.

Question 6

This problem solving question was found challenging by some candidates. The base of the cuboid is a square so the volume must be divided by the area of the base to find the height, i.e $180 \div (6 \times 6)$. However many candidates only divided 180 by 6 giving 30. A diagram would have made this a more straightforward question as candidates had to understand the physical situation from a description only. Other incorrect methods included $6 \times 4 = 24$ or $180 \times 6 = 1080$.

Question 7

Most candidates showed good understanding of standard form with many answering both parts correctly. There were some candidates who found this question challenging, more in **part (a)** than **part (b)**. Candidates need to remember that in standard form there is only one digit in front of the decimal point.

(a) The most common incorrect answer was 64×10^4.

(b) The most common incorrect answer was 6×10^4 instead of 6×10^{-4}.

Question 8

Candidates occasionally treat vectors as if they were fractions, often including a horizontal line between the two entries and trying to 'cancel' down their answers, taking out common factors in the entries.

(a) The treating of vectors as fractions (with or without a fraction line) was apparent with answers such as $\begin{pmatrix} -11 \\ 5 \end{pmatrix}$ when the vector subtraction was incorrectly interpreted as $-2 - \frac{1}{5}$.

(b) In this part, the common error was to give a single entry, 0 or 18, in the vector brackets.

Question 9

The frequently occurring misunderstanding was to divide 2100 by 3 (or occasionally, 7) instead of the total number of parts, 10. Some divided correctly but then did not carry on to complete the method by multiplying 210 by 3.

Question 10

This was the least well answered question on the paper and a fairly large number of candidates did not attempt it. The correct approach is to concentrate on the information, 'correct to 1 decimal place' first. This means that candidates have to go to the next decimal place and so subtract 0.05 m from the length of the truck for the lower bound and add 0.05 m for the upper bound. Sometimes the lower bound was correct but the upper bound was given as 8.24, as if candidates knew the length couldn't be 8.25 but didn't notice the less than sign in the answer line. The common incorrect answers were 8.1 and 8.3, or 8.2 for both answers.

Question 11

(a) The answer to this part was sometimes given as t^3 as candidates divided the indices instead of subtracting.

(b) This part was more successfully answered, with the most common incorrect answer of u^{10} coming from adding 5 and 5 rather than multiplying.

Question 12

Many candidates recognised the need for trigonometry but chose to use cosine instead of sine. There were quite a few candidates who gave the answer as 6.9 but as inexact answers must be given to 3 significant figures, this did not gain the accuracy mark. If there was no working, just the answer of 6.9 was not able to be given any marks. This is a good example of why it is vital to show method.

Question 13

(a) Many candidates did not follow the instruction to write each number correct to 1 significant figure before starting to work out an estimate for *p* and so gave the exact answer, 58.6. Some found the exact answer then rounded this correct to 1 significant figure, 60. Some rounded the values correct to 1 decimal place instead of to 1 significant figure. Sometimes the operations were copied incorrectly, for example, the denominator became an addition, or the 10 was not squared. Some did not show all or any of their working as specifically asked for in the question. The incorrect answer of 12.92... came from not rounding and then ignoring the correct order of operations.

(b) Candidates were more successful with this part but occasionally an answer of 51 was seen following their 58.6 in the previous part.

Question 14

This question was answered correctly by a vast majority of candidates. Candidates must ensure that they answer with values from the given list and write a single value for each answer.

(a) Most gave 28 although 27 was given by small number of candidates.

(b) This part was not answered by a few candidates and an incorrect number was picked by some.

(c) This part was correctly answered by more candidates than the previous part. There were two numbers in the list that are prime but candidates only had to give one. Some gave many answers, including 28, which they had already picked out as a multiple of 7, or 27, the cube number, showing that they were not clear what prime numbers are.

Question 15

This was a straightforward fraction question with an addition where only one fraction had to be changed in order to get a common denominator. This was well attempted, with the majority showing full working so a significant number gained full marks. Some candidates omitted to check the form of the answer required as some left their answer as an improper fraction and so didn't gain the final mark. A common misconception showing a lack of understanding of fractions was $\frac{5}{6}+\frac{2}{3}=\frac{7}{9}$.

Question 16

(a) Very nearly all candidates answered this question correctly. Candidates should check to see how many terms are required as, occasionally, more than one term was given.

(b) This part proved to be much more challenging for many candidates. Most showed that they were finding the difference between terms and many used this to generate an expression involving $3n$, but there were many errors in finding the required expression. Candidates who attempted to use the nth term formula frequently went wrong, usually because they misremembered the formula but also because of errors in substituting values. A common incorrect expression was nth term = $n + 3$. This is an obvious place for candidates to check their work to see if their nth term expression gave the right values. Also there were some answers that were simply integer values rather than expressions in n.

Question 17

(a) This part was well answered but some of the answers showed a lack of precision in their wording as it was common to see, 'All angles are the same' when it should be that the angles in the corresponding place in each triangle are the same or two expressions such as Angle A = Angle P. Other true statements such as, 'The angles add to 180 in both triangles', 'Both triangles have acute angles' or 'One triangle is an enlargement of the other' did not get the mark as these did not explain what make the triangles similar. The use of the word 'congruent' was incorrect.

(b) Many found the length of AC correctly by using scale factors. A frequent incorrect method of dealing with similar triangles was for candidates to write 18 – 12 = 6 so 27 – 12 = 15.

Question 18

This problem solving question had three parts to the method, converting the distance from kilometres to metres to match the speed given in m/s, finding the time using distance ÷ speed and finally converting the answer in seconds to minutes and seconds as required by the question. Many candidates found at least one of these stages challenging. Many did not convert the 10 km to 10 000 metres so $\frac{10}{20}$ was often seen. Some who got as far as 500 seconds either stopped there or wrote this as 8 minutes 33 seconds. An answer of 8 minutes 33 seconds with no working gained no marks.

Question 19

(a) (i) Candidates were mostly correct in this part. Some only gave the horizontal line and others added extra lines, most commonly diagonals.

(ii) In this part, the diagonal lines were often missing or just one diagonal was drawn. Candidates must ensure their lines go all the way across such diagrams so the lines are not too short.

(b) Common incorrect quadrilaterals given were square, parallelogram and trapezium. Other words or phrases such as obtuse angle, diamond, hexagon, pentagon, rectangular prism, cylinder and cube were also seen. Candidates need to know that quadrilateral refers to a four sided two dimensional shape so that the answer cannot have more than four sides or be three dimensional.

Question 20

(a) Most incorrect answers seen were from dividing by the wrong power of 10 as 3.67 and 367 were often seen. Some answers had completely different figures such as 4000, 1835 or the correct value rounded to 37.

(b) (i) This part was very well answered with candidates gaining partial credit for accurately measuring the distance between the towns when the actual distance they calculated was incorrect.

(ii) This part was often missed out by candidates. Incorrect answers included 43° (the angle from north towards *S* anticlockwise), 7.8 cm, the distance between *S* and *T* on the scale drawing or a compass direction.

Question 21

(a) The occasional incorrect answers seen were 8 00 or 8 15.

(b) (i) The vast majority of candidates gave the correct distance as the relevant distance was against a labelled point on the axis.

(ii) The duration of Michael's rest was occasionally given as 20, 40 or 60 minutes. The duration was slightly more challenging to calculate as the scale used had to be worked out.

(c) Only a minority of candidates could clearly explain that the first line before he stopped was steeper than the line afterwards. There had to be a comparison of the two lines not just a comment about one of the lines.

Question 22

(a) Many candidates wrote down the correct co-ordinates for point *P*. Only the occasional reversing of the co-ordinates was seen.

(b) These last two parts proved challenging for candidates and were most likely to have been left blank. A few used the formula with two points from (–2, –4), (0, –1) and (2, 2) for finding the gradient but made numerical errors with the negative signs. Only a few attempted a rise ÷ run calculation based on a triangle drawn on the graph. Some tried to use the whole line with an answer of $\frac{8}{5}$ using (3, 4) as the top most point which is not on the line. Some showed no working and just gave an answer such as 2 or 3.

(c) Candidates were not confident with the process for finding the equation of the line. Not many equated the *m* in the equation with the gradient they had found in the previous part. The remaining value, *c*, is where the line crosses the *y*-axis, in this case, –1. Some candidates reversed these values when substituting. An answer of $y = 1.5x + -1$ did not gain full credit as the signs had to be resolved into $y = 1.5x - 1$.

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

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

General comments

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

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

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

Comments on specific questions

Question 1

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

Question 2

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

Question 3

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

Question 4

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

Question 5

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

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

Question 6

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

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

Question 7

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

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

Question 8

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

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

Question 9

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

Question 10

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

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

Question 11

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

Question 12

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

Question 13

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

Question 14

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

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

Question 15

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

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

Question 16

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

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

Question 17

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

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

Question 18

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

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

Question 19

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

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

Question 20

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

Question 21

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

Question 22

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

Question 23

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

Question 24

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

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

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

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

Ensure that the questions are read carefully, make sure that working is shown especially when a question states 'You must show all your working'.

Premature rounding should be avoided.

Answers should be given to three significant figures unless a question states otherwise.

General comments

The vast majority of candidates were able to attempt all the questions in the time given. Scripts were generally well presented with clear writing. The presentation of diagrams was generally good with the majority of candidates using a ruler where appropriate. A small number of candidates needed to improve presentation, for example, when writing powers and indices they needed to ensure these are clearly raised above the answer line.

Comments on specific questions

Question 1

Many candidates rounded this number correctly. Common incorrect answers were 3.060, 3.058 and 3.1.

Question 2

Although most candidates gave the correct answer, a small number wrote an equivalent fraction which was not in its simplest form.

Question 3

This question was attempted by the majority of candidates and many gave the correct factorisation. Some candidates appeared to be confused by the 'x', leading to answers of $x(2x)$ or $x(2x - 0)$ or $x(2x - x)$.

Question 4

Although some candidates were able to give the correct co-ordinates, this question was not generally well answered. (3, −8) was the most common incorrect answer and a wide variety of incorrect responses were seen.

Question 5

Many correct answers were seen. Incorrect answers included 0.205 from using $\frac{1}{3}$ as 0.33, or $\frac{1}{24}$. Some multiplied by 60 and gave an answer of 12.5. Others wrote an incorrect fraction calculation, such as $\frac{1}{3} - \frac{1}{8} = \frac{1}{5}$. Some candidates used a calculator and gave a final answer of 0.21 without showing a more accurate value in their working.

Question 6

Most candidates gave the correct answer. 0.27 and 0 were the most common incorrect answers.

Question 7

Many correct answers were seen for this question. Mean was the most common incorrect answer. There were some candidates who appeared not to understand 'types of average' with answers such as 'frequency' and 'car'.

Question 8

(a) This question was answered very well. The most common incorrect answer was –6.

(b) There were many correct answers seen from candidates who could correctly key the expression into their calculator. Some had not cube rooted the whole sum to give an answer of 4.

Question 9

Many candidates found this question challenging. Many changed the sign when grouping like terms together, hence a variety of incorrect answers were seen, such as $14x - 13y$, $14x - 37y$, $-6x - 37y$, with some forgetting the x or y and writing $14x + 13$ or $14 + 13y$.

Question 10

(a) This part was generally well answered by most candidates. 21 and 51 were the most common incorrect answers. Only one answer was required and candidates need to realise if more than one answer is given all need to be correct to score the mark.

(b) The word irrational appeared not to be understood by several candidates. Common incorrect answers were 0.7 and $\frac{2}{3}$.

Question 11

The majority of candidates were able to give the correct answer. Others gained partial credit for one correct component. Only a small number of candidates wrote a fraction line in the vector.

Question 12

(a) Many candidates were unable to give the correct answer, with positive being seen often. Others gave a variety of descriptions such as speed = distance ÷ time.

(b) Many candidates wrote answers as units, for example km/h. Many gave the same answer to both parts.

Question 13

Many correct answers were seen in this question. Candidates found working out and measuring the length easier than measuring the angle. Many measured the angle incorrectly as 55° from the North but gained partial credit for a correct length of 7 cm.

Question 14

Many candidates gained partial credit for $2w + 2h = P$ but could not then progress to write the correct expression. Others started incorrectly with $2w = P - h$ or $w + h = P - 2$. Candidates who wrote $w + h = \frac{P}{2}$ often had $\frac{P - h}{2}$ as their final answer.

Question 15

Many candidates found this topic challenging. The most common incorrect answer was 120 +/− 5, giving 115 and 125.

Question 16

This question was correctly answered by the majority of candidates. Only a small number subtracted 5 rather than added. Checking answers may have helped some find errors as some, having reached $7x = 21$, wrote the answer as 7 rather than 3.

Question 17

Many candidates showed full working and scored full marks. Some tried to change the denominator of both fractions to 315 and therefore were dealing with large numbers. Candidates need to realise that cancelling before multiplying makes the question simpler. Few candidates worked totally in decimals and some did all the working in fractions but then gave their final answer as a decimal, losing the final mark.

Question 18

There was a good response to this question with many correct answers seen. The common incorrect method was 7.7 – 5.5 = 2.2 and then 9.8 – 2.2, leading to the answer of 7.6. Some gave an answer greater than 9.8 which should have been obviously incorrect from the diagram.

Question 19

Candidates need to ensure they read the question carefully. Many who used the correct method stopped at the amount and did not go on to find the interest. Many used the compound interest formula and some worked out the answer year by year. Not many candidates incorrectly used simple interest.

Question 20

This simultaneous equations question was answered well, with many candidates showing both the correct method and correct answers. Many candidates tried to equate the coefficients of the x terms and then made errors subtracting their equations. Candidates who equated the coefficients of the y terms and then added were more successful. Several candidates scored the special case mark for answers satisfying one of the original equations.

Question 21

(a) **(i)** This part was almost always correctly answered.

(ii) This part was not as well answered although there were no consistent incorrect answers emerging.

(b) Many correct answers were seen in this part. The common incorrect answers were $n + 3$ or 17. Other incorrect answers seen were $5n$ or $2n + 3$.

Question 22

(a) Many correct answers were seen in this part although some candidates confused volume and surface area.

(b) Many fully correct nets were seen. Partial credit was often gained for two correct rectangles in the correct position. The majority of candidates had ruled lines.

Question 23

Very few candidates scored full marks on this question. Many gained partial credit for 72° or for 108° but were unable to make further progress. Some simply divided either 360 or 180 by 3. A significant number of candidates did not attempt this question.

Question 24

(a) Most candidates knew to use trigonometry and were able to make progress by using the sine ratio, leading to the correct answer. Some however didn't gain the accuracy mark as the answer wasn't rounded to at least 3 significant figures. The common method error was to use the cosine rather than the sine ratio. A small number of candidates had a negative answer and they perhaps should have realised from the context of the question that this could not be correct.

(b) Most candidates who knew to use Pythagoras' theorem gained full marks. Several who did not have the correct answer in **part (a)** were able to earn full marks in this part as a follow through. Common errors were omitting to square root or using trigonometry again.

Question 25

(a) The majority of candidates were able to correctly measure the angle.

(b) Most candidates understood what was required in this part and many correct answers were seen. The main errors were to use $\frac{45}{480} \cdot 360$ or $\frac{360}{480} \cdot 45$.

(c) Although a significant number of candidates scored full marks, quite a number did not attempt this question. The incorrect answers were usually 100° for Geography from the question or simply labelling the remaining sector of 140° as Geography.

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae and definitions and show all working clearly. They should be encouraged to spend some time looking for the most efficient methods suitable in varying situations.

General comments

The level and variety of the paper was such that candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as most candidates attempted the whole paper.

Working was generally well set out. Candidates should ensure that their numbers are distinguishable, particularly between 1, 7, 4 and 9 and always cross through errors and replace rather than try and write over answers.

Candidates showed very good number work in **Questions 1**, **12** and **14**, and demonstrated good algebra skills in **Questions 2**, **6** and **15**.

Candidates found challenging volume scale factor in **Question 19**, circle theorems in **Question 8** and vectors, **Question 25**.

Comments on specific questions

Question 1

The vast majority of candidates could find the required percentage. The most common error was to attempt $\frac{1.2 \times 16}{100}$ and a small number tried to find 16 as a percentage of 1.2. Occasionally $\frac{1.2}{16}$ was found but the result was not converted to a percentage.

Question 2

This question on factorisation was answered extremely well by candidates. A few added superfluous elements to their factorisation such as a 1 in front of *y*, which was condoned.

Question 3

Most candidates could use their calculators efficiently and gave the correct answer without having to write down intermediate steps of working. More marks were lost due to truncating or rounding to 1 or 2 significant figures rather than calculation errors.

Question 4

Candidates should understand that bounds should be applied to dimensions before any calculations are carried out. Those who did not gain the mark were usually multiplying 15 by 3 and then adding 0.5. Some used an incorrect bound of 15.4 or 15.49 whereas others applied the correct bound but did not multiply by 3 to find the perimeter.

Question 5

This was a well attempted question which only the least able candidates found challenging. Some candidates gave an incorrect answer of 30 having calculated $180 \div 6$ rather than $180 \div 6^2$. Some candidates incorrectly assumed that the solid was a cube and so gave the answer 6.

Question 6

Candidates demonstrated an excellent knowledge of the rules of indices with very few losing marks in either part of the question. Very occasionally, the answers t^3 and u^{10} were seen.

Question 7

The vast majority of candidates selected the appropriate trigonometric ratio and calculated the length of the side accurately. Some rounded the value of $\sin 35$ prematurely and so lost the accuracy mark for the final answer. Candidates should always ensure that their calculator is in the correct mode to calculate degrees.

Question 8

A minority of candidates were able to correctly calculate the required angle. Many candidates gave an answer of 130°. Candidates sometimes referred to the opposite angle of a cyclic quadrilateral, but used this incorrectly with the centre as one of the vertices of the shape; hence 50° was a common incorrect answer. Some candidates worked out $2 \times 130° = 260°$ but did not recognise that this would be the reflex angle and gave it as their answer.

Question 9

Many candidates demonstrated that they could use their calculator to convert the recurring decimal into a fraction but it was the higher achieving ones who could demonstrate a method, which was required for both marks. The most common method was to multiply the decimal by 10 and 100 and subtract, although various other suitable methods were also seen, such as splitting the decimal in to 0.4 and $0.0\dot{7}$. When using the subtraction method, candidates should understand that they are eliminating the recurring part of the decimal and care needs to be taken with the place value here. It seemed that some were using a method without understanding what they were aiming to achieve. A common error was to misinterpret the recurring decimal as $0.\dot{4}\dot{7}$ and some ignored the fact that it was a recurring decimal, giving $\frac{47}{100}$ as the answer.

Question 10

Most candidates understood how to deal with the function and the majority gained at least 1 mark, even if there were then errors in the simplification. The most common error in the method was to equate $1 - x$ with the function and solve for x.

Question 11

Some candidates demonstrated sound understanding of probability and were able to obtain the correct answer. Many candidates did not understand the significance of the phrase 'without replacement' in the question and an answer of $\frac{4}{25}$ was often seen. It was also common to see the answer $\frac{2}{5}$, the probability of an even number being picked from the 5 cards.

Question 12

Candidates clearly understood the definitions of different types of numbers and there were very few incorrect choices in all parts of the question.

Question 13

The most successful candidates were those who recognised the format of completing the square and could find the values of *a* and *b* with very little working. Some knew that the value of *a* was 2 but then did not know how to proceed to find *b*. Many gained a mark for expanding the right-hand side of the equation correctly but then did not know how to relate this to the left-hand side and compare coefficients. The incorrect expansion of the right-hand side to $x^2 + a^2$ was often seen. Some decided to subtract *b* and then square root the left-hand side without any expansion of $(x+a)^2$ which made the necessary comparison of like terms impossible. A few used the quadratic formula on $x^2 + 4x - 9$ but could not usefully use their result.

Question 14

Candidates demonstrated a sound knowledge of dealing with fractions in this addition and showed the required clear working. A significant number of candidates did not gain the final answer mark, as they left their answer as an improper fraction, usually $\frac{3}{2}$, or converted to a mixed number but forgot to simplify the fractional part. Candidates should be encouraged to look for the most efficient ways of dealing with fractions; in this case just converting $\frac{2}{3}$ into $\frac{4}{6}$. Although correct, it was extremely common to see denominators of 12, 18 and 24 which ultimately leads to more arithmetic errors and is more time consuming.

Question 15

A high level of skill was demonstrated dealing with this expansion and simplification. The vast majority of candidates were able to gain at least 1 mark even if errors were made. Errors in the double bracket expansion tended to involve a missing term or a value of 3 rather than 2. The most common error in the single bracket expansion was to omit the x from $-6x$ or to ignore the negative sign and make it positive. There were some errors collecting like terms, some of which could have been rectified with careful checking. Method errors at this point involved multiplying the x^2 terms to make $2x^4$ and some looked to try and factorise the expression back into two brackets.

Question 16

Candidates should ensure that they read the information in proportion questions very carefully, as the majority of errors come from setting up the incorrect relationship at the beginning of the working. It was often seen as a direct relationship, or without the square root. Those that set up the correct relationship usually went on to gain full marks. Some made a correct start and found a constant of 6, but then continued incorrectly in the search for the value of *y*, with $\frac{6}{\sqrt{99}}$ being a common error. Of those who did not score, the most common answer was 10, gained from ignoring the information given in the question and simply substituting 99 into $\sqrt{x+1}$.

Question 17

This question proved challenging for candidates. A large proportion did not recognise the expression in **part (a)** as the difference of two squares. Candidates attempting to factorise often gave the answer $(p+q)(p+q)$, whilst others resorted to combining terms incorrectly, resulting in expressions in pq or p^2q^2 or similar. **Part (b)** of this question could either be attempted by using the answer to **part (a)** or by attempting to solve simultaneously. Where candidates had a correct factorisation in **part (a)** not all of them recognised how this could be used to answer **part (b)**; where they did identify the connection, the answer was generally correct. Candidates who did not have a correct factorisation in **part (a)** or who did not identify the connection between their factorisation and **part (b)** often tried to solve the equations simultaneously. Some did this successfully; others were able to get as far as $(2+q)^2 - q^2 = 7$ or $p^2 - (p-2)^2 = 7$ but did not know how to proceed. Many took a trial and error approach, often arriving at an answer of 7 using the first equation only, finding $p = 4$ and $q = 3$.

Question 18

There were many completely correct answers to the simplification in **part (a)** and a large proportion gained one mark, usually for an answer of $81y^{12}$ where candidates were unaware that the power also applied to 81. Those who did deal with 81 correctly sometimes showed some manipulation of the number, either by writing it as 3^4 before raising it to the power of $\frac{3}{4}$ or they showed that the 4^{th} root was 3 before cubing it, but the majority appeared to go straight to their calculator. It was the ability to manipulate powers which helped in **part (b)** and this was carried out very successfully. Those who changed 4^p to $\left(2^2\right)^p$ were more successful than those who evaluated 2^3 to 8 who then often did not know how to proceed.

Question 19

Volume scale factors proved to be the most challenging topic on the paper. Candidates need to understand that a length scale has to be converted when working with a volume or area. The majority of candidates used a linear scale factor and divided 12 by 20. Conversion of units was more successful and if a method mark was awarded, it was usually for a correct multiplication by 100^3 to give an answer in cubic centimetres.

Question 20

A good number of completely correct simplifications were seen and the majority of candidates were equipped with a correct starting point, where they usually earned a mark for a correct denominator. It was also relatively common to award 2 marks when a correct common denominator and numerators for both fractions were shown. This was often followed with a sign error when dealing with the $-2(x+2)$ part of the numerator, leading to the incorrect answer of $\frac{x+3}{(x+2)(3x-1)}$. Those who tried to deal with the subtraction as one fraction straight away often made this error and could not gain the mark for a correct numerator and so candidates should be encouraged to show this intermediate step in the working. Care should be taken with all signs in the expression as there were many cases of a plus erroneously becoming a negative and vice versa. Candidates should also take care with brackets and be aware that $x+2(3x-1)$ is not the same as $(x+2)(3x-1)$. Some candidates who correctly multiplied the numerators and denominators by the appropriate expressions to give fractions with a common denominator then cancelled these back again before expanding brackets. Following a completely correct method to arrive at a single fraction, it was fairly common to then see terms being cancelled incorrectly; for example cancelling an x seen as part of an expression in the numerator with an x seen as part of an expression in the denominator. Less able candidates sometimes resorted to merely adding or subtracting terms in the numerators and in the denominators.

Question 21

This was a multiple step 3-D trigonometry question which less able candidates found very challenging. Many candidates did gain a mark for making a first correct step of identifying the angle required and this should be encouraged, either by clearly showing the angle on the diagram or preferably by drawing out a triangle with clearly labelled vertices and the angle identified. Work cannot be credited if it is ambiguous which angles or lengths the candidate is referring to. The main reason that candidates could not progress further from this point was that they did not recognise the need to calculate the length *AM* or *AC* using either Pythagoras' theorem or trigonometry. Many incorrectly labelled *AM* as 8 or 4. Some calculated the length *AV* and then used sin or cos to find the required angle. Although correct, this was an unnecessary step and often led to an inaccurate answer due to rounding within the working. There were many attempts to find an incorrect angle, notably *AVM*, *VAB* or adding on angle *BAM* to the correct angle *MAV*.

Question 22

Almost all candidates could give the next term in the sequence in **part (a)** and the majority could also find the expression for the *n*th term. Those who did not score were typically offering $n+3$ as the answer. Some were confusing values in the general formula; a check to see if their formula produced the required values would have been beneficial. **Part (b)** was also carried out successfully. Any errors were usually made in the numerator, with 29 or 33 being the most common. Some did not appreciate that different sequences were being used to generate the numerator and denominator.

Question 23

Part (a) of this question was answered well by the majority of candidates with many able to correctly evaluate and obtain the correct matrix. Some candidates used a correct method, but made arithmetic errors; this often led to 1 mark being awarded for 2 or 3 correct elements in the matrix. Those who did not know how to deal with the question often just squared each value in the matrix. **Part (b)**, to find an inverse matrix, was equally well attempted. There were a good number of fully correct answers seen, which were commonly from calculating the determinant, and using this, together with swapping the position of the two elements on the leading diagonal and changing the sign on the other two elements. Where fully correct answers were not seen, a number of candidates were able to find the determinant but made errors in changing the entries within the matrix, or made errors in finding the determinant or did not attempt to find a determinant. A small number of candidates attempted this part by setting up simultaneous equations; however they were often unable to solve these without error to obtain the correct final answer.

Question 24

The majority of candidates found the deceleration of the car correctly in **part (a)**. Errors seen were dividing the time by the speed; using 70 seconds as the time; and calculating the area under the graph for the final 10 seconds. The vast majority of candidates understood that they needed to find the area under the graph to find the distance in **part (b)** and most did this successfully. Some found the area of the rectangle but forgot to halve the base $\times$ height for the triangle. The most common error in the method was to multiply the total time of 70 by the speed of 20, forgetting that this only applies for a constant speed throughout the whole journey.

Question 25

Candidates should be encouraged to show clearer working in vectors questions, particularly showing a route, which would gain credit and focus the candidate on the direction of the vector. It was common to see the correct fractional lengths of the vectors on the diagram and in the working. However, without a clear route written down or arrows on the diagram, the direction of *KB* or *BL* or *KC* or *AL* was often incorrect in **part (a)**. Finding the proportion of *CB* that covered either *CK* or *KB* proved challenging for less able candidates. A position vector was required in **part (b)** and it was clear that a large proportion of candidates did not understand this term. It was common to see the answer as half of the answer for **part (a)**. Again, the direction of different parts of the route was often incorrect. Arithmetic errors were sometimes made when dealing with the fractions and signs when simplifying, but those who set out their working clearly were able to gain a mark for a correct route.

Question 26

Candidates demonstrated a good understanding of equations of straight lines with many completely correct answers given, particularly in **part (a)**. Even where errors were made, there was the opportunity to gain part marks within each part of the question. Errors were often made in calculating the gradient in **part (a)**, often through dealing with the negative value incorrectly, but as long as the correct working was shown, 2 marks were still available. Non arithmetic errors in finding the gradient included calculating the difference in x divided by the difference in y; inconsistency in which co-ordinate was being subtracted; and mixing up x and y values within the calculation. Candidates should be aware that they may be given a $(0, y)$ co-ordinate and that the value of y is the intercept of the line. Many candidates substituted the value of the gradient into the general equation of a line to find the intercept which was unnecessary, and if the gradient was incorrect, led to an incorrect intercept if point $(6, 9)$ was chosen. Many did gain the mark available for giving an equation $y = mx - 3$, even if the gradient was calculated incorrectly. Less able candidates struggled to find the perpendicular bisector in **part (b)**, with many not attempting the question. A good proportion understood the relationship between a straight line and its perpendicular, and many gained both marks for either the correct answer, or following through correctly from an incorrect gradient in their equation for **part (a)**. A common error was to only apply half of the relationship between the gradients, and so give either the reciprocal or the negative value of the gradient. Again, any further working was unnecessary as the point $(0, 2)$ was given, and many gained a mark for recognising this and using it correctly within an equation.

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

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

General comments

A significant number of candidates demonstrated an expertise with the content and showed good mathematical skills. Only a very small number of candidates were unable to cope with the demand of this paper. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Omissions appeared to be due to lack of familiarity with the topic or difficulty with the question rather than lack of time. Candidates showed particular success in the basic skills assessed in **Questions 6**, **7**, **8(b)**, **12** and **14** and also the matrices in **Question 22(a)**. The more challenging questions were **Questions 10**, **16(b)**, **18**, **21(b)** and **23**. Candidates were very good at showing their working although sometimes stages in the working were omitted and credit for method could not always be awarded. It was rare to see candidates showing just the answers with no working. Some candidates truncated prematurely within the working or gave answers to less than the required 3 significant figures. This was particularly evident in **Questions 2**, **8(b)** and **24**.

Comments on specific questions

Question 1

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

Question 2

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

Question 3

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

Question 4

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

Question 5

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

Question 6

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

Question 7

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

Question 8

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

Question 9

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

Question 10

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

Question 11

Quite a few fully correct matrices were seen. Some candidates had the elements of the two columns of the matrix reversed. A small number of candidates left this question blank.

Question 12

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

Question 13

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

Question 14

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

Question 15

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

Question 16

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

Question 17

Some good work was seen on this question with quite a few candidates gaining full credit. Most candidates were able to identify a correct denominator. A common error was simplifying the term $2x(x-5)$ which was often seen as $2x^2-10$. A number of candidates spoilt their working by incorrectly cancelling brackets once they had a single fraction. A few answers showed missing brackets such as $2x(x-5)+x+3(x+3)$ with no recovery seen, leading to an answer of $2x^2-10x+x+3x+9$. A small number of candidates achieved a correct answer and then continued with incorrect simplification such as $\frac{3x^2-4x+9}{x^2-2x-15}=\frac{2x^2-4x+9}{-2x-15}$.

Question 18

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

Question 19

Candidates demonstrated competence in algebraic manipulation, with quite a few gaining full credit. It should be emphasised that a formula must contain an equal sign, as some omitted the subject in their final answer, resulting in the loss of credit. Less able candidates often achieved partial credit for correctly multiplying by *m* and then gathering the terms in *m* on one side. These candidates then did not understand the need to factorise in order to isolate *m* and often had *m* appearing on both sides of their final formula. Errors were often made with a division where only one term on one side was divided, notably $m-m=\frac{k}{p}$ following the correct line of $Pm-m=k$. Candidates should be encouraged to keep each line of working separate as many were introducing their next step on the line they had just written down. This often led to incorrect statements for which they could not gain credit.

Question 20

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

Question 21

Part (a) was well answered. Common incorrect answers were: Y only, $X \cap Y$, $(Y \cap X')$ and $(Y \cup X)'$ but all options of sections shading were seen. Some candidates shaded X' and Y separately expecting that the cross hatched part to be marked as their answer. Candidates need to be sure to shade only the area which is asked for. In **part (b)(i)** candidates were asked to identify how many gardeners grew melons and out of those, how many did not grow carrots. A number obtained 16 for the number who grew melons, a number got 7 for the number who grew carrots and a number got 9 for the number who did not grow carrots, given that they grew melons. Many candidates combined the information correctly for an answer of $\frac{9}{16}$. Many candidates did not recognise conditional probability but rather considered the entire group. Common incorrect answers were: $\frac{44}{68}$ (or $\frac{11}{17}$) from $\frac{n(C')}{n(\varepsilon)}$; $\frac{9}{68}$; and $\frac{7}{16}$. There were some candidates who showed a lack of understanding of probability and gave an answer greater than 1, often 9, 7 or 16 with no denominator at all. **Part (b)(ii)** was the most challenging question on the paper, and only the most able candidates gave the correct answer of 46. It was much more common to see the values 6 or 44 given, 6 resulting from $(M \cap P) \cap C'$, and 44 arising from n(C') and ignoring the extra 2 in $M \cap P \cap C$. This question was also frequently left blank.

Question 22

Part (a) was generally well answered with most candidates gaining full credit. A mark was also frequently given when there was an arithmetic slip, often when multiplying by 0.Only a small minority of candidates did not know the process for multiplying matrices and tended to multiply corresponding elements instead. **Part (b)** was also well answered but with fewer candidates gaining full credit than in **part (a)**. Some candidates gained partial credit either for working the determinant or for writing down the adjoint matrix. A common error was to calculate the determinant as 1 and less often as 13. Very few candidates did not gain any credit at all and when this did happen it was clear that they had no idea that they needed to calculate a determinant and possibly knew they need to swap some of the elements around and/or change signs but not which ones.

Question 23

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

Question 24

Many candidates gained partial credit for a correct application of Pythagoras' theorem in 3D for a relevant line. Many candidates were able to correctly identify the angle required. A minority of candidates incorrectly gave $\tan^{-1}\left(\frac{12}{18}\right)$ as their answer or found $\angle AGC$. Although there were many accurate answers, a number of candidates rounded prematurely to 3 figures in the working i.e. $\sqrt{373} = 19.3$ and then found $\tan^{-1}\left(\frac{12}{19.3}\right)$ which gave 31.87, rather than 31.85. Less able candidates often couldn't identify the angle required and did not use Pythagoras' theorem on a relevant triangle.

Question 25

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

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

It is important that candidates use the diagrams to record the information that they have found out or label the information so that what they have discovered can be seen. For example, in finding angles candidates should mark them on the diagram or use the correct angle notation. This applies to all questions, but in particular to questions on geometry.

General comments

The questions based on algebra were answered very well. One issue was candidates remembering that $x \times x = x^2$ and $x \times 1 = x$. In questions aimed at number topics there was some early rounding or truncating of results which gave inaccurate answers. There were a number of mathematical words in this paper and candidates needed to have learnt the meaning of these words. Some candidates did not give the correct answer so they had either not learned the word, they did not know its meaning or they confused its meaning with another word. In questions where candidates are asked to 'show all their working' or to 'show all construction arcs' it is essential that these elements are clearly shown. This applies particularly to questions on fractions or other numerical topics where the calculator is not used.

Comments on specific questions

Question 1

Most candidates answered this question correctly. The most common incorrect answers were 1.89, 1.9 and 1.9000.

Question 2

The two most common errors seen were when candidates used the wrong common factor. For example, $2x(x - 1)$ was given, or the correct common factor was used but the other factor was incorrect so, e.g. $x\,(2x - x)$ was given.

Question 3

This was a well answered question with the two most common errors made when candidates either multiplied the two fractions together or multiplied the two original fractions by 60 giving an answer of 12.5. Some candidates converted their answer to decimals but only gave the answer correct to 2 significant figures.

Question 4

It was evident that a lot of guesswork had been applied here with mean and median appearing as the answer as frequently as the correct answer.

Question 5

Some candidates were confused about what was required in **part (a)**, and some actually gave the gradient. Having given the gradient in **part (a)** they often gave the y-intercept in **part (b)**. So common incorrect answers seen were, in **part (a)** just −8, 3, (3, −8) or (0, 3) and in **part (b)** −8, −3 or $\frac{1}{3}$.

Question 6

Part (a) was answered well. Some candidates gave an answer of −6, and in **part (b)** they often left the answer in surd form or used the wrong order of operations and gave an answer of 4.

Question 7

In **part (a)** for a prime number 21, 51 and $\frac{2}{3}$ were the common incorrect answers and in **part (b)** 0.7, 21, 31, $\frac{2}{3}$, and $\sqrt{121}$ were usual incorrect answers for an irrational number.

Question 8

In **part (a)** a few candidates wrote 30 or 31 as the answer as they misread the graph or the scales. Although most gave the correct answer in **part (b)**, a few gave 'negative' or 'none'.

Question 9

This question required all the working to be shown but there were many responses that had the correct answer with no supporting working. The two common methods that candidates used successfully were to multiply directly to give $\frac{84}{315}$ and then to cancel, or candidates cancelled first, reaching something like $\frac{4}{5}\times\frac{1}{3}$ and then multiplied the two fractions together.

Question 10

This question was answered well. The most common error was to subtract h first so $2w = P - h$ was the first step and the answer given was $w = \frac{1}{2}(P - h)$.

Question 11

In many responses the working was difficult to follow. Those who did not reach the correct answer often got one of the two terms correct so answers such as $18m + 1$ or $2m + 2$ were given.

Question 12

The main errors seen in this question were just finding the area of the whole circle by using $\pi\times 6.2^2$, finding the arc length with $\frac{217}{360}\times 2\times\pi\times 6.2$ or a mixture of both $\frac{217}{360}\times 2\times\pi\times 6.2^2$.

Question 13

In **part (a)** there were many different answers seen and the most common, other than the correct answer, were 3, 5 and 8. In **part (b)** candidates attempted to draw the net of the entire object or, of those who drew just one triangle, many drew the sloping sides inaccurately, often of length 4 cm. Some candidates did not construct the triangle at all. They appeared to guess where the top vertex should be and hence some triangles were not symmetrical. A common construction was to draw the perpendicular bisector of the base and then to measure the sides to find where they meet this bisector. Many attempts at this bisector had only one pair of construction arcs.

Question 14

In **part (a)** many candidates correctly substituted $x = 7$ into the equation to reach $49a + a = 150$. However, they either subtracted a to give $49a = 150 - a$ or divided by 49 to give $a + a = 150 \div 49$ and finally they divided the result by 2 giving an answer of 1.53. Most candidates found **part (b)** demanding and the most common answers included 7 and $\pm$ 7. Some candidates attempted to rearrange the equation without substituting 3 for a and that often led to an expression with 150, a and a square root such as $\sqrt{\frac{150-a}{a}}$.

Question 15

Although many candidates did use Pythagoras' theorem, they often worked out the two lengths incorrectly, so instead of 5 they sometimes used 9 and instead of 13 they sometimes used 11. Other candidates' attempts involved finding the gradient of the line.

Question 16

In this question, successful candidates wrote down the bounds for both numbers so $9.5 \leqslant 10 < 10.5$ and $3.5 \leqslant 4 < 4.5$ before selecting the correct values to substitute into $2A \div h$ i.e $A = 10.5$ and $h = 3.5$.

Question 17

Most candidates remembered how to factorise the denominator to $(x - 5)(x + 5)$. However many struggled to factorise the numerator. Some tried double brackets whilst others had a single bracket but with incorrect terms e.g. $x(x^2 + 5)$.

Question 18

The two most common errors were to write down the relationship as directly proportional, using $y = k(x + 1)^2$ or omitting the square so that they used the relationship y is inversely proportional to $(x + 1)$. The best solutions used $y = \dfrac{k}{(x+1)^2}$, found the value of k to be 3.5 and then substituted $x = 4$ into the formula.

Question 19

There were a number of ways to solve this question. The simplest method was probably angle $MJL = 68°$, because angle JML is 90°, hence angle $NKL = 68°$ using the angle properties of the circle, then angle $KNL = 76°$ and hence $d = 180° - 68° - 76° = 36°$. The angles needed to be written on the diagram or clearly labelled, using correct notation, in the working space.

Question 20

In **part (a)(i)** those candidates who answered incorrectly usually used 40 as the denominator with the numerator as 8, 15 or 31. A few responses had the answer as an integer, and again 8 or 31 were popular. In **part (a)(ii)** a common error was just to exchange the 23 and 7 which was correct but the intersection contained 8 when it should have been 2 and the 2 was outside both sets when it should have been 8. In **part (b)** the most common error was to shade the parts of sets A and C that are outside set B.

Question 21

Part (a) was usually answered very well. The error commonly seen was that 5×0 was written as 5. In **part (b)** the most common error was to multiply the numbers instead of adding them. In **part (c)** there were numeric errors particularly with the negative number and some candidates multiplied the row in the first matrix with the row in the second matrix.

Question 22

The most common error in **part (a)** was to give the vector the wrong way round, $s - t$, and in **part (b)** the line BD was divided into quarters and not fifths so, for example, $DN = \frac{1}{4}DB$ was used. Another common error was to use $\overrightarrow{CN} = +t + \frac{4}{5}\textit{their}(\mathbf{a})$ instead of $\overrightarrow{CN} = -t + \frac{4}{5}\textit{their}(\mathbf{a})$ in their working.

Question 23

Part (a)(i) was answered well, but a few candidates misread the scale and gave an answer of 6. In **part (a)(ii)** some candidates just wrote down the lower quartile or the upper quartile alone, or rarely, both figures without the subtraction. A few candidates misread the graph's scale again. In **part (b)** again some candidates misread the scale on the vertical axis or they just gave the readings, 46 and 120.

Question 24

The most common error was to dash the wrong lines so the $x = 3$ was solid and one or both of the other two lines were dashed. Some candidates confused the horizontal and vertical lines so they drew $x = 2$ and $y = 3$. The line $y = x + 4$ was sometimes drawn as $y = 4$. If candidates drew the three lines correctly then they sometimes showed the region $y \leqslant x + 4$ on the wrong side.

Question 25

In **part (a)** some candidates thought there were 6 sides or 6 angles so 360° ÷ 6 or 60° were seen leading to 120°. Those candidates who found 72° treated it as the interior angle so they worked out $\frac{1}{2}(360° - 72°)$ or $360° - 2 \times 108°$ or 144°. Some found the interior angle of 108° but did not progress any further. In part **(b)** a common answer was 49 : 4, or it was used in their working, which came from cancelling 73.5 : 6. Some candidates found the square roots of each number but then did not progress any further.

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

To be successful in this paper, candidates had to demonstrate their knowledge and application of various areas of mathematics. Candidates who did well consistently showed their working out, formulas used and calculations performed to reach their answer.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed and emphasise that in show questions candidates must show every step in their calculations and not start with the value they are being asked to show.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Attention should also be paid to the correct presentation of a length of time rather than the time of day. Candidates need to be encouraged to make it clear that a length of time differs from the time of day through the use of notation i.e. a length of time should be in the form … hours and … mins or correct decimal form rather than written as a time of day e.g. 7:30 or 7 30.

Candidates should also be encouraged to process calculations fully and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

The standard of presentation was generally good; however candidates should be reminded to write their digits clearly and to make clear differences in certain figures. A large number of candidates write the digits 4 and 9 identically and similarly 0 and 6 and 1, 2 and 7. Many candidates also overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite. There was evidence that most candidates were using the correct equipment.

Comments on specific questions

Question 1

(a) Nearly all candidates successfully found the amount. This question proved to be one of the best answered of the whole paper.

(b) The vast majority of candidates found the correct change. Few incorrect answers were seen with the most common being not calculating the change but just the cost of the coffee and two biscuits ($5.10). It is important for candidates to read the question having done a calculation to ensure that the question has actually been answered.

(c) (i) This part proved to be very successfully answered by nearly all candidates. Most candidates showed their multiplication sum and demonstrated that they could use their calculators correctly. A very small number of candidates attempted this question without a calculator and usually did not reach the correct answer.

(ii) This part proved very challenging for all candidates. The best solutions showed good understanding of the context of the question and showed full working out to calculate the amount Harriet was paid for the extra 8 hours and added this to their answer from the previous part. The most common incorrect answer given was \$519.75, as candidates added 8 to 34 and calculated all 42 hours at time-and-a-half. Many candidates did not reach the correct final answer but gained partial credit for correctly finding the pay for the 8 hours (\$99) but did not add it to their previous answer. A significant proportion of candidates used the correct full method but did not gain full credit because they rounded prematurely (1.5×8.25 rounded to 12.38 or 12.4 or truncated to 12.37) which led to answers of 99.04, 99.2 or 98.96 instead of 99 for the extra 8 hours. In most cases candidates were still able to gain partial credit as they had shown their working out clearly. Very few candidates used the alternative method of $8 \times 1.5 = 12$ hours which then gave them $34 + 12 = 46$ hours and finally $46 \times 8.25 = \$379.50$. Most candidates who attempted this method were successful and gained full credit.

(d) Most candidates understood that they were required to find the number of hours worked each day and then to add these together. Although most candidates attempted this method, only a small majority correctly found the total number of hours to be 33 due to errors in writing length of time in the correct format. The most common error saw candidates writing 7 hours and 30 mins as 7.3 or 7.30 instead of the correct decimal form of 7.5 hours. This often led to errors when adding their times together.

(e) The majority of candidates correctly identified that they needed to divide by the exchange rate although many candidates did not gain full credit due to errors in rounding. The question indicated that their answer had to be 'correct to the nearest cent' so answers of 85.2 did not gain full credit. Most candidates showed their working out which allowed them to gain a method mark if they could not do the division correctly. A few less able candidates incorrectly multiplied by the exchange rate. This led to an answer of \$1 035 986.65. Candidates should consider the size of their answer and whether it is sensible in relation to the context of the question.

(f) This part on calculating compound interest challenged all but the most able candidates. Many candidates were successfully able to quote the correct formula to calculate compound interest with many then able to substitute the correct figures. A few candidates worked year-on-year. Many less able candidates attempted to find simple instead of compound interest.

Question 2

(a) The vast majority of candidates showed understanding of order of operations or used the calculator to successfully find the correct answer to the sum. The most common incorrect answer was 22 by not following the correct order of operations.

(b) Most candidates placed one pair of brackets in the correct position to make the statement correct. A small number of candidates did not attempt this question. Some candidates used two pairs of brackets. Candidates again should be reminded to read the question carefully before and after giving their solution.

(c) The best solutions to ordering a list of decimals, percentages and fractions showed comparison of each by converting to decimals (or percentages). Candidates who did this before ordering generally were successful in gaining full credit. Often candidates who did not convert to decimals only gained partial credit, with one value out of order. All candidates attempted this question.

(d) (i) Candidates were very successful at using their calculator to find the correct answer.

(ii) Candidates again were successful in using their calculator to find the cube of 8. This proved to be one of the best answered questions on the whole paper. Few incorrect answers were seen with the most common being 24 from 8×3.

(e) A small majority of candidates correctly identified the smallest prime number to be 2. Many candidates however thought it was 1, 3, 5 or 7.

(f) Most candidates achieved full credit by giving a full list of factors of 18. The most common error was the omission of 1, 18 or both, with some candidates also including 4 as a factor. A few less able candidates wrote a list of multiples instead of factors.

(g) Candidates were more successful at identifying a common factor of 16 and 72 as either 4 or 8. Successful candidates often wrote a complete list of factors for both 16 and 72 and then identified the common factors. A common incorrect answer was 144, which was the LCM of 16 and 72.

(h) Most candidates correctly simplified the fraction fully. However a significant number of candidates showed understanding of simplifying but did not cancel fully and left their answer at $\frac{7}{35}$ or $\frac{2}{10}$. A few candidates gave the answer of 0.2, which again demonstrates the importance of reading the question fully as it clearly indicates that their answer must be a fraction.

(i) Finding the value of the prize proved to be the most challenging part to this question. The best solutions showed full working out, showing division by 5 and then multiplication by 11. The most common error involved candidates finding $\frac{5}{11}$ of \$160, which led to the common incorrect answer of 72.72. This question again demonstrates the importance of not rounding prematurely in candidates working. Some candidates showed that they understood that they needed to divide by $\frac{5}{11}$ but found $\frac{5}{11}$ as a decimal and then rounded it to 0.45. This therefore led to the incorrect answer of $\frac{160}{0.45}$ = 355.55. Candidates who showed where 0.45 had come from gained a method mark but just $\frac{160}{0.45}$ gained no marks as full working was not seen.

Question 3

(a) (i) Completing the bar chart involved a number of steps which most candidates did not show in their working out although many candidates did draw a bar of correct height of 6. Candidates had to correctly identify the heights of the 3 given bars and then subtract this total from 40 to find the height of the bar for senior tickets. Candidates who showed this working out gained full marks but few candidates showed any working out so gained either full marks or no marks, depending on if they drew a bar of the correct height. A significant number of less able candidates did not attempt this question.

(ii) All candidates attempted this question and it proved to be the most successfully answered part of this question. Common errors involved misreading of the vertical scale.

(iii) The majority of candidates identified the correct mode. However a large proportion of candidates gave the frequency of adult tickets (17) instead of the word 'adult'.

(iv) Many candidates found the correct probability. Candidates should be reminded that probabilities must be given as fractions, decimals or percentages and not ratios or in words.

(b) (i) Most candidates gave the correct range but many incorrect answers were seen, such as 18 to 104; {18,104} or 104 – 18 with no solution seen. A few less able candidates used 104 and 60 from the first and last numbers in the list and gave the incorrect answer of 44.

(ii) Most candidates successfully found the median. Most candidates gained full credit by writing an ordered list and then correctly identifying the middle value. The most common incorrect answer was 31 from the middle value of the original list (unordered).

(iii) Most candidates correctly found the mean. Most showed their working out and those who did not gain full credit usually made an arithmetic error in addition, but still gained partial credit if the addition had been shown in the working. A small number of less able candidates calculated the range or median in this part.

Question 4

(a) Most candidates correctly found the acute angle at *C* to be 62 and then went on to recognise the isosceles triangle and then found the value of *a* to be 56. Many candidates gained partial credit by correctly finding 62 but did not go on to find *a*.

(b) Calculating the interior angle of a regular 10-sided polygon proved to be one of the most challenging questions on the paper with many candidates not attempting the question. Successful solutions followed one of two methods: finding the exterior angle by dividing 360 by 10 and then subtracting the answer from 180, or finding the sum of all interior angles $(10 – 2) \times 180$ and then dividing by 10. Many candidates gained partial credit for completing one step of the above methods but did not complete the full method to gain full credit.

(c) A small majority of candidates correctly applied the circle theorems. Few candidates marked the angle at *F* as 90° on the diagram but most candidates who gained one or two marks used 90° in their working. The most common error was to assume that *x* and *y* were equal and therefore the answers of 32 and 32 were often seen.

(d) This part proved to be very challenging for all but the most able candidates. Many were able to identify angle *CED* as 28° but very few candidates were able to give the correct reason with the correct wording. A common error was to give the answer of 67° using angle *EDF* as the alternate angle. Equally seen was 95° (adding the two given angles).

(e) Finding the length was well answered by the majority of candidates who correctly identified that they needed to use Pythagoras' theorem. Good solutions showed all working, including squaring, adding and square rooting. Some candidates identified Pythagoras' theorem but subtracted instead of adding, and some less able candidates multiplied to find the area or simply subtracted or added the length of *PQ* and *QR*.

Question 5

(a) (i) Most candidates identified the need to add the algebraic terms to find the perimeter of the rectangle. However many did not gain full credit as they did not write their solution in its simplest form. Common incomplete simplifications were $7a + 7a + 2a + 2a$ or $14a + 4a$ or $2(7a + 2a)$. Less able candidates often only added two sides instead of all four. A number of candidates confused perimeter and area in **parts (i)** and **(ii)**.

(ii) Fewer candidates were able to give a correct expression for the area of the rectangle. Many gained partial credit for showing $7a \times 2a$ but few simplified to $14a^2$. A common incorrect answer was $14a$. A number of candidates calculated perimeter instead of area in this part.

(b) A small majority of candidates gained full credit by identifying the first three terms of the sequence. Little working out was seen, especially from candidates who did not gain any marks. Common incorrect answers were 5, 10, 15; 2, 7,12; 6, 11, 16; 5, 25, 625; or 25, 625, 390 625. Candidates who used the *n*th term correctly but started with $n = 0$ gave 5, 6 and 9 as their answer.

(c) (i) Completing the table was the most successful part of this question. Few incorrect values were seen; the only common error was an omission of a minus sign.

(ii) There was good plotting of points with very few straight lines joining points seen and even fewer thick or feathered curves drawn. Common errors were to draw the curve beyond $x = 1$ or $x = –1$, or plotting at (0.5, 12) instead of (1, 12). Some less able candidates plotted the 1st quadrant points in the 4th quadrant.

(iii) Many candidates correctly drew the line $y = 8$ on their graph. It is important to remind candidates that all straight lines must be ruled. Some candidates did not draw the line long enough to be able to complete **part (iv)**.

(iv) Finding the solution to the equation was well answered by many candidates. However, the majority of correct answers came from calculation rather than reading the intersection from their graph.

Question 6

(a) Most candidates were able to plot two or more of the points. However a significant number of candidates did not attempt this part of the question. Candidates showed little difficulties with the scales of the axes but candidates lost marks for inaccuracies of plotting.

(b) Candidates generally identified the correlation as positive. However some described the correlation using test marks rather than the type of correlation seen. Few candidates gave the wrong correlation of negative or no correlation. A large number of candidates did not attempt this part.

(c) Identifying the point was very well answered by most candidates. The most common incorrect points indicated were (41, 56) or (13, 44). Some candidates circled more than one point.

(d) Many candidates were able to draw an acceptable line of best fit. The most common incorrect line simply joined the corners of the grid. Less able candidates often joined all the points with straight lines.

(e) Most candidates gave a score for the written test within the acceptable range. Many candidates correctly used their line of best fit to gain a follow through mark. The most common errors involved values around 10 from using 25 as the score on the written test instead of the speaking test.

Question 7

(a) Good answers contained all three parts to describe a rotation, including degrees and direction and centre of rotation. The most common error was to omit the centre of rotation or give the wrong direction. Less able candidates could correctly identify the transformation as rotation but often did not give the centre or angle or direction. A significant number of candidates described more than one transformation.

(b) Good solutions in this part contained the correct transformation, enlargement, and the correct scale factor and centre. The most common error was to omit the centre of enlargement or give the wrong scale factor. Again a significant number of candidates described more than one transformation.

(c) Many candidates were able to translate the shape correctly. Many less able candidates did not attempt this part or translated in the wrong direction, often one left and three up. Some candidates translated the square and not the ‘flag stick’ and therefore not the whole shape.

(d) Many candidates were able to correctly reflect the shape in the line $y = 1$. Common errors were to reflect in the x-axis or a different line in the form $y = k$. A significant number of less able candidates rotated the shape instead of reflected.

Question 8

(a) This question is a ‘show that’ question so candidates must show all their working and not use the given answer in their working. Good solutions usually showed calculation of the area of the circle first and then multiplied by the height to find the volume. The most common error was to use 113… but not clearly show where this had come from. Candidates had to show $\pi \times 6^2$ for it to be classed as full working. Those who did show the correct method sometimes did not gain full credit as they did not show the unrounded result which rounds to 1923. This question proved to be very challenging to many candidates and many did not attempt the question.

(b) Calculating the shaded area proved challenging for all but the most able candidates and a large proportion of candidates did not attempt it. A large variety of successful methods were seen. The most common method used was to find the area of the semi-circle, find the area of the half square and then subtract them. However an alternative method involved finding areas of the whole circle, the whole square, subtract and then halve their answer. Many candidates who did not gain full credit often gained two marks for finding the area of either the semi-circle or the half square.

Question 9

(a) Most candidates were able to correctly simplify the expression. Some common incorrect answers were $6a + 2b$, $6a - 4b$ or $10a + 4b$.

(b) The majority of candidates successfully substituted the given values and found the correct answer. A common error when substituting $x = 3$ into $4x^2$ was working out 12^2 not 4×3^2. Also the 3×-2 often became 3×2 or $3 + -2$. This led to answers such as 138, 42 or 37, although if the correct full substitution was shown the candidate gained partial credit.

(c) (i) Most candidates solved the equation correctly. The most common error was $x = \frac{20}{4} = 5$.

(ii) Solving the two step equation was the most successful part of this algebra question. Nearly all candidates correctly solved the equation. The most common error came in the first step where candidates subtracted 5 from 16 instead of adding, hence leading to the incorrect answer of $\frac{11}{3} = 3.66\ldots$

(iii) Good solutions showed each step of the working, usually by expanding the bracket first, subtracting 5 and then dividing by 10. Errors often occurred in the first step when expanding the bracket or adding 5 instead of subtracting.

(d) Making r the subject of the formula proved to be the most challenging part of this question and the least attempted. Candidates who recognised the correct first step usually then went on to gain full credit. The most common errors were to subtract 5 from p or attempt to divide by 3 with errors (usually $\frac{p}{3} = r - 5$).

Question 10

(a) This construction question was challenging to all but the most able candidates, with a large number of candidates not attempting either part of the question. Candidates found bisecting the angle easier than **part (b)**. Some candidates did not show arcs and therefore must have used a ruler and protractor. Candidates should be reminded that when asked to show all construction arcs that a compass must be used.

(b) Shading the correct region to satisfy the conditions given in the question was very challenging for candidates. Few fully correct solutions were seen, with many candidates not attempting this part. Many candidates gained partial credit for an acceptable arc centre C, or for showing 10.5 cm.

MATHEMATICS

Paper 0580/32
Paper 32

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required, particularly in those questions involving money. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer and the loss of the accuracy mark. In 'show that' questions, such as **Question 6(b)(iv)**, candidates must show all their working to justify their calculations to arrive at the given answer. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

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

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

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

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

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

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

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

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

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

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

Question 2

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

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

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

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

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

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

Question 3

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

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

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

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

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

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

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

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

Question 4

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

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

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

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

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

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

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

Question 5

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

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

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

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

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

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

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

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

Question 6

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

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

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

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

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

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

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

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

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

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

Question 7

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

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

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

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

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

Question 8

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

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

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

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

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

Question 9

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

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

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

MATHEMATICS

Paper 0580/33
Paper 33 (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 learning mathematical terms and definitions would help all candidates to answer questions giving the relevant name or using the relevant process.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. Candidates were able to complete the paper within the required time and most candidates made an attempt at most questions. The standard of presentation and amount of working shown was generally good although the formation of figures on some scripts did lead candidates to make errors in later work and made their work difficult to read. Numbers 4 and 7 were often difficult to distinguish as were the numbers 1 and 7. Centres should continue to encourage candidates to show all working including any formulae used and substitutions made, as some candidates showing no working and giving incorrect answers are not able to score any of the available method marks.

Attention should also be given to the degree of accuracy required, and candidates should be encouraged to avoid premature rounding in workings. Candidates also need to consider whether an answer is possible e.g. a decimal value given for the quantity of a musical instrument in **Question 3(d)**.

Comments on specific questions

Question 1

(a) The majority of candidates were able to write the number in figures. Those who did not score the mark usually misplaced the zero or inserted extra zeros, often between the 3 and 2 or at the end of the number. A few candidates swapped the 9 and 6 around.

(b) (i) A large majority of candidates scored both marks. A few scored a follow through mark for correctly adding their values in the middle row, providing at least one of them was negative. A common error was to write –1 in the middle row or 1 or 7. Those who did not score marks often used numbers that bore no connection to adding those below them.

(ii) The majority of candidates scored full marks. Many others were able to calculate one of the values in the middle row, scoring one mark, and many scored a follow through mark for multiplying this pair correctly.

(c) A large majority of candidates scored either one or two marks. Those who scored one mark usually managed to write three of the values in the correct order. Many showed the decimal equivalents which helped in ordering the numbers and in some cases earned them a method mark when the order was incorrect.

(d) Most candidates scored the mark for writing one number as a percentage of another. A few found 142% of 304. Rounding or truncating their decimal answer to 2 significant figures, straight from their calculator, lost some candidates the mark with answers of 46% or 47% frequently seen.

(e) (i) Although many scored full marks for the HCF many others were confused with LCM. Most drew a double factor table which was often the only mark earned. However, in many cases this was also the source of the confusion, especially those with 2, 2, 7, 7 stacked on the outside left-hand side. This often resulted in $2 \times 2 \times 7 \times 7$ or 196 as the answer. Some gave the answer as 2×7 or just 2 or 7.

(ii) This was answered well by the majority of candidates and those who scored full marks in **part (e)(i)** usually scored full marks in this part also. Many others scored one mark for the answer left as $2 \times 2 \times 7 \times 7$ or for a multiple of 196 evaluated. Candidates scoring no marks often gave 14 (the HCF) as the answer or just 7 or 2. Most candidates used double factor trees, often repeating the one drawn in **part (e)(i)**. Few candidates listed multiples of 28 and 98 and when lists were seen they did not always identify 196 as the LCM.

(f) This part was the most challenging part of this question. It was generally answered well with the majority scoring full marks, although less able candidates found it more challenging. Some scored the method mark for the correct division. Errors were made by some candidates who multiplied by 60, an unnecessary attempt to convert the units of time. A small number were confused by the powers of 10, giving the answer as 3.879.

Question 2

(a) This part was generally answered well although common errors of rhombus, quadrilateral and parallelogram were seen together with a variety of other mathematical terms. A small but significant number of candidates gave no response.

(b) (i) In this part candidates were required to find the perimeter of the trapezium drawn on a grid. This was generally not answered well. Many reached the incorrect answer of 15 by assuming or estimating the sloping edge to be 4 cm rather than measuring it accurately as 5 cm. Some were confused with area and gave the answer as 14.

(ii) Many candidates were able to find the area of the trapezium. Incorrect answers were varied with 10 (from $0.5 \times 5 \times 4$), 20 (from 5×4), 200 (from $4 \times 5 \times 5 \times 2$) and the perimeter 16 or 15 being seen regularly.

(c) (i) The majority of candidates identified the transformation as a translation and many scored full marks. Some candidates missed the negative sign on one or both components of the vector and a few inverted them. A few candidates stated it was a reflection.

(ii) Nearly all candidates recognised the transformation as a rotation and many scored full marks. Many gave the size of rotation as 90° although not all gave the direction. Common errors included giving the direction as anticlockwise, omitting the centre or stating an incorrect centre.

(d) (i) A large majority of candidates were able to draw the correct reflection of the trapezium. A few scored one mark for reflecting it in a different vertical line.

(ii) Candidates found this part more challenging, with less able candidates not scoring marks. Many candidates drew the correct size enlargement but errors were made in the placement of the image. Sometimes the length of the vertical side was drawn 3 squares long instead of 2.5. There were a small but significant number of no responses.

Question 3

(a) Many fully correct answers were seen. Some candidates did not cancel the given ratios to their simplest form, with division by the total 63 frequently seen. Others did not include ratio symbols in their working. When decimals were used the answer was more often given to 2 significant figures rather than 3.

(b) (i) A large majority gave a clear and complete method to show there were 27 violins.

(ii) This part was generally answered well with a very large majority giving the correct answers.

(c) This part was found challenging with only the more able candidates achieving full marks. Candidates who were able to find 20% of the 15 instruments gave 3 oboes but were confused by the 'twice as many flutes as clarinets'. Instead of splitting the remaining instruments in the ratio 2 : 1, candidates often treated them as equal ratio parts and doubled the 3 to give the incorrect answer of 6 flutes.

(d) Many correct answers were seen with a few common incorrect methods Candidates often incorrectly gave a decimal value to represent a number of musical instruments. Some candidates gave the incorrect answer of $8\frac{2}{3}$ or 8.66 or 8.7 following $12 - \frac{1}{3} - 3$. Others subtracted 3 trombones from the total 12 and divided the remainder by 3 leading to an incorrect answer of 6. A good method seen involved fractions; trumpets $\frac{1}{3} = \frac{4}{12}$, trombones $\frac{3}{12} = \frac{1}{4}$ so horns equal $\frac{5}{12}$. However, some left the answer as a fraction rather than 5.

(e) **(i)** This part was generally answered correctly.

(ii) This part was generally answered correctly.

(f) Many candidates gave the correct answer although a few rounded the total cost when it should have been left as an exact amount of money. Many candidates found 65% of the value rather than the remaining 35% required.

Question 4

(a) The table of values was generally completed correctly. Sign errors were sometimes made when substituting $x = -2$ into $y = 5 + 2x - x^2$ resulting in the value 5 rather than –3.

(b) A large majority of candidates scored full marks in this part with some excellent graphs seen. Straight line segments were seen on just a few scripts.

(c) **(i)** Most candidates drew the correct line of symmetry for the graph although some were too short.

(ii) Many correct equations for the vertical line of symmetry were given although less able candidates found this more challenging. Common errors included 1, $y = 1$, (1, 6) or answers of the form $y = mx + c$.

(d) Many candidates were able to read off the *x*–coordinates for the points of intersection of the curve with the horizontal line. A common error was to give the points of intersection with the *x*-axis, and some candidates did not read the scale on the *x*-axis correctly. There were some candidates who only gave one correct value for *x*, usually the positive one, as the minus sign on the negative value was omitted.

(e) **(i)** This part was nearly always correct.

(ii) More able candidates coped well with this part, usually scoring full marks. Many candidates found the gradient but not the equation of the line. Others found the intercept, although in some cases it was not sufficiently defined, with just the number 4 seen in the working without $c = 4$. The formula to find the gradient caused some confusion with many inverting it or mixing up the co-ordinates in various ways. Very few candidates drew a triangle on the grid to aid the calculation of the gradient.

Question 5

(a) Generally, this part was answered very well with an accurate measurement correctly converted.

(b) Many candidates gave a fully correct response. Many others only scored one mark for the correct base either measured in centimetres or converted to metres. Some candidates used the less efficient method of adding the areas of two triangles rather than working with the single large triangle. Other candidates did not convert their measurements into metres. Less able candidates used the slanting sides of the triangle in an attempt to find the area.

(c) There were relatively few completely correct responses. Many candidates who demonstrated a correct method to construct the angle bisector did not interpret the context of the question and drew the path too short or allowed it to go beyond the play area. Common errors included drawing intersecting arcs from *B* and *D* and joining this point to *C* to form the path. Others bisected the right-angle, *ECB*; some drew the diagonal of the rectangle and others bisected the line *CD*.

(d) (i) Many candidates calculated the correct circumference of the circle and there were many fully correct responses. In this part and the next, a few candidates lost accuracy marks for using a less accurate value of π such as 3.14 or $\frac{22}{7}$ and not the values stated on the front cover. Some candidates confused the formulae for circumference and area of a circle and used them in the wrong part of the question.

(ii) Many candidates calculated the correct area of the circle. A common error was to use the incorrect formula $\pi \times \text{diameter}^2$.

Question 6

(a) (i) **(a)** Many candidates found the correct angle, but relatively few gave the correct reason referring to an isosceles triangle.

(b) Most candidates correctly determined that the angle required had the same value as the previous response. Again, relatively few gave the correct reason. In this part and in **part (a)(iii)** candidates were expected to give mathematical reasons such as 'alternate' and 'corresponding' angles rather than 'F' or 'Z' angles.

(ii) This part was generally answered well. Most candidates applied the correct sum of angles in a triangle to work out the required angles based upon their answers in **part (i)**.

(iii) Many candidates gave the correct angle, but few offered a fully correct reason.

(b) Most candidates knew the angle was a right-angle. Very few offered a completely correct mathematical reason for the angle between the tangent and radius being 90°. Answers often involved less concise descriptions of the diagram.

Question 7

(a) (i) There were many varied answers to this part. Correct answers were often seen but many did not find the correct time taken by the train in hours and consequently were not able to calculate the speed. Some candidates tried to divide by an actual time, rather than the travelling time.

(ii) Most candidates were able to interpret the horizontal line on the distance/time graph and gave the correct answer.

(iii) This part was answered well by most candidates, although some lost the mark for drawing the line to an incorrect end position.

(iv) Candidates were required to recognise which part of the graph gave the fastest speed. Many found this challenging and answers were split between those who gave the correct pair of stations, *A* and *B*, and those who gave *B* and *C*.

(b) **(i)** This part was found challenging. Several candidates displayed a knowledge of the formula to find time from distance and speed but did not read the distance correctly from the graph or were unable to convert their answer to a correct time in hours and minutes.

(ii) Many candidates were able to work out the correct arrival time based upon their journey time in the previous part. A few candidates gave an incorrect time notation such as omitting pm in the 12-hour clock or including pm in the 24-hour clock.

(iii) Many candidates found this part challenging and some omitted it. Some candidates scored full marks either for the correct graph or for following through from their previous answer. However, some candidates did not pinpoint the correct starting position. Others attempted to draw a journey starting from the wrong station, so that the line was going in the opposite direction.

(iv) Many candidates understood that the answer came from reading off the point of intersection of their lines on the graph and gained the mark from doing this accurately.

Question 8

(a) **(i)** This was generally well answered with a large majority completing the frequency table correctly. Some candidates made an error in the frequency column or incorrectly wrote down the frequencies in the tally column.

(ii) Many candidates identified the correct mode although many incorrectly wrote down the corresponding frequency value of 8. In this part and in **parts (a)(iii)** and **(a)(iv)** many candidates did not appreciate that the data was presented in a discrete frequency table rather than a simple list.

(iii) Only a minority worked out the correct range. Most candidates stated the difference between the largest and smallest frequency values.

(iv) A minority found the correct median. Some candidates wrote out a list of all the numbers, but they were generally successful. Many gave the answer 4 from finding the median of the frequency values.

(v) Overall, a minority of candidates found the correct mean value. Many lost an accuracy mark by rounding their final answer. Some candidates were unable to calculate the mean from a frequency table and a common error was to calculate $\Sigma f \div 6$.

(vi) Most candidates gave the correct probability, but it was common to see the incorrect answer of $\frac{4}{24}$, again as a result of misinterpreting the data in the table.

(b) Nearly all candidates drew the correct bar chart. A few candidates had one incorrect bar height.

(c) Several correct comparisons were seen. However, many candidates merely stated that the results were displayed as a tally chart and a bar chart on the two days.

Question 9

(a) The majority of candidates demonstrated a good understanding of this question and calculated the correct difference in the price of the tickets. Some arithmetic errors were made and some used an incorrect combination of adult and child tickets.

(b) Many correct times were given but incorrect answers occurred frequently with a large variety of times given. Errors were often made by those who set up a subtraction sum and treated the numbers as if they were decimal values rather than time, hence 1735 – 1240 led to 495 which became 535. Another common incorrect answer was 555, counting one hour out.

(c) This part was generally well answered.

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

Candidates sitting this paper need to ensure that they have a good understanding and knowledge of all of the topics on the extended syllabus.

Candidates should not cross out their working and just give an answer on the answer line. The method needs to be seen clearly to enable method marks to be awarded.

Unless directed otherwise, candidates should give answers correct to at least 3 significant figure accuracy. This often requires candidates to retain numbers in their working that are more accurate than 3 significant figures otherwise premature approximation is likely.

General comments

Many candidates demonstrated that they had a clear understanding across the wide range of topics assessed. The majority of candidates attempted most questions on the paper.

The presentation of some candidates' work made it very difficult to follow their thought processes. By setting their work out in a clearer order, some candidates may make fewer slips and mistakes. Some candidates wrote over their answers which made it difficult to know which number is actually written and whether a sign is a plus or minus sign.

For questions involving algebra, candidates are advised to complete each step on separate lines, rather than trying to do more than one step on the same line. Marks in algebra are generally awarded for individual steps clearly seen.

Candidates should ensure that they know how to convert between different units when working with lengths, areas and volumes.

Candidates need to read the questions carefully. In particular, when worded questions have been completed candidates should read the question again to ensure that they have a sensible answer and one that precisely answers what is asked.

Comments on specific questions

Question 1

(a) (i) The translation of shape *T* was done very well. The most common errors seen were translations that were correct in only one of the two directions or translations by $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$.

(ii) The rotation of shape *T* was again done very well. The most common error seen was a rotation through 180° but with an incorrect centre, usually (5, 2).

(iii) Most candidates were able to state rotation and give 180°. The centre of rotation caused the most problems with (4, 6) or (5, 6) the most common errors. Some candidates chose to describe the transformation as an enlargement but had problems with the centre and also often did not give a negative enlargement. Candidates who described the transformation using more than one transformation, for example a rotation and translation, did not score as a single transformation was specifically asked for.

(b) (i) Candidates who first drew the line $y = x$ were generally successful in drawing the reflected shape correctly. Candidates who did not draw $y = x$ often drew shapes that were distorted and not similar to *T*. A common error was to draw, and then reflect in, the line $y = -x$.

(ii) Whilst some candidates were able to give the correct matrix, common errors included giving the identity matrix, using -1 or giving the co-ordinates of two or more of the points.

Question 2

(a) Most candidates completed the table correctly.

(b) The quality of the curve drawing was very high with curves seen passing through the correct points. Candidates read the scales carefully and plotted the non-integer values of *y* generally very accurately. The most common errors seen were the mis-plotting of either (−3.5, −4.1) at (−3.5, 4.1) or (−3, 2) at (−3, −2) which gave the curve the wrong general shape. Only a few candidates used a ruler or had curves that were not smooth.

(c) Many candidates correctly gave the value of *x* where the curve crossed the *x*-axis with acceptable accuracy.

(d) Although there were a small number of correct lines and answers given, this part proved challenging with many candidates omitting to attempt this part. Various strategies were seen for finding the solution, many algebraic, some drawing the curve $y = x^3 + 3x^2 + 2x + 2$ and some using their calculator. However, the question required a suitable straight line to be drawn and evidence of the line $y = -2x$ being drawn or stated.

(e) Whilst some candidates were successful in giving a correct value for *k*, there were as many who did not attempt to answer this part. Common errors seen included giving the answer 2 or 6, or non-integer answers.

Question 3

(a) Most candidates recognised that Pythagoras' theorem could be used and many were successful in using it to obtain at least one of 80 and 130. Candidates who used longer alternative methods involving trigonometry often made errors with premature approximating. Other common errors included adding the internal lengths *AD* and *BD* as part of the perimeter or using Pythagoras' theorem incorrectly, for example, calculating $DC = \sqrt{150^2 + 170^2}$.

(b) Candidates needed to use the cosine rule in this part and many were successful. Of those using the cosine rule, a common error was to see $120^2 = 100^2 + 150^2 - 2 \times 100 \times 150 \cos ABD$ written correctly, followed by $14400 = 2500 \cos ABD$. Others incorrectly assumed that angle $DAB = 90°$.

(c) (i) Most candidates used a correct trigonometrical ratio and went on to write 28.07….and then 28.1°. Candidates should be aware that angles are required to be given to 1 decimal place accuracy and that 28° alone is not accurate enough. A few candidates were successful in using longer alternative methods, such as the cosine rule.

(ii) Candidates who considered this question by marking their 28.1° angle on the diagram often correctly evaluated $360° - 28.1°$. Common errors included attempting reverse bearing type calculations such as $180° + 28.1°$. Also, because *C* was stated as due north of *B*, many other candidates gave answers such as *D* is north-west of *B.*

(d) Candidates were generally successful in working out the areas of triangles *ADE* and *BCD*. Triangle *ABD* was more challenging and required a method akin to $\frac{1}{2}\times 100\times 150\times \sin ABD$. A common error was to again assume that angle $DAB = 90°$ and simply to calculate $\frac{1}{2}\times 100\times 120$, or to assume that the perpendicular height of triangle *ABD* bisected side *AB*.

Question 4

(a) (i) To score full credit in this question, candidates needed to assign their numerical answers to the correct statistical word. Whilst the majority of responses showed the range came from $27 - 20$, only those who evaluated this as 7 were awarded the mark. The mode was successfully found by most candidates. The method for the median was frequently seen either by a list of 14 correctly ordered scores or by 22 and 23 selected. Candidates generally calculated the mean accurately, providing an answer correct to at least three significant figures.

(ii) Most candidates answered this correctly. Common errors included $\frac{1}{14}$ and $\frac{3}{13}$. Candidates who gave 0.21 as their most accurate answer did not score.

(b) This question proved challenging, with few candidates able to work out what to do with the scores when given to them algebraically. Some were successful in starting with the expression $(n-1)(x+1)$ but were unable to proceed any further. Others incorrectly assumed that the ratio of the means and scores would be equivalent and tried to set up an equation to solve.

(c) (i) The mean from the grouped frequency table was generally worked out carefully and accurately. Although the odd slip was made, usually when selecting the mid-interval values, most candidates showed clear working and they were consequently frequently awarded the method marks. The most common conceptual error seen was the multiplication of the number of days by the class width rather than by the mid-interval values.

(ii) Many candidates gained full credit on this question. Others gained partial credit for correctly drawing the 3rd and 4th bars but not dividing the frequencies for the 1st and 5th groups by the class width of 10. Some candidates didn't use a ruler and their bars did not follow the grid lines accurately enough.

Question 5

(a) Almost all candidates recognised that they needed to split the area into regions and most correctly worked out the area of the rectangle as 3×1.2. The area of the semi circles however was not always completed correctly. The most common errors included using 1.2 as the radius or using the wrong formula for the area of a circle. Premature rounding of the 1.13 to 1.1 and then evaluating $1.1 + 3.6 = 4.7$, caused candidates not to gain the final accuracy mark.

(b) Whilst some candidates were successful with this part, the majority of candidates were unable to deal with the variety of units involved. Most candidates multiplied their area by 20 or 0.2 but incorrect conversions such as 20 cm = 0.02 metres and 100 cm^3 = 1 litre were commonly seen. Other candidates did not use their previously found area and tried to restart the question, more often than not making errors or only considering the rectangular section of the pond.

(c) There were many different methods that could be used to answer this question but most involved two unit conversions. Some candidates were successful with their chosen approach. As with the previous part, many candidates could not convert from litres to cm^3 or m^3 correctly. In addition, many candidates were not sure whether they should be multiplying, dividing, adding or subtracting the various numbers. The easiest way to complete this part, used by a minority, was to consider the ratios $\frac{x+20}{1007} = \frac{20}{946}$ and solve directly for *x*, avoiding any unit conversions. This question had a high number of candidates who offered no response.

Question 6

(a) Many correctly completed Venn diagrams were seen. Of the candidates not scoring full marks, most were able to place the 90 in the correct part of the diagram and the 30 in the intersection. The most common error was to then incorrectly interpret the ‘40 students play baseball’ as ‘40 students **only** play baseball’ and to thus incorrectly place 40 instead of 10, leading to 80 instead of 110

(b) A good proportion of candidates understood the set notation and gave the correct answer or the correct answer followed through from their diagram.

(c) Again there were many correct answers or correct answers followed through from their diagram. Probabilities were given primarily as fractions. Candidates should be aware that converting to decimals and percentages from fractions is not required after a fraction has been stated.

(d) There were some good responses seen to this part with a fair proportion of candidates evidencing their clear understanding of the problem and the need to find the product of the probabilities. Errors seen included using a denominator of 240 and/or treating the question as a ‘with replacement’ problem and calculating $\frac{p}{q} \times \frac{p}{q}$ rather than $\frac{p}{q} \times \frac{p-1}{q-1}$.

Question 7

(a) (i) Whilst many candidates were successful in first evaluating s as 1991.475, a variety of errors were seen. Some candidates misread the given values, for example, some omitted the minus sign or decimal point from the -2.2. Others evaluated $(at)^2$ rather than at^2. Having obtained a value for s, only a minority of candidates both rounded their value correctly to 4 significant figures and gave it in standard form. Common errors included rounding incorrectly, rounding to 4 decimal places rather than 4 significant figures, having an incorrect power of 10 or writing an incorrect answer on the answer line, in standard form with 4 significant figures, but with no evidence as to where it had come from.

(ii) Whilst there were clear rearrangements seen by some candidates, many candidates scored zero or one mark on this question. Common misconceptions seen included not multiplying each term by 2, dividing by ut rather than subtracting ut and square rooting both sides rather than dividing by t^2.

(b) (i) A large number of candidates were able to produce algebraically accurate workings to reach the required result. Candidates generally showed clear products for the areas of the two rectangles and often formed a correct equation relating their difference to 62. The most common errors included slips with minus signs, particularly when brackets were removed or multiplied out or omitted in error.

(ii) A large number of candidates were able to factorise the expression correctly. The most common errors were sign errors within either or both of the brackets.

(iii) Very few candidates were able to make the connection between **part (b)(ii)** and this part. Most candidates attempted to solve the quadratic afresh by either completing the square or using the quadratic formula. Having then obtained the answer 7, it was evident that few candidates had read the question carefully as many made no further progress. Of those who did substitute 7 back into the rectangle lengths, only a minority obtained the correct difference in perimeters. The common errors included arithmetic slips, finding areas rather than perimeters or only getting as far as working out the lengths.

Question 8

(a) The crucial part of this question is to divide by the original cost, $2.50. In fact, most candidates started this question correctly by calculating $\frac{2.65}{2.5}$. Whilst many candidates went on from here to arrive at the correct answer of 6%, it was common for candidates to go no further than giving final answers of 1.06, 106, or 0.06. Other candidates merely subtracted the two costs to get 0.15, which was not far enough to score.

(b) Most candidates were able to correctly find the interest as \$52.50, but not all went on to give the total value of the investment of \$552.50. The most common errors were to omit to divide the 1.5 by 100 or to use compound rather than simple interest.

(c) This question was only completed correctly by a minority of candidates because some candidates found it difficult to access as an initial population was not given. Of those using the correct method, marks were lost because 1.6 was used instead of 0.016 or '1' was not subtracted at the end or premature approximation gave an answer of 37% rather than 37.4%. The main incorrect method arose from the use of simple interest.

(d) Although in structure this part was similar to **part (c)**, but with the interest rate to be found rather than given, candidates were noticeably more successful here. Of those candidates who set up an equation of the form $6400 \times x^{22} = 2607$, most usually went on to find the 22nd root of a number. The main errors seen arose from trying to add or subtract 1 before rooting the answer or from premature approximation. Others forgot it was a decrease giving the answer as 96% or giving -4% as the final answer. Candidates who did not score had generally started incorrectly, sometimes with simple interest or were just guessing interest rates and evaluating.

Question 9

(a) For candidates familiar with functions, this question was straightforward, evidenced by the high success rate. The main errors seen were those who found $\text{hg}(2)$ rather than $\text{gh}(2)$ or who found $\text{g}(2)\times\text{h}(2)$, as well as arithmetic slips.

(b) Again, this part was well answered with many scoring full marks and others scoring 1 mark for writing $x = 7y - 2$ by changing the x and y or for a correct first step in rearranging, usually, $y + 2 = 7x$. The most common misconception was seen by those who did not understand inverse function notation and stated $\text{f}^{-1}(x) = \dfrac{1}{\text{f}(x)} = \dfrac{1}{7x-2}$.

(c) Many candidates started off their response to this correctly by writing $\left(x^2+1\right)^2 + 1$. Candidates generally then attempted to expand the bracket and collect like terms. A very common error was to forget to add the $+1$ back on after expanding. Errors in the expansion were also common with the middle term(s) frequently missing.

(d) Candidates familiar with functions were often able to set up the equation $3^{7x-2} = 81$ and solve correctly. For those candidates not recognising that $81 = 3^4$, the equation was more difficult to solve with candidates guessing and substituting values for x or sometimes using logs. Logs are not on the syllabus and will never be necessary in solving equations of this form. Candidates who reached $7x - 2 = 4$ generally reached $x = \dfrac{6}{7}$, with only a few candidates making slips in this final stage.

Question 10

(a) The majority of candidates gave the correct answer. The most common errors seen were $\sqrt{1000} = 31.62\ldots$ and $\dfrac{1000}{3} = 333.3\ldots$.

(b) This part was answered well with the correct answer often given. Many candidates were able to score at least the first method mark even if they were unable to correctly rearrange the formula to make x^3 the subject. Common errors included miscopying the given formula as $V = \dfrac{4}{3}\pi r^2$, or having the correct formula but square-rooting, rather than cube-rooting, in the final step.

(c) This part was more challenging with only a minority of candidates recognising that the perpendicular height, h, needed to be found first, using Pythagoras' theorem. It was very common to see candidates simply using the slant height in the given formula for the volume of a cone. Of those attempting to use Pythagoras' theorem, few were able to correctly work out the perpendicular height as $2x$ because either the squares of the given lengths were added rather than subtracted or because they were unable to square $x\sqrt{5}$ correctly. Nevertheless, some candidates completed this question correctly and produced clear solutions to support all stages of their working.

(d) Most candidates recognised that the product of the three given lengths needed to be used but most overlooked the fact that, because the constant cross-sectional area was a triangle, they also needed to divide by 2. Whether or not candidates had used the correct cross-section, many found it difficult to deal with the $\frac{1}{2}$ appearing in two lengths and the cross-section so that attempts to divide through by one or more of them frequently led to an incorrect equation. Again, some candidates completed this question correctly with clear algebraic manipulation shown.

Question 11

A number of candidates scored full marks on this question and they produced neat and clear solutions to support their working, which was required to be shown. The candidates who were most successful set their working out carefully and kept each part of the journey separate. Some candidates drew timelines to help assimilate the information given.

The question asked for the average speed of the whole of Brad's journey. In order to be able to work this out, candidates needed to realise that they had to find both the total distance travelled and the total time taken for the whole journey.

To find the total distance travelled, candidates needed to find the distance travelled in each of the three parts and add them together. Candidates generally demonstrated good knowledge of distance $=$ speed $\times$ time. Most worked out the taxi ride as 16.5 km and the bus ride as 104 km. The main errors came from premature approximation when converting minutes into hours or because candidates used minutes rather than hours, giving 990 and/or 6240 as their distances. The distance taken by the plane, 6200 km, was more challenging and required finding an arc length. Errors in this came from using the wrong equation for the circumference of a circle or not finding the correct fraction of the circumference or misreading 55.5 as 55. However, many candidates were successful in accurately finding the three distances and a good proportion then added the three distances together to arrive at a total distance travelled of 6320 km.

The journey begins at 16 30 one day and ends at 14 36 the next day. Taking into account the 6 hour time difference the total journey time is 16 hours and 6 minutes. The overall average speed therefore is $\frac{6320}{16.1} = 393$ km/h. A common error was for candidates to work out the times travelling each section of the journey, namely 55 mins, 7 hours 10 mins and 1 hour 36 mins and to work out the total time Brad was actually moving to be 9 hours 41 mins. Candidates who showed working and calculated $\frac{6320}{9\frac{41}{60}}$ were awarded 9 marks.

The most common misconception seen was for candidates to work out the average flight speed as $\frac{6200}{7\frac{1}{6}} = 865$ km/h, then to find the mean of the three speeds, $\frac{18 + 865 + 65}{3} = 316$ km/h.

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the extended syllabus. The recall and application of formulae and mathematical facts to apply in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions. Candidates must learn to hold accurate values in their calculators when possible and not to approximate during the working of a question. If they need to approximate, then they should use at least four figures.

General comments

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

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

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

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

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

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

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

Comments on specific questions

Question 1

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

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

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

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

(d) A small number of candidates incorrectly wrote down $1763000 = 58000\left(1+\frac{x}{100}\right)^{21}$ as a first step and some others used the analogy of simple interest rather than compound interest**.** Those who had the correct first step usually went on to write down $\sqrt[21]{\frac{58\,000}{1\,763\,000}}$ as part of the working and were given credit for this. There were many correct answers but some candidates could not use the calculator to evaluate correctly and others gave an answer of –15%.

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

Question 2

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

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

Question 3

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

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

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

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

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

Question 4

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

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

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

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

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

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

Question 5

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

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

(c) This was almost always answered correctly.

(d) (i) The majority of the candidates drew the line correctly. A small number did not use a ruler and there were a few examples of the line being too short.

(ii) This part was answered well. A small number of candidates gave a negative value for the upper end, presumably because the *y* co-ordinate is negative.

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

Question 6

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

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

(ii) The majority of candidates were able to factorise correctly using parts. There were a few errors transferring to the number line.

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

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

Question 7

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

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

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

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

Question 8

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

(ii) Most candidates identified angle *BCD* as 32° and used the sine rule correctly to find *BC*. In some cases, 95 was used in the sine rule in place of 32 or 53.

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

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

Question 9

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

(b) This part was almost always correctly answered.

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

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

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

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

Question 10

(a) (i) This part was answered well and the majority of candidates scored full marks. A few took the square root rather than the cube root in order to find *r* and a small number made an error when transposing the formula.

(ii) This question proved more challenging. The most common error was to not subtract the volume of the sphere from the volume of water in the cylinder. A small number of candidates used an incorrect formula for the volume of a cylinder with $V = \frac{1}{2}\pi r^2 h$ an example. Many candidates were not able to convert from cm^3 to litres.

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

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

Question 11

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

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

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

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

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key messages

To do well in this paper, candidates need to be familiar with all aspects of the syllabus. The recall and application of formulae in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Work should be clearly and concisely expressed with intermediate values written to at least four significant figures and only the final answer rounded to the appropriate level of accuracy.

Candidates should show full working with their answers to ensure that method marks are considered where answers are incorrect.

General comments

The paper proved accessible for most candidates and this was reflected in the excellent responses to some questions. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity with the topic or challenges posed by the question rather than lack of time. The presentation in some cases was very good with methods clearly shown.

Most candidates followed the rubric instructions but there were a significant number of candidates not gaining accuracy marks by either making premature approximations in the middle of a calculation or by not giving answers correct to the required degree of accuracy. This was particularly obvious in 'show that' questions. Many candidates didn't show values to the degree of accuracy required at the end of these questions. As a result they didn't gain the final mark despite an otherwise good solution.

Conversion of time from decimal form into hours and minutes and vice versa proved challenging for some candidates.

The topics that proved to be more accessible were percentages, average speed, mean of grouped data, drawing an exponential graph, simple indices, transformations, volumes of hemispheres and cylinders, sequences and probability. The more challenging topics were problem solving in coordinate geometry, calculating the volume of a frustum and determining what straight line to draw in order to solve an equation.

Comments on specific questions

Question 1

(a) **(i)** Almost all candidates dealt with the minutes correctly. Many forgot to allow for the time difference and 7 hours was a common error. Others added on the hour and some answers were seen with 8 hours.

(ii) The common method was division of 90 by 36 followed by multiplication by 60. Others simply divided by 0.6 or $\frac{3}{5}$. A few gave their answer in km/min. Incorrect times were usually due to reading a wrong value from the table rather than a miscalculation, although some converted 36 minutes as 0.36 hours.

(iii) This proved to be a challenging question. A large majority were able to calculate the distance travelled by the train in 35 seconds, but some did not allow for the length of the train and gave this distance as their answer. Some used the length of the train incorrectly, adding it to the distance travelled and giving an answer of 970 m. A small number of candidates gave an answer of 970 without any working and could not be awarded any marks. A small number weren't able to convert 35 seconds into hours.

(b) (i) Many correct responses were seen with most errors involving ratios not in their simplest form.

(ii) Candidates displayed a good understanding of percentage increase and fully correct solutions were common. Some lost the final mark by giving an answer with only two significant figures. The most common error involved expressing the increase as a percentage of the premium fare.

(iii) Many candidates gave fully correct responses while some made slight slips with the number work but still earned most of the marks. Some candidates showed the method as 70% $\times$ 220 rather than 0.7(0) $\times$ 220 or $\frac{70}{100} \times 220$. This only gained marks if a correct result was shown. A small number made an error in finding the number of children, often dividing 220 into 13 parts.

(c) Candidates were less successful in this part. Although working in standard form was the most efficient method, many candidates converted to an ordinary number, sometimes introducing an error due to incorrect place value. Several candidates did not realise that this was testing a reverse percentage situation and calculated 88% of the number or occasionally 112% of the number.

Question 2

(a) A large majority of responses were correct. Most errors were the result of incorrect rearrangement, such as $7x - 5x = 3 + 17$.

(b) Some candidates did not understand the requirement to give integer solutions and division by 4 was often seen with $\frac{7}{4} < n \leqslant 2$ as the final answer. Some of those that gave integer values often omitted 0 and, to a lesser extent, –1 was also omitted. Some less able candidates combined the –7 and 8 into a single inequality (or equation) such as $4n \leqslant 15$.

(c) (i) This part was almost always correct.

(ii) A large majority of candidates gave a correct simplification. Omitting to raise 5 to the power of 3, omitting to raise x to the power of 3 and adding the indices for y to give y^5 were common errors. On rare occasions, 5^3 was given as the simplest form instead of 125.

(iii) Although this part proved more challenging, many correct solutions were seen. Most candidates appreciated that it was necessary to cube root but had difficulty combining this with the reciprocal. Some candidates earned either one or two marks for partially correct solutions. Dealing with the reciprocal usually meant writing a fraction with one in the numerator and the given expression in the denominator rather than as an inverted fraction directly.

Question 3

(a) (i) Many correct translations were seen with a few candidates earning partial credit for a translation with a correct displacement in one direction. The more common error involved treating the translation as $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

(ii) Fewer correct answers were seen especially from the less able candidates. The line $y = x$ appeared to cause confusion. Some used the x-axis while others used $y = -x$. Many attempted to draw the line and in several cases, it went from the origin to (6, 7), the top-right corner of the grid. Although some clearly had the correct idea, slips were made in plotting the vertices, in particular (4, –1) was incorrectly plotted at (4, 0).

(b) Many fully correct answers were seen. Some candidates spoilt their answers by including a second transformation such as translation or reflection. Some had difficulty in locating the centre and a variety of incorrect centres were seen. Some were unable to differentiate between clockwise and anticlockwise.

(c) (i) Many candidates were able to give a correct matrix. Errors usually involved the use of –2 along the wrong diagonal or in some cases candidates used 0.5 or –0.5 along either diagonal.

(ii) Not all of those with a two-by-two matrix were able to calculate the determinant. Some gave their answer as the reciprocal of the determinant and others misunderstood the signs.

Question 4

(a) (i) Candidates were asked to show that the volume of the bowl is 368 cm^3, correct to the nearest cm^3. To earn full marks they were expected to show the volume to a greater accuracy than 368. The correct substituted formula was usually seen but a significant number of candidates just gave 368 as an answer rather than 367.8 or better. These candidates didn't gain the final mark. A few only gave the volume of a sphere.

(ii) A majority of candidates calculated the correct radius of the tin. Some candidates misunderstood the given percentage, treating a full bowl as 80% of the tin. They were unable to obtain the correct radius but usually earned credit for their method for calculating the radius. Some candidates experienced a problem with the formula for the volume of a cylinder and expressions such as $2\pi r^2 \times 10$ were common errors. Some candidates gave an answer of 3.1 with no more accurate values seen in the working. This would have been avoided if candidates always worked with more than 3 significant figures.

(b) (i) The key to answering this question correctly was recognising that the given formula required the candidate to use the slant height and not the perpendicular height. Although many did use the correct slant height there were many who used the perpendicular height. Not all those applying Pythagoras' theorem did so correctly. Other errors involved the omission of the area of the base.

(ii) **(a)** Not all candidates realised the empty space was a cone similar to the whole cone. This gave a ratio of heights 1 : 4. Most candidates calculated the radius of the empty cone and then worked with volumes. A small number used the ratio of volumes to find the volume of the empty space and only a few realised if the ratio of volumes is 1 : 64 then the volume of salt is $\frac{63}{64}$ of the whole cone. A common error was using the formula for the volume of a cone with a radius of 1.75 and a height of 4.5.

(b) Most candidates attempted to divide the volume of salt by the given rate to find the required time. For some, the conversion between mm^3 and cm^3 proved difficult and answers such as 945 and 9.45 were common. A significant number of candidates did not round their answer to the nearest second.

Question 5

(a) (i) Many correct answers were seen. Some candidates found –3 in their working but spoiled this by giving a final answer of 1.

(ii) Many candidates succeeded in finding the correct value in this part. It was apparent that some candidates did not use the graph, preferring to use the given function. There was no pattern to the wide variety of incorrect answers.

(b) This question divided the candidates into two groups. Those who successfully identified the line as $y = 5 - 3x$ usually drew the line accurately and identified the correct solutions. For most of the other candidates the procedure to find the line was unclear. The most common incorrect approach was to pick out $3x$ from the original equation and draw the line $y = 3x$. If this was identified in the working, candidates could earn follow through marks for their solutions. A slightly higher proportion of candidates made no attempt at a response. Not giving an equation for a line was common, even when random lines were seen drawn on the grid.

(c) Many good attempts were seen, even for those who could not complete earlier parts of the question. Most knew the definition of a tangent, and most lines were drawn accurately at $x = -2$. For some, the tangent did not quite touch the graph, or it was mistakenly drawn at $x = 2$. On rarer occasions, a perpendicular line was drawn at $x = -2$. The scale of the graph sometimes caused a problem in calculating the gradient and occasionally some candidates omitted the minus and gave the absolute value.

(d) (i) Apart from the occasional slip, this part was generally well answered.

(ii) Many candidates were able to draw a curve through the correct points. The final section of the curve between $x = 1$ and $x = 3$ sometimes touched or crossed the x-axis.

(iii) Some candidates missed the instruction asking for the positive solution and some gave both. A small number gave just the negative solution. A few confused the intersection with the line drawn in **part (b)**.

Question 6

(a) Calculating the mean of grouped data was widely understood and many gained full marks. Common errors usually involved using the interval widths or the upper/lower boundaries rather than midpoints. A few simply added the frequencies and divided by 5.

(b) Many candidates understood that area represented the frequency and drew fully correct histograms. Only the occasional slip in drawing the bars resulted in a loss of marks. Many less able candidates simply copied the method of the given bar by dividing the frequency by 10.

Question 7

(a) Most candidates had a good understanding of co-ordinate geometry. These candidates were able to find the gradient of AC and then substitute the co-ordinates of A or C into $y = mx + c$ to find the equation. A few slips were seen in calculating $9 - (-3)$ or $1 - (-2)$. Substitution of the co-ordinates of both points A and C into $y = mx + c$ and solving simultaneous equations was rarely seen.

(b) Very few candidates realised that the gradient of a straight line was the tangent of the angle between the line and the positive x-axis. Some candidates found the co-ordinates of the intercepts on both axes and used the triangle generated to find the required angle. Pythagoras' theorem was often used to find the hypotenuse followed by either the sine rule or simple trigonometry. Final answers were often inaccurate because of premature rounding of intermediate values. Many candidates made no attempt at a response.

(c) (i) Knowing that the diagonals of a kite are perpendicular was essential and the majority of candidates knew this property. More able candidates with a correct answer in **part (a)** often gained full marks. Some spoiled their final answer by rounding 2.875 to 2.88. Some candidates gained partial credit for a correct method to find the y-intercept following an incorrect gradient. A significant number of incorrect responses were seen, although these solutions often gained a mark for a correct substitution of (3.5, 2) into $y = mx + c$. Using a gradient of 4 for the line BD was a common error, with candidates working out a parallel line rather than a perpendicular line for the diagonal BD. Many candidates made no attempt at a response.

(ii) Knowing that the diagonals of a kite bisected each other was essential in determining the co-ordinates of D in an efficient method. Some used their knowledge of midpoints to set up two simple equations, $\frac{x+3.5}{2} = -0.5$ and $\frac{y+2}{2} = 3$, that led to the correct co-ordinates. Others used an informal vector approach, finding the displacement from B to (–0.5, 3) and using this to find the co-ordinates of D. Fully correct responses were in the minority. Many of the incorrect answers were not accompanied with any working.

Question 8

(a) (i) A sizeable majority of candidates gained both marks. Some used replacement of the counters and repeated the given probability. The denominator was often not expressed in its simplest form and $(x + 3) - 1$ was often seen. This was not a problem here, but it sometimes led to difficulties in the next part when expanding brackets.

(ii) **(a)** This part proved more of a challenge and slightly fewer fully correct solutions were seen. Many of these responses showed clear working with all relevant stages shown. Errors were mainly due to a slip with a value or sign within their working. Candidates who did not simplify their denominator in **part (a)(i)** were more prone to making errors with the algebraic manipulation. Less able candidates treated the fractions as if they should be added and attempted to find a common denominator. A few candidates attempted to solve the quadratic equation.

(b) A large number of fully correct solutions were seen. Despite factorisation being stated in the question, a number of candidates used the formula or occasionally completed the square. Those attempting to factorise sometimes didn't show a multiplication of two brackets and just showed the two separate factors. It was clear that some had used their calculator and then tried to work backwards to find the factors, often unsuccessfully, with reversed signs a common error.

(c) If two solutions were seen in the previous part then this part was almost always correct or followed on correctly from their solutions to the equation.

(b) A large majority used clear and efficient methods and earned full marks. Some used a full or partial tree diagram while others multiplied the three probabilities for each colour and added the results. Answers were usually fully simplified. Some candidates recognised the correct combinations but repeated them, usually three times. Replacement methods were seen in a few cases while others used two counters rather than the required three.

Question 9

(a) (i) Most candidates were able to use the efficient method of the sine rule using angle $ACD = 46°$. Others used longer methods involving CD, BD and BC which were prone to errors often due to premature rounding within the calculation. A few used a method involving a perpendicular from D to AC. Some only gave trigonometry expressions implicitly rather than explicitly and often did not show their answer to at least two decimal places to earn the final mark. Some used the sine rule with a right-angled triangle and others used x to represent more than one length rather than use precise labelling such as AC.

(ii) Almost all of those that were successful in **part (a)(i)** were able to calculate BD correctly. Not all used the efficient route of finding AB, preferring instead to find CD or CB as a first step. Answers of 11 were sometimes seen, lacking the required degree of accuracy of three significant figures.

(b) (i) The difficulty here was finding a single variable linking EF and FG in order to form an equation. Those who started with $0.5ab\sin 40 = 70$ could go no further than isolating the product ab. Many started correctly with x and $2x$ while others started with the equally valid approach of using $\frac{x}{3}$ and $\frac{2x}{3}$. The downside of this alternative was that the answer x represented the total length $EF + FG$. Having calculated x correctly, a number of candidates forgot to divide it by 3 to find EF.

(ii) Very few correct responses were seen in this part. The most common incorrect answer was 40, or a number that rounded to 40. Both the correct answer of 140 and the incorrect answer of 40 (or angles that rounded to these values) were almost always accompanied by working, usually $0.5ab\sin C$ with a and b and the area replaced by values from the previous part. Very few were able to just quote the answer and a high proportion of candidates made no attempt at a response.

Question 10

(a) **(i)** Incorrect answers were extremely rare.

(ii) Almost as many correct answers were seen in this part with just the less able candidates finding it more of a challenge. $19 - 4n$ was a common incorrect answer.

(iii) Candidates were only slightly less successful in this part. Some candidates earned a mark for equating their incorrect linear formula to -65. A common misunderstanding led to several candidates evaluating their formula for the nth term with $n = -65$.

(b) Many correct answers were seen and any loss of marks usually resulted from an arithmetic slip.