MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

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

General comments

This paper proved accessible to a large majority of candidates. Most candidates showed some working and it was usually set out clearly. Candidates should show all their working to enable method marks to be awarded with each step shown separately.

The questions that presented least difficulty were **Questions 11(a)**, **14**, **18**, **22(a)** and **24(a)**. Those that proved to be the most challenging were **Questions 2**, **5(b)**, **20(c)** and **21**.

Comments on specific questions

Question 1

This question was answered well by many candidates. Most answers included the figures 46, but with incorrect place values when candidates did not know how many centimetres there are in a metre or divided instead of multiplying.

Question 2

Some candidates did not seem familiar with order of rotational symmetry. Common incorrect answers included 1, 2, 4 or attempts at finding angles. The answer 1 would often be accompanied by a single vertical line of symmetry on the diagram.

Question 3

This was answered well by most candidates. A very small number omitted the decimal point from their answer. Sometimes 5% was given as 0.5 instead of 0.05. Occasionally, $\frac{5}{25} \times 100$ was seen. Some achieved the correct value but then went on to take that from $25.

Question 4

Candidates who identified p as the common factor usually went on to give the correct answer. Some attempted to use an incorrect common factor, often 5. Some seemed to have little understanding of what was required, giving answers that appeared to be attempts at simplifying the given expression, so $6pt$ or $5p^2t$ were seen.

Question 5

(a) This was well answered, with most indicating the correct position for the probability on the scale. Some calculated the probability as 0.5 but then did not draw an arrow on the scale as a few seemed not to realise that half a division corresponded to the probability of selecting one pen.

(b) This part was not answered very well as many seemed to be under the impression that the arrow had to point to one of the dividing lines on the diagram. Candidates sometimes showed a correct probability as a decimal or percentage but then did not go on to plot the value correctly. A very small number of candidates showed two arrows rather than attempting to indicate the combined probability of red or blue.

Question 6

(a) Some candidates appeared not to be confident of rounding to the nearest 10 as answers such as 847 and 8500 were seen.

(b) This part was also challenging for some with common incorrect answers of 16.1, 16.10 or 160.86

Question 7

In most cases, the candidates who showed the conversions to decimals went on to achieve both marks. Often the candidates that did not show any working were incorrect in their ordering, suggesting uncertainty of the required methods to convert to a common form. A recurring error was to place 37% as the largest value.

Question 8

Most candidates made a good attempt at this, with the majority showing correct construction arcs and drawing a triangle that was within the required tolerance. A number of candidates drew one arc or a side which was 1 cm too long or short. The most common error was a triangle with no arcs either because they had been erased or that compasses were not used.

Question 9

Most candidates were able to perform the correct calculation, but many had difficulty giving their answer to the correct accuracy. Instead of an answer correct to 2 significant figures, many answers were rounded or truncated to 2 decimal places. A small number of candidates who reached the value of 4.6 spoilt their answer by including superfluous zeros but many of these were awarded a partial mark for a correct interim value. Those that ignored the order of operations obtained an incorrect answer of 16 (from $16.379 - 0.879 \div 4.2 \times 1.241 = 16.119...$). A small number rounded each number in the calculation before inputting into their calculator.

Question 10

This was answered well. Occasionally, the first step of dividing 518 by 7 was replaced by dividing 518 by 2 and 5 for each answer in turn.

Question 11

(a) This was very well answered. Sometimes the thousands became hundreds and some muddled teens and tens so fifty and sixteen were seen.

(b) Many candidates did not appear to understand standard form so this was not well answered. Quite a number rounded 15 060 to 15 100, or other rounded forms, before attempting standard form so 1.5×10^4 was a common answer. In questions of this type, all the digits should be present.

Question 12

Many candidates recognised what was required here, although a significant number were unable to deal with the negative terms correctly. A large number of candidates adopted a factorising approach, for example showing $c(5-2)+d(-1-3)$. Many of these candidates didn't simplify further and there were also many sign errors seen. Often the final answer was $3c-2d$ which gained partial credit as one term was correct.

Question 13

Most candidates were able to complete this correctly. There were few candidates using inaccurate values for π. Candidates who did not gain the method mark were usually unable to substitute 12 into the correct formula, frequently either substituting 6, working with $2\pi r$, or squaring π instead of (or along with) squaring 12. A small number used $2\pi r^2$ or $\frac{1}{2}\pi r^2$. A few did not use π in their calculations at all.

Question 14

This was very well answered. The candidates who did not score usually had multiplied rather than divided and gave $7 148 500. In this question, more than many others, it was clear that some had reversed digits (i.e. 24 560) when using their calculators – this is another area, particularly with numbers with many digits, where candidates must take care.

Question 15

This proved to be a challenging question for many candidates. Some found the rate over 10 years (15) rather than per year. Many did not seem to know the formula for simple interest and so used a method that was completely incorrect, including using the compound interest formula. Writing $P\times r\times T$ equal to 690 rather than just the interest, 90, was a commonly seen incorrect first step. Others also forgot to divide by 100.

Question 16

There were many good answers seen to this fractions question. Candidates who used a cancelling method usually reached the correct final answer. Some candidates started correctly, but then attempted to use a common denominator or inverted one or other of the fractions. Some made errors in arithmetic as they tried to cancel down to the simplest terms. According to their working, a few candidates seemed to think multiplying by $1\frac{1}{7}$ was the same as multiplying by 1 then by $\frac{1}{7}$.

Question 17

This was generally answered well, the common errors being to add the coefficients or multiply the powers. A number of candidates attempted to factorise the expression to $x(2x^2\times 3x)$.

Question 18

This was generally answered well; the most common errors were to give an incorrect answer for the missing fraction or give 0.8 for the decimal.

Question 19

(a) Most candidates knew that the median meant the middle but many didn't order the data first and some only counted one of the 14s. A very common approach was to cross numbers off at either end of an ordered list but this was often unsuccessful because many continued until they had a single value, either 32 or 38; they did not realise that, in this case, there was a middle pair. Some found the middle values from the unordered list. Others identified 32 and 38 correctly but calculated $32+38\div 2$ rather than $(32+38)\div 2$, suggesting that they had used their calculators without considering the order of operations. A significant number found the mean rather than the median.

(b) This was answered more successfully than **part (a)**. A significant number either made errors identifying the largest and smallest values, or didn't complete the subtraction, suggesting that the range was '8 to 93'. Others calculated the mean and very occasionally, 14, the mode, was seen in either **part (a)** or in this part.

Question 20

(a) Whilst most candidates gave the correct response, answers seen ranged from 0.009 to 21 000 km, suggesting that candidates were not considering whether their answers made sense within the context. A number of candidates made errors based on the misunderstanding of the vertical scale where one square represents 3 km.

(b) Most candidates clearly understood that Juan had arrived at the shop and that he stopped. Some candidates stated that Juan stayed in the shop for a period of time but the question required candidates to describe what was happening at a particular instant. Common misconceptions included 'Juan is moving at a constant speed'.

(c) The majority of candidates completed the travel graph correctly and drew an accurate ruled line. The errors seen included un-ruled lines or lines going to an incorrect time on the axis. Some candidates drew two straight lines from (15 15, 15) to (15 45, 6) and then to (16 15, 0) as they thought the return journey should replicate the outward journey.

Question 21

There were some excellent answers seen to this question. There were many candidates who identified the need to use cosine who were then unable to rearrange their equation to make x the subject. A common error was for candidates to round the final answer as well as intermediate values, for example giving cos 43 to only 2 decimal places, and then using the rounded values in the next step of their calculations, leading to inaccurate final answers which could not gain the accuracy mark. A large number of candidates opted to use tangent, which calculated the vertical side, and of these, only a minority went on to use Pythagoras' theorem in a longer method.

Question 22

(a) Candidates answered this algebra question well. The most common error was to expand $8(w + 11)$ as $8w + 11$. Candidates should not leave their answer in an embedded form, i.e. as $8(4 + 11) = 120$ instead of just the required 4, on the answer line.

(b) This was not answered as well as the previous part and a variety of errors were seen. Some candidates were unable to complete a correct first step, sometimes either adding 2 or subtracting 2 from the right-hand side. Others were unable to deal with the division by 3, often multiplying $x - 2$ by 3. A number of candidates who reached $x - 2 = 9$ went on to state that $x = 7$. Other errors occurred when candidates tried to do two steps at once.

Question 23

There were many excellent responses seen as well as many who did not attempt the question. Clear algebraic methods leading to fully correct solutions were seen in many cases. Candidates should be able to analyse the equations to see which method is the simplest to use and that also has the fewest places where errors (method or arithmetic) might be made. The simplest elimination method with these specific equations is to multiply the first equation by 1.5 then add; other than that, both equations need to be multiplied in order to eliminate one variable. Candidates using elimination methods frequently made sign errors or made an incorrect decision as to whether to add or subtract their equations as well as arithmetic errors. Candidates using substitution or equating methods were usually able to rearrange one or both equations, but many made errors when dealing with the resulting algebraic fractions. Candidates who substituted into the first equation reached the correct solutions more frequently than those who substituted into the second equation.

Question 24

(a) This was answered well by a large number of candidates. Some did not see the symmetry (apart from the sign changes) in the table so gave different absolute values for $x = \pm 5$.

(b) Whilst there were some excellent graphs, there were significant issues with accuracy of plotting the points that were not on the major grid lines and drawing the graph as it approached the asymptotes. A significant number of candidates plotted both parts of the graph either in quadrants 4 and 1 or 2 and 3. Many did not realise that there should be nothing between $x = -1$ and $x = 1$ and joined the two parts of the graph together. Some ruled lines between some or all of the points. A few candidates plotted the points but did not draw in the curve.

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

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. The vocabulary of mathematics should be learnt and questions should be read with care.

General comments

Many candidates made a good effort at the questions and there were few questions not attempted. While most did show working where necessary, there is still a need for many to show the steps of a calculation prior to using their calculator.

Questions in context, for example **Questions 6, 9, 11, 18** and **22**, often had answers which were totally unrealistic for the situation.

Comments on specific questions

Question 1

This question was very well answered. There were a number of candidates who omitted the letter in the answer. Also some added all items instead of subtracting $2t$ while other incorrect responses included $7t^3$.

Question 2

This question on temperature needed careful reading as there were two lines of information before the question. Many candidates used incorrect calculations, often producing a totally unrealistic answer for the highest temperature, such as 120.8°C. Other errors seen included just changing the sign on one of the values to give −63.8 or 57, while just 63.8 was also seen. Some did attempt a correct calculation but often ended with an answer of −6.8.

Question 3

The topic of bearings is often found challenging. Many candidates clearly did not know which angle to measure resulting in working from *B* instead of *A*. The most common error was to give the distance from *A* to *B*, 6.5 cm. Reading the wrong scale on the protractor led to the response at or close to 67°C.

Question 4

(a) There were very few errors in this part although doubling, rather than squaring 24, was seen occasionally.

(b) Cube root was not so well known but many did find it correctly. Some gave a square root instead, while others multiplied or divided the square root by 3.

Question 5

(a) Most candidates were able to find the correct probability and often chose the correct letter, although *A* and *D* were seen at times.

(b) This part was not so well answered, often through not reading the question carefully and noting that it was not taking a blue ball that was required.

Question 6

(a) Most candidates read the distance scale correctly but the common error was not reading the question carefully and giving the distance 2.4 km from home to school. Misreading of the scale meant 1.3 was seen at times.

(b) Common incorrect answers were 5, 15 or 20 minutes but there were quite a lot of totally unrealistic responses also.

Question 7

Ordering of values was done very well with most correct. Many showed the decimal conversions and generally those who made an error gained a partial mark. Some, after converting to decimals, thought that 0.8 was the lowest, presumably as it was the shortest number. The reverse order was also seen at times.

Question 8

The question only required the angle for 'Walk' but some found all the angles or attempted to draw a pie-chart or even a bar chart. Most found the total but some left this as their answer, while after the correct fraction written quite a few multiplied by 100 instead of 360°. However, many did find the correct angle.

Question 9

Some made the error of multiplying 30 000 by 68.14 even though this produced a totally unrealistic amount of dollars. The vast majority of candidates divided and it was rare for them then to make an error.

Question 10

Converting kilograms to grams was done well although some used 1 kilogram equal to 100 grams. Few managed the area conversion correctly with 140 and 1400 being common incorrect answers. Some candidates squared the value to give 1.96 or other answers with figures 196.

Question 11

The average speed calculation was not answered well, even though the vast majority knew they had to divide distance by time. Just dividing by one of the clock times, rather than a time period, was often seen. Others made some progress with a correct time period but could not sort out the units. Dividing by 90 gave an unrealistic speed of 1.5 km/h while not converting 30 minutes to a decimal was also quite common. A number of candidates used 1.3 for the time.

Question 12

Most candidates produced a line with negative gradient. However many drew a line that passed through one or both corners of the grid and consequently came outside reasonable limits. Reading the scale caused problems at times where, for example, three rows above 6000 was recorded as 6300 instead of 6600.

Question 13

(a) This part was quite well answered but taking 6^0 as 6 or 0, instead of 1, were seen quite often. Others clearly did not understand indices since responses of 12 and 12^2 were seen.

(b) This part was also quite well answered with a variety of the acceptable forms seen. Some candidates left their answer as $\frac{1}{5^4}$. From a variety of incorrect answers 625, −625, $5^{\frac{1}{4}}$, -5^4, 0.16 and 1.6 were the most common.

Question 14

(a) A few candidates did not read the question carefully and shaded 1, 3 or 4 squares. Around half of the candidates shaded the correct squares. There was a wide variety of incorrect responses with most correct for the square in the first column but not finding the other square.

(b) Some candidates gave word answers such as 'line', 'shape' or 'congruent' or an angle such as 180°. One mark, usually for the lines of symmetry, was most often awarded, while 4 or 1 were most commonly seen in one or both parts.

Question 15

(a) While most candidates could find the mode, 18, the first in the list, was often seen. There was also a few who attempted mean or median in this part.

(b) Most who knew the term 'mean' gained the marks for this part although again some attempted the median. Some did not divide the total by 10 or incorrectly added the data items.

Question 16

Surface area of a solid was not understood by many candidates. Many found the volume while some gave just the area of one rectangle. Others found and added the three different areas without doubling or regarded it as an open box so just five areas were totalled. Of those who did find six areas it was common for four of them to be the same, usually 4 by 15.

Question 17

Although subtraction of mixed numbers is a challenging fractions question, this was successfully answered by most candidates. Quite a few worked correctly but didn't earn the last mark by not changing the improper fraction to a mixed number as requested in the question. While use of decimals was rare, some did revert to a decimal answer. There were quite a significant number of candidates who did not attempt to find a common denominator or could not correctly change mixed numbers to improper fractions.

Question 18

There were a significant number of candidates who attempted a simple interest calculation instead of compound interest. Those who knew the formula for compound interest and dealt with it correctly usually reached the correct answer. However some of those then found the interest by subtracting 750. Others added 750 to the correct answer. Year on year calculations were also successful for some but did produce some errors.

Question 19

The Pythagoras' theorem calculation was not well answered with quite a number of candidates thinking it was a trigonometry question. Others squared the lengths and then added, leading to an answer greater than the hypotenuse. Answers needed to be 3 or more significant figures so those who just gave 7.6 without more accuracy seen didn't earn the final accuracy mark.

Question 20

(a) Most candidates attempted to find the gradient from two points with difference in y's divided by difference in x's. While successful for some, many made errors or reversed the calculation. Few just used the diagram to find vertical divided by horizontal for two clear points at the intersection of grid lines. The use of end points was a problem since the top point could not be read accurately so should not have been used. Many candidates did not understand what was meant by 'gradient'.

(b) The continuation to the full equation was not very successful with many not connecting with **part (a)**. Those who read the value +1 from the graph often gained the mark but some did not substitute their answer to **part (a)** for m in the equation. Others tried to start the question again using substituted points and invariably didn't reach the correct answer. There were also many blank responses to this part.

Question 21

(a) Many candidates had difficulty identifying a rhombus from the quadrilaterals, with the parallelogram letters being the most common incorrect answers.

(b) There were many blank responses in this part. Rhombus was the most common incorrect response and there were a lot of cases of polygons which were not quadrilaterals as well as the word 'quadrilateral'.

(c) Around half of the candidates did not understand the meaning of congruent and common errors were to select the two trapezia or the two parallelograms as having that property.

(d) The final part was well answered although this was probably due to the correct answer to **part (c)** being also allowed as similar figures. A few candidates thought the two trapezia were similar.

Question 22

(a) There were very few fully correct answers to forming an expression with many clearly not understanding the difference between expression and equation. Just adding the prices was a common error but many did form the correct expression but then made it into an equation.

(b) The solution to the equation was quite well answered but rarely from equating the expression in **part (a)** to 60.55. Nearly all who made progress went back to the original information, working out the cost of the magazines and subtracting from the total cost. Some got no further than that but many correctly divided by 3.15. The common error was to multiply 60.55 by 8.

Question 23

The angle bisector described as a locus was found challenging by many candidates who bisected the wrong angle or constructed the bisector of a side. Most who gained partial marks did so from an arc from point R, although there were many cases of lots of arcs drawn, some at 13 cm since the scale was not applied. Many did not clearly mark the position of the bird table, but full credit was given for the intersection of a correctly constructed bisector and a correct arc. Shaded regions were seen a number of times. Many candidates did not attempt the question.

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

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. Ensure that the questions are read carefully.

General comments

The vast majority of candidates were able to attempt all the questions in the time given. Working was generally well presented with clear writing. Some candidates prematurely rounded in the middle of a question. Candidates should be encouraged to show the method, even though they are using a calculator.

Comments on specific questions

Question 1

Most candidates were able to give the correct answer. There were some answers of obtuse and some not related to angles.

Question 2

Although most candidates gave the correct answer, a small number gave 5.6 or 5600.

Question 3

Most candidates gave the correct answer. The most common incorrect answer was 4300.

Question 4

Many candidates understood how to factorise. A small number tried to combine the terms to give $17x$ or $27x$ or made an equation to reach a numerical answer. Some tried to take x out as a factor in addition to 3.

Question 5

(a) This question was almost always correctly answered. There were a few blank responses and $(6 - 2 \cdot 5)$ was seen a number of times.

(b) This part was also very well answered with the most common incorrect answer being $(8 + 6)$. Some candidates put in more than one pair of brackets.

Question 6

(a) The majority of candidates answered correctly but 10 and 4 were seen at times.

(b) This part was almost always correctly answered.

Question 7

(a) Almost all candidates knew cube numbers and answered this part correctly. Common incorrect answers were 47 and 87.

(b) There were many correct answers in this part. Common incorrect answers were 57 and 87. A small number of candidates wrote the same number for both parts or more than one number.

Question 8

(a) This part was generally well answered. Some of the incorrect responses were due to not knowing where $\frac{5}{8}$ was on the scale, rather than not knowing that the probability is $\frac{5}{8}$. A small number gave the three-quarter mark and some drew arrows between the given marks on the scale.

(b) This part was very well answered although $\frac{3}{8}$ was seen (probability of red).

Question 9

Finding just the reduction, 100.8, was the main error. The vast majority of candidates answered correctly. Almost all did this question in stages and it was very rare to see $560 \cdot 0.82$.

Question 10

Candidates confused area and circumference and also radius and diameter. A few used an inaccurate value of π, 3.14. The most common error was to find the area of the circle. There were also quite a few candidates giving their final answer as 9 (the diameter).

Question 11

There were a significant number of candidates who did not know what was meant by standard form. Some just rewrote 72 000 and 0.0018 in the answer space. Others rounded the given numbers to one significant figure.

(a) Those who knew standard form almost always got the answer correct. $72 \cdot 10^3$ and $720 \cdot 10^2$ were the most common incorrect answers.

(b) This was not so well answered with an index of 3 instead of –3 being a common error.

Question 12

This question was well attempted. Most expansions were correct but the middle terms were occasionally missing. Also seen were correct expansions but incorrect combining terms or other errors in the final answer. Some gave $2x$ instead of x^2 for the first term. Candidates should ensure they write their final answer on the answer line.

Question 13

(a) Many correct answers were seen in this part. The main incorrect answers were x^9, or 18 from multiplying the indices.

(b) Almost all answers were correct for this part although 10 from 2 + 10 = 12 was seen occasionally.

Question 14

Many candidates knew to use Pythagoras' theorem. This was a 'show that' question but many did not understand that they needed to give an answer more accurate than 41.8 to gain full credit. Several attempted trigonometry but did not give a full method. Several candidates did not make any attempt at this question.

Question 15

(a) This question was almost always correctly answered.

(b) Most answers were correct for the mode. The most common incorrect answers were 7 or both 7 and grey on the answer line.

Question 16

Although volume was found a significant number of times, many candidates were able to give the correct answer. Many gained partial credit for just one area or repeating areas more than twice.

Question 17

The majority of candidates were able to give the correct answer to all three parts. The main errors were with the addition or subtraction of negative numbers. Only a small number incorrectly wrote a fraction line in the vector.

Question 18

Many candidates scored full marks for a correct list. Some just multiplied each number by 30. Quite a few candidates, after dividing by 12, rounded before multiplying by 30.

Question 19

There were many correct answers seen to this problem solving question, although quite a number did not take an algebraic approach to find the correct value of *n*. Some made progress with the algebra but there were errors in the manipulation.

Question 20

(a) The majority of candidates were able to give the correct co-ordinates.

(b) Plotting the point was well done but a few plotted at other points on the line $y = 3$.

(c) Most candidates knew rhombus. Parallelogram was seen a few times and kite sometimes after a correct (1, 3) for point *D*.

(d) Several candidates did not understand rotational symmetry with 4 being a common incorrect answer.

Question 21

(a) This part was almost always correctly answered. The most common incorrect answer was 45.

(b) This part was not as well answered. Many candidates either stated that the graph needed extending or ignored the fact that the graph does not show \$420 and just described how to read off a graph, e.g. find 420 on the *x*-axis then read up to the line and across. For those who had the right idea there was a variety of correct methods, common ones included \$42 · 10, \$21 · 20 or \$35 · 12. Some chose values too low on the line, usually suggesting reading \$1 which was not accurate enough.

(c) Most candidates produced accurate lines, although some did not attempt the part. Incorrect lines were usually due to values being used that were too low for accuracy.

Question 22

(a) Almost all candidates read the value correctly although a few misread the scale.

(b) The points were generally plotted correctly.

(c) The majority of candidates were able to draw a ruled line of best fit within tolerance. A small number joined all the points.

(d) Although many candidates were able to state negative, several gave a description. Direct was seen several times.

Question 23

(a) Several candidates scored full credit for a correct bisector with correct arcs. Others scored partial credit for a bisector without arcs. Some had bisected the incorrect angle.

(b) Most candidates understood that an arc was needed and many correct ones were seen. This was the most successful part of this question.

(c) Candidates found this part very challenging and it was rare to award credit.

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 need to be reminded that prematurely rounded intermediate answers bring about a lack of accuracy when the final answer is reached. They should also remember that, unless asked otherwise, inexact answers should be given to 3 significant figures and exact answers should not be rounded.

Candidates should also be reminded to check that their calculator is in the correct mode to use degrees in angles questions.

Comments on specific questions

Question 1

This was answered correctly by the vast majority of candidates. Some candidates subtracted the correct answer of 1.25 from the original amount giving 23.75 as their final answer.

Question 2

This factorisation was done correctly by almost all candidates. Of the few who did not score, errors seen were to omit the addition sign in the bracket or to multiply the terms.

Question 3

The vast majority of candidates demonstrated efficient use of the calculator by showing a correct unrounded value in their working. The majority of these then went on to gain the second mark for rounding correctly but some left their final answer as 4.57 or 4.58, truncated or rounded to 2 decimal places. Candidates should be aware that 4.60 is not an answer given to 2 significant figures.

Question 4

The overwhelming majority of candidates were able to write the number in words for **part (a)**. Unambiguous poor spelling was condoned. A few confused the words fifteen and fifty and sixty and sixteen. Most candidates understood how to write a number in standard form in **part (b)**. When asked for a number in standard form, unless instructed otherwise, it should be given exactly. The main reason for not gaining a mark here was due to candidates rounding the number to 1.5 or 1.51 when in standard form.

Question 5

Most candidates were able to gain full marks for this question. The most common error was to incorrectly combine the *d* terms and give an answer of $3c - 2d$. A significant number of candidates combined the like terms and wrote $(5-2)c+(-1-3)d$ but did not complete the simplification.

Question 6

The equation was solved correctly by the vast majority of candidates, with most multiplying both sides by 3 as the first step. Of those not scoring both marks, most were awarded the method mark for reaching $x-2=9$, which was then followed by the common error of subtracting 2 to give an answer of 7. A few less able candidates made an incorrect first step, such as $x-2=6$, $\frac{x}{3}=3+2$ and $3x-2=9$.

Question 7

Candidates have a good understanding of the rules of indices and a large majority gained both marks. Occasionally an answer of $6x^6$ was given where the powers were multiplied instead of added. Those who did not score were often seen taking x^2 as a factor from both terms to give $x^2(2x\times 3)$ as their answer.

Question 8

Candidates demonstrated a good knowledge of working with fractions. They understood the need to convert the mixed number into an improper fraction before multiplying, although some just multiplied by $\frac{1}{7}$ and either ignored, or forgot about, the whole number. Many then created unnecessary work for themselves by finding a common denominator before multiplying. A minority confused multiplying with the method for dividing and inverted one of the fractions. Candidates should be encouraged to cancel fractions before multiplying, hence reducing the need for unnecessary calculations and cancelling large values at the end.

Question 9

Most candidates quoted the correct formula for simple interest and were able to go on to solve for the value of *r*. A few made errors when solving, but since working was so clearly shown, were able to gain the method mark for substituting correctly into the correct formula. Those who did not score were generally either using an incorrect formula, often omitting the division by 100, or substituting incorrectly, often using 690 rather than 90 for the interest earned. Others had not read the question carefully or did not understand the terminology and attempted to find the rate for compound interest.

Question 10

This was a fairly complex simplification involving indices and there were many fully correct answers. It was more common to score 1 mark for dealing with one of the three issues correctly in both the numerator and the denominator and it was also common to see either the numerator or denominator simplified completely, with answers such as $\frac{x^{-4}}{0.0625}$ and $\frac{x^{-4}}{\frac{1}{16}}$ being the most common. Many only applied the power outside the bracket to the numerator and so an incorrect step such as $\left(\frac{x}{8}\right)^{-4}$ was often seen. Many made a correct sensible first step of inverting the fraction and making the power positive but a common error in doing this was to also invert the power. Many candidates clearly understood what the numbers in the power meant, as correct cube root signs were often seen, with the 4 remaining as a power outside the bracket. Candidates often stopped at this or went on incorrectly from that point.

Question 11

Candidates who recognised the need to factorise almost always scored full marks in this question. Less able candidates did not appreciate the need to factorise and so could not isolate r correctly. There was much incorrect algebraic manipulation from those who realised that r should only appear once and many left r in both sides of the formula.

Question 12

Few candidates employed the incorrect method of carrying out the calculation and then applying a bound at the end. However, it was very few candidates who scored 2 marks, with the vast majority gaining 1 mark for the use of 15.15. Candidates should understand that a bound is an exact value and so should not be rounded, even when many decimal places are involved. Area and perimeter were often confused in the question, with many multiplying 15.15 by 4. The other common error seen was to add 0.5 rather than 0.05 and so use 15.6.

Question 13

Candidates who were familiar with and well practised in using the area formula usually gained both marks for this question. There were some rounding issues with many candidates giving an answer of 44.9, so incorrect to 3 significant figures. Sometimes the formula was seen with cos rather than sin and occasionally the $\frac{1}{2}$ was omitted. Candidates who were unfamiliar with the formula often found a perpendicular height using right-angled trigonometry and then applied the $\frac{1}{2}b \times h$ formula correctly, so carrying out the same process but in two steps. This did sometimes lead to inaccurate answers due to premature rounding and sometimes the incorrect base was chosen for the perpendicular height found. Some assumed a right-angled triangle and used Pythagoras' theorem to find the missing length which they then used as the perpendicular height. Candidates should never assume a right angle on a diagram; unless there are other properties on the diagram which make it a right angle, it will always be defined.

Question 14

This proved to be one of the more challenging questions for candidates who tended to treat it as linear. Hence the most common response was to multiply 4.9 by the linear scale of 10 000 000 and then divide by the cm to km conversion of 100 000. Part marks were sometimes awarded for those who correctly carried out one step; this was more often for dividing by $100\,000^2$ as many candidates were familiar with dealing with conversions between cm^2 and km^2.

Question 15

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. Those that set up the correct relationship and worked step by step to find a multiplier first, usually went on to gain full marks. This methodical working should be encouraged as many method marks were awarded in this question where candidates made either arithmetic or rearranging errors. A significant number of candidates used the correct relationship and found the correct value of k but then set up the equation as $y = \frac{32}{x}$, omitting the square from the x. This appeared to be a deliberate step rather than an oversight, so candidates need to understand that the relationship used to find k, is the relationship used in the final equation when giving y in terms of x.

Question 16

The most frequent answer was 70.7 which scored 2 out of 3 marks. The majority of candidates employed the most efficient method of using the sine rule to find the missing angle. This was usually carried out correctly to reach 70.7, although there was some confusion with less able candidates who were attempting to find the sine of the lengths 12 and 8, or who rearranged incorrectly after setting up a correct ratio. More able candidates had come across the ambiguous case triangle and understood the need to subtract the acute angle from 180 to find the obtuse angle with the same sine value. Others either did not worry about their angle being acute or did not understand how to find the obtuse angle. A minority of candidates decided that the triangle was isosceles and used 180 – (2 $\times$ 39) to find x.

Question 17

The majority of candidates understood the required method of subtracting the smaller sector from the larger sector. This was one of the questions where premature rounding caused many to lose the final answer mark, as candidates rounded the area of each sector to 3 significant figures before the subtraction, leading to an answer of 6.29. Those who worked in terms of π until the final calculation fared better. One misconception commonly seen was that the area of the shaded sector would be $\frac{45}{360}\pi(5-3)^2$. Other method errors involved incorrect formulae for the area of a circle and some halved the radii given on the diagram. Some confused the area with the arc length. A small minority did not deal with the fraction correctly, either ignoring it completely to find the area of either one or both circles, or just multiplying by 45, the number of degrees. A minority who had been introduced to radians attempted to use the radian formula for the area but used degrees. Some candidates, who had perhaps seen problems of this nature which involved a straight line, found the correct area of the larger sector but then used the sine rule for the area of a triangle to find the area to subtract.

Question 18

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 $-2(2x+4)$ part of the numerator, leading to the incorrect answer of $\frac{x^2-3x+8}{2(x+1)}$. 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. Candidates should also take care with brackets in their working and be aware that $2\times 2x+4$ is not the same as $2(2x+4)$; some show the multiplications they intend to do on the printed question but if an error is made, merit cannot be given for an incorrect mathematical statement, even if their intention is to multiply each term. 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, but these candidates were in the minority. Perhaps due to the nature of the terms in the fraction, it was far less common to see terms being cancelled incorrectly following a correct answer. Less able candidates sometimes resorted to merely adding or subtracting terms in the numerators and in the denominators.

Question 19

Candidates were well practised in multiplying matrices with the majority carrying out the process correctly in **part (a)**. 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 multiplied the equivalent elements from each matrix. **Part (b)** was not so well attempted and it was clear that many candidates did not understand the notation for the determinant. As a result, a noticeable proportion of candidates did not attempt this question. A significant number of candidates worked out the inverse of the matrix **M**, whilst others gave $-\frac{1}{2}$ as the answer. Many confused the notation with absolute value, finding –2 correctly but then gave an answer of 2. Others appeared to be finding the length of a line with a calculation involving the square root of the sum of squares.

Question 20

The most successful candidates set up a correct tree diagram so that all options could be seen, along with the probabilities of each event. Those who did not draw a diagram often gained 1 mark for finding one of the two possibilities, usually $\frac{9}{10} \times \frac{15}{16}$. One of the probabilities used in the calculation for either of the possible outcomes was often 1 minus the correct value. The most common incorrect attempt was to multiply $\frac{15}{16}$ and $\frac{3}{4}$, the two probabilities given in the question referring to travelling on the bus. Less able candidates multiplied all three given probabilities or added probabilities together. Candidates should recognise that a probability greater than 1 is incorrect and re-think their strategy.

Question 21

The majority of candidates identified the transformation as a translation to gain at least one mark in **part (a)**. Care should be taken when giving the vector for a translation, in particular checking that it is given in the right direction for both the *x* and *y* values. Many candidates did not score the vector mark because of this. A few gave a co-ordinate rather than a vector but very few added in a fraction line between the numbers. **Part (b)** was less well attempted, with a significant proportion of candidates not making any attempt. The vast majority of attempts showed the correct line of $y = x$ drawn but then many were not able to use this correctly. Some drew a rotation of the shape and many drew a reflection of either shape *T* in the line $y = 6$ or shape *A* in the line $y = 1$ even after drawing the correct line of $y = x$ on the diagram.

Question 22

This was a multi-stage problem which even the most able candidates found challenging. However, the majority were able to gain at least one method mark by showing a correct multiplication of at least 2 values or by showing a correct conversion. Many made a correct first step of multiplying 6 by 1.2 and gained credit for this, even without the conversion of metres into centimetres. Others sensibly multiplied 1.2 by 3600 to find the speed in metres per hour. Many gained 2 method marks for reaching an answer containing the digits 2592 but had either ignored the conversions or dealt with them incorrectly. Those who gained full marks tended to multiply 1.2 by 100 before multiplying, giving a value in cm^3 which they then divided by 1000 at the end. Less common but equally valid was to convert $6\,cm^2$ into $0.0006\,m^2$ which was then multiplied by 1000 at the end. It was fairly common to see candidates finding the radius of the pipe from the area of the cross-section and either using this incorrectly or then going on to use it in the area of a circle formula, hence getting back to a value close to 6. A significant proportion of less able candidates decided not to attempt the question and some sketched a pipe and wrote some of the figures down but then could get no further with any calculations.

Question 23

Candidates completed each statement with varying degrees of success but a good knowledge of set notation terminology was evident. Candidates clearly understood the intersection of two sets, with the vast majority giving the correct values; a small number confused it with the union of sets. Similarly, the majority understood the second statement and gave the number of elements rather than listing the numbers, which was the most common error. The number 8 was seen on numerous occasions, which presumably came from 5 elements in *A* and 3 in *B*. Those who drew a Venn diagram were the most successful in completing the third statement and many correct answers were seen, although it did cause difficulty for many. A large number of candidates had the universal set symbol on one side of the intersection. It should also be noted that B^{-1} is not acceptable notation for the complement of *B*. The final statement caused by far the most problems, with a minority understanding that the given set was a subset of *A*.

Question 24

A good grasp of functions was demonstrated in both parts of this question. A large majority gave the correct answer in **part (a)** and clearly understood the terminology. Some candidates thought that $3\left(2^x\right)$ simplifies to 6^x but could still gain the method mark by showing clear working. The most common error was to multiply g(3) by f(3), resulting in an answer of 32. **Part (b)** was also well understood. The most common error here was a simple sign error in rearranging $y = 3x - 5$ to $y - 5 = 3x$. Some candidates gained a method mark for rearranging the equation but then forgot to interchange *x* and *y*.

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 $\overrightarrow{BO}$ or $\overrightarrow{OA}$ was often incorrect in **part (a)**. A position vector was required in **part (b)** and it was clear that a large proportion of candidates did not understand this term. Many of those who did make an incorrect attempt were finding $\frac{1}{2}\overrightarrow{PQ}$ or $\frac{1}{2}\overrightarrow{QP}$. Errors in signs were sometimes made when simplifying brackets, but those who set out their working clearly were able to gain a mark for a correct route.

Question 26

Many fully correct answers were seen on the final question of the paper and a significant proportion of candidates gained method marks within it. The majority of candidates understood the need to calculate the area under the graph to find the distance travelled, and even if they struggled with the deceleration, were able to gain 1 or 2 marks for finding the area. Those gaining full marks understood that the time taken to come to rest is the initial speed divided by the rate of deceleration and this was the most efficient calculation to use. Some used –2.5 as the gradient to find the missing co-ordinate of (23, 0). Many candidates using this method used a positive gradient, resulting in an *x* value of 7. A common misconception was to think that the length of the sloping line was 2.5 and candidates then used Pythagoras' theorem to calculate the length of the base of the triangle. Some used the trapezium rule to calculate the area but the majority split the graph into the rectangle and triangle part. This meant that less able candidates who did not know how to deal with the deceleration were often able to gain a mark for finding the distance travelled at a constant speed.

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

There were many candidates demonstrating an expertise with the content and showing good mathematical skills. There was no evidence that candidates were short of time, as almost all attempted the last few questions.

Candidates were very good at showing their working and it was rare to see candidates showing just the answers with no working. There were only a few instances of marks not credited due to rounding or truncating prematurely within the working or giving answers to less than the required 3 significant figures.

Candidates showed particular success in the basic skills assessed in **Questions 2**, **3**, **7**, **11** and **15(b)** which were all number or algebra topics. The more challenging questions included the handling data questions **5(b)** and **18(b)**, as well as **Questions 13**, **19(c)**, and **21(b)**.

Comments on specific questions

Question 1

This question was answered correctly the vast majority of the time but for those with incorrect answers, the common errors were to add 57 and 63.8 to give the answer 120.8 or to make it negative and give –120.8. Another incorrect answer was 63.8, a clear misunderstanding of the question, interpreting it as what is the highest temperature of the two given values? An occasional incorrect answer was to find the correct answer of 6.8 but then to add it onto the 63.8 to get 70.6.

Question 2

This question was very well answered with only a small minority of candidates not scoring. All variations of acceptable answers were seen with some candidates neither rounding nor truncating their calculator result and giving answers with up to 9 decimal places. Those who did not score the mark usually rounded too soon, with 7.61 being a common answer given with no more accurate answer in the working. A few candidates gave a completely wrong answer, usually without working. These answers ranged from 4.36 to 447.56 with no evidence of a common wrong approach.

Question 3

Overall this question was well answered with relatively few incorrect answers. The most common errors were often in attempting to simplify following a correct expansion, for example $a^4 + 3a = 4a^4$. Another common incorrect answer was $2a^3 + 3a$.

Question 4

This question was less well answered although correct answers were often seen. There were quite a few different incorrect responses, with $(A \cup B)'$ or $(A \cap B') \cup (A' \cap B)$ being the most common. Some candidates shaded $A \cap B$ rather than $(A \cap B)'$.

Question 5

(a) This part was generally very well answered. The majority of candidates correctly found the mode. A small number of candidates found either the median, mean or range or gave the highest value 96 as their answer.

(b) This question was very challenging for candidates. Most incorrect answers included a reference to the mean being a decimal or recurring; a statement about the range being too big; a comment about dividing by an odd number or a comment about the original values being rounded therefore causing inaccuracies. Only a very small proportion of candidates knew why the mean was not a suitable average to use in this situation, i.e. because the 96 kg parcel was an extreme value so would distort the mean.

Question 6

This question was answered correctly by the majority of candidates, who were able to calculate that $\frac{12}{32}$ or $\frac{3}{8}$ of the children walked to school. Most went on correctly to find the angle of the pie chart as 135°. The most common error was to calculate $\frac{12}{32} \times 100 = 37.5$. Candidates earned partial credit if they realised that it was 37.5% of the circle. Other incorrect methods seen included finding $\frac{12}{32} \times 180$ or thinking that the area of the circle was relevant and introducing πr^2 into the calculation.

Question 7

This was very successfully answered with nearly all candidates realising that a division was necessary to do the conversion. There were no issues with accuracy here either as most gave an answer correct to 2 decimal places or correct to at least 3 significant figures. Very occasionally some candidates made a slip and gave an answer of $44.03, misreading 3000 for 30 000. There were some rare cases of incorrect rounding to 441 without showing working. Candidates are advised when a question is worth more than one mark that there is usually a method mark available.

Question 8

This question was well answered in general. Correct answers were often accompanied by angles shown on the diagram to help with the understanding. The most common incorrect responses were either 180 − 102 = 78 or 360 − 102 = 258. Occasionally 102 was seen as the answer.

Question 9

The majority of candidates were able to correctly isolate the *x*-terms and numbers and score at least one mark, although there were some issues dealing with signs correctly. The most common error was in dealing with the fraction. When multiplying by 2, which nearly all realised they needed to do, some terms were missed. Those who made an error attempting to double first, before isolating *x*-terms, were usually unable to score as they usually had one of these two common incorrect starting points $x-13>2(12+3x)$ or $x-26>12+3x$. Those who correctly collected *x*-terms on one side and numbers on the other were able to score a method mark for a correct starting point but often also made errors in dealing with the multiplying by 2. A common incorrect line of working was following $\frac{x}{2}-3x>25$ by $x-3x>50$ leading to the common incorrect figure of –25 in the answer. Some candidates who managed to reach –10 by dividing by –5 forgot to reverse the inequality sign. This was not an issue for the small minority who collected *x*-terms on the right hand side where they were positive.

Question 10

This was reasonably well answered with most candidates able to demonstrate a valid strategy to remove the decimal element of the given number by multiplying by 10, 100 or even 1000, and then subtracting appropriate values. Some candidates made errors when subtracting two values involving a recurring decimal, e.g. 67.77 – 0.677 = 67.093 but usually they showed sufficient working to achieve the method mark. Another valid, but less common, method was to break the decimal down into two, giving $0.6+0.0\dot{7}=\frac{6}{10}+\frac{7}{90}=\frac{61}{90}$. A small minority of candidates misunderstood the recurring decimal notation and solved for $0.\dot{6}\dot{7}$ = $\frac{67}{99}$. Some did not give the answer in its simplest form with $\frac{67.1}{99}$ or $\frac{6.1}{9}$ occasionally given as the answer. Some showed no working but gave the correct answer. Candidates are advised that this question asked for all working to be shown so insufficient or no working meant that full credit could not be awarded.

Question 11

This question was well answered by most candidates. The majority of candidates used the method $\frac{29}{8}-\frac{5}{3}$ = $\frac{87}{24}$ – $\frac{40}{24}$, usually correctly, with the occasional candidate accidentally adding instead of subtracting. Other methods included $3\frac{15}{24}-1\frac{16}{24}$ = $2\frac{39}{24}-1\frac{16}{24}$ = $1\frac{23}{24}$ with some candidates following $3\frac{15}{24}-1\frac{16}{24}$ with $2\frac{-1}{24}$ and stopping there. It was quite common for candidates to miss the final instruction to give the answer as a mixed number in its simplest form and they stopped at $\frac{47}{24}$. Occasionally there were arithmetic slips but a mark of 0 was rarely awarded.

Question 12

This question was reasonably well answered but there were quite a few candidates who did not achieve the correct answer. Those who worked geometrically, first finding the exterior angle of 4° and then 360 ÷ 4 = 90, were generally more successful than those who used an algebraic approach of solving 180(*n* – 2) = 176*n*. Incorrect responses often started with 180(*n* – 2) = 176 which gave an answer of 2.98. Some candidates gave this as the number of sides without seeming aware that the number of sides must be an integer, others rounded it to 3. Other incorrect starts also often came from incorrectly remembering a formula, e.g. 180(*n* – 1) = 176*n* or 360(*n* – 2) = 176*n.* Those who used the exterior angle method sometimes worked out 360 – 174 instead of 180 – 174 which again leads to a non-integer answer. A few scored partial credit for finding the exterior angle but going no further.

Question 13

There was an even split between correct and incorrect answers in this question. Many of the responses involved the answer 352, or figures 352 for an incorrect conversion. A significant proportion of the incorrect answers were 2200 where candidates did not realise that capacity is not a linear measure. There were some candidates who took the cube root of the linear scale factor rather than cubing or who used squaring rather than cubing. Occasionally candidates incorrectly found $5.5 \times \left(\frac{75}{30}\right)^3 \times 1000$, not appreciating that this gave a larger capacity for the smaller container.

Question 14

This question proved to be a good discriminator for the candidates. There were quite a few correct and efficient arguments but there were also many incorrect or incomplete responses, and quite a few candidates did not respond at all. Among the correct responses there was a variety of approaches with some candidates rearranging the equations then converting gradients to decimals before demonstrating that $m_1 m_2 = -1$. Others rearranged one equation and used $m_2 = \frac{-1}{m_1}$ to show what the gradient of the perpendicular line should be before finally rearranging the second equation to confirm the result. Common errors included quoting gradients in terms of *x*, for example that the gradient was $\frac{5}{4}x$. Others simply used the coefficients of *x* from the original equations, i.e. 5 and 4, as the gradients or tried to use an incorrect relationship such as $m_1 = -m_2$. Another fairly common error was to attempt to solve the equations simultaneously. Some tried to demonstrate that the lines were perpendicular by drawing a sketch.

Question 15

(a) Many candidates were able to derive the correct expression for the total cost of *x* magazines and *y* cards. There were, however, a significant minority who wrote this as an equation instead. Some did not understand the need to multiply *x* by 2.45 and *y* by 3.15 and simply wrote $x + y$. Another common error seen here was $x + y = 5.6$, which was the cost of one magazine and one card.

(b) Nearly all candidates were able to answer this correctly, even those who were not successful with **part (a)**. A rare error was to divide the total by 8 rather than first subtracting the cost of the magazines. Also occasionally candidates substituted 8 for *y* instead of *x*; these candidates ought to have been suspicious that this did not give an integer answer.

Question 16

This question was fairly well answered. The most common error here was drawing the line $y = x + 1$ incorrectly, with $y = x$ or $y = 1$, $x = 1$ or $y = x - 1$ all seen. Others who started with the correct *y* intercept were sometimes slightly inaccurate in using the gradient to draw the line. The line $y = 5$ was usually correct and those who drew this often gave a region that satisfied two of the given inequalities. Most of the candidates who drew the correct lines also found the correct region. Very few shaded the required region rather than the unwanted ones and most labelled the region *R*. The standard of drawing was usually quite good and the lines were drawn with a ruler. A few dotted or non-ruled lines were seen.

Question 17

Whilst many were able to complete both aspects of the construction, occasionally candidates left some ambiguity as to the position of the bird table, e.g. they shaded a region or did not indicate it clearly. A significant number of candidates were only able to complete one aspect of the construction. For some this was the angle bisector correctly constructed with arcs, but more often it was the arc of correct radius from *R*. Often incorrect attempts included finding perpendicular bisectors of one or more sides. Drawing from *Q* to the midpoint of side *SR* was also seen for an incorrect attempt to bisect angle *Q*.

Question 18

(a) This question was well answered by about half of the candidates. The most common incorrect answers were 0.45 which came from 0.6×0.75; 0.25 coming from $1 - 0.75$ or 0.4 coming from $1 - 0.6$. Some candidates incorrectly added 0.4 to 0.75 instead of multiplying, without appreciation that a probability answer cannot be greater than 1.

(b) This question proved challenging for many candidates with correct answers not particularly common. Successful responses were often accompanied by a tree diagram or other method of analysing the problem. There were many different incorrect methods but one of the most common was to work out the probability of passing third time using $0.4 \times 0.25 \times 0.75 = 0.075$, but then not also taking into account those who passed first time or second time. Final answers of 0.9 and 0.775 were also seen fairly often.

Question 19

(a) There were some answers of $4x$, possibly from misinterpreting 'angle at centre is twice angle at circumference'. Some candidates assumed that angle AOB was 90°. Candidates are advised that when a diagram says 'not to scale' they cannot make assumptions such as these; angles that are right angles will be marked as 90° or drawn using a right-angled symbol. Many reached $180 - 4x$ but then spoilt this by subsequent work, e.g. dividing by 4 to give $45 - x$ or giving the answer $176x$. There were a number of numerical answers in **part (a)** and **part (b)** where candidates missed the instruction that the answer should be an expression in terms of x.

(b) A significant number of candidates realised that their answer was **part (a)** ÷ 2 but it was common to miss or ignore the instruction to give the expression in its simplest form so, e.g. $\frac{1}{2}(180 - 4x)$ was a common final answer. Some were able to obtain a follow through mark here.

(c) Fully correct answers were uncommon in this question but many were able to obtain partial credit for showing the working 180 – their **part (b)** – x. Again it was common to see answers that were not in their simplest form but even more common was sign errors in simplifying. It was common to see $90 - 2x + x$ correctly becoming $90 - x$ but this was then very regularly followed by $180 - 90 - x$ instead of $180 - (90 - x)$.

Question 20

(a) This question was well answered with the majority of candidates scoring full marks. The small number who did not do so usually made a sign error with $(3y - 2x)(6 - a)$ seen a few times, although quite often this was preceded by a correct partial factorisation. Some gave the partial factorisation $3y(6 - a) + 2x(6 - a)$ as their final answer.

(b) This factorisation proved to be more challenging. Those not scoring full marks were often able to gain partial credit for $3(x^2 - 16y^2)$ with a much smaller number gaining the 2 marks for partial factorisation. Answers such as $(3x + 48y)(x - y)$ were fairly common and some candidates did not spot the common factor of 3, preferring instead to use surds in their factorisation.

Question 21

(a) Most candidates answered this question correctly. A common error was to evaluate the left hand side as $3^{-2} \times 3^x = 9^{x-2}$ following this by a common incorrect answer of 4. Others correctly started with $3^{-2} \times 3^x = 3^4$ but then followed this with $-2 \times x = 4$ instead of $-2 + x = 4$.

(b) This was one of the most challenging questions for candidates. A large number of candidates thought $32x^{-2} = \frac{1}{32x^2}$. This basic misunderstanding resulted in a significant number of candidates being unable to obtain any further marks. Many candidates were unable to deal with either the negatives or the fraction in the indices. Those with most success on this question began with the working $x^{-\frac{1}{3}} \div x^{-2} = 32$ followed by $x^{-\frac{1}{3} - -2} = 32$. Some stopped at $x^{\frac{5}{3}} = 32$ and were unsure how to proceed from here.

Question 22

(a) This question was generally well answered with most candidates demonstrating a good knowledge of matrix multiplication. The most common errors were arithmetic slips, especially with calculations involving negative numbers. A very small number simply multiplied the corresponding elements of the two matrices.

(b) In this question candidates were less successful than in **part (a)**, as some were unable to form an appropriate equation that would allow them to find k. For those who did form the correct equation, problems with sign errors sometimes caused them to lose the final accuracy mark. Some candidates appeared to be using trial and error to find k, but these candidates were usually unsuccessful.

(c) This part was often well answered and it was not unusual for candidates who did not score well in the previous parts to score here. Many correct responses were seen and those who did not earn both marks were often able to gain partial credit for either a correct determinant or for correctly rearranging matrix **A** to form the adjoint matrix. Common incorrect values for the determinant were –10 or 13. Almost all candidates used this method with use of simultaneous equations being extremely rare.

Question 23

(a) In this question a large proportion of candidates were able to draw a correct tangent at $t = 24$. These were generally well drawn although some occasions of 'daylight' between the line and the curve were seen. Some misread the scale on the horizontal axis and drew a tangent line at $t = 22$ instead. Others simply read the value of the graph at $t = 24$ rather than drawing a tangent. Of those who drew a correct tangent, most went on to accurately find the gradient of their line. Common errors here were to again misread the scales on the graph and some incorrectly attempted (change in x)/(change in y) or forgot to give a negative answer.

(b) A variety of responses were seen here but many focused on acceleration or deceleration. Common incorrect responses were about the speed without mentioning the rate of change in speed or simply gave the answer distance. Some simply stated that this was how steep the line was or gave a calculation or that it was m from $y = mx + c$. Others gave a description of what was happening rather than an interpretation of the gradient, such as 'the train is slowing down'.

(c) This was well attempted and many correct answers were seen. Some mistook constant speed for constant acceleration and gave the distance travelled in the first 5 seconds of the journey. Others simply multiplied 22 by 4 thinking that the constant speed lasted for 22 seconds. Problems with the scale continued here with some misreading 22. A common incorrect answer was 78 from working out the area under the graph between 0 and 22 seconds.

MATHEMATICS

Paper 0580/23
Paper 23 (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

It is very important that candidates show their complete method in their working and to read each question carefully to ensure that the answer is given in the form requested.

Some candidates do not know the difference between some linked concepts, for example highest common factor (HCF) and lowest common multiple (LCM), square/cube numbers and prime numbers, surface area and volume.

In reading scales on graphs it is clear that some candidates assume the scale is always going up in tenths. It is also important that any straight lines drawn are ruled. On graphs any corrections must be clearly shown and labelled.

Comments on specific questions

Question 1

This question was answered well although some responses showed little attention to the context and gave an answer of 4 or −4 by adding rather than subtracting.

Question 2

Most candidates gave the correct answer although some calculated a quarter of 256 instead of the fourth root leading to the answer of 9.797…

Question 3

27 for the cube number was usually correct in **part (a)** but in **part (b)** 57, 87 and very occasionally 77 were considered as prime.

Question 4

There was the obvious confusion between highest common factor (HCF) and lowest common multiple (LCM) with some candidates giving 420 or 840 as the answer. Those who did give a factor as the answer sometimes gave 3 or 7.

Question 5

There were very few candidates who did not know standard form. However some did not use the correct format so in **part (a)** gave 72×10^3 or $.72 \times 10^5$ and in **part (b)** gave 18×10^{-4} or $.18 \times 10^{-2}$.

Question 6

Most candidates could expand the brackets although a few did not simplify them leaving their answer as four terms. Common errors included thinking $x \times x = 2x$ and $3 \times 5 = 8$.

Question 7

Some candidates treated the gradient of the original line as 5 so they gave an answer of $-\frac{1}{5}$. Many did find the correct gradient of the original line but they did not know the rule for finding the gradient of the perpendicular line. In some responses there were attempts to write down the equation of a perpendicular line which was not requested and there was insufficient information to do this completely.

Question 8

In **part (a)** some candidates gave the answer as 21 which was not sufficiently accurate. In **part (b)** many did not know how to find the obtuse angle so gave answers by adding to 90° or 180° so giving 111.1° or 201.1°, whilst others subtracted from 360° giving 338.9°.

Question 9

A very common incorrect answer was to give the volume of 332.5. Those who attempted area often worked out one of each of the three different areas, giving half of the required answer. Some gave just one area, either $9.5 \times 7 = 66.5$ or $7 \times 5 = 35$. Some knew that there were six areas but it was sometimes comprised of e.g. four of 9.5×7 with two of 7×5, giving a final answer of 336.

Question 10

Many responses started with $391 + n + n - 1$ but some omitted to divide this by 3 when equating to $5n$, so a common incorrect answer was 130. Those who did not use algebra found the question very challenging.

Question 11

(a) Most answers seen were correct although occasionally an incorrect common factor was selected, such as 2 or x.

(b) Again this was answered very well with the main error being incorrect signs inside the brackets $(x - 3)(y + 2)$.

Question 12

There were those who, having worked out the two sides 3 and 7, then found the gradient using either $3 \div 7$ or $7 \div 3$. Some candidates who used Pythagoras' theorem correctly, gave their answer to only 2 significant figures. Some found the sides of the triangle as 11 and 5 by adding the ordinates instead of subtracting them. There were some numeric errors seen such as sides of 8 and 3. Those who used Pythagoras' theorem usually used the method correctly.

Question 13

Those candidates who attempted to use $y = mx + c$ and form two simultaneous equations usually made errors and this method rarely led to the correct answer. The most successful method was to work out the gradient using difference in y ÷ difference in x. However some used difference in x ÷ difference in y, whilst others worked out difference in y incorrectly as $6 - 5 = 1$ rather than either 11 or –11. Those who wrote down the correct equation still made errors in making k the subject.

Question 14

(a) Many candidates wrote the expression as $\frac{1}{2}n$ or 2^{-n}. Some gave the next term rather than the *n*th term.

(b) Many candidates didn't recognise this sequence as powers of 5 so $5n$ and $5n^2$ were common answers. Some could not put the term-to-term rule of × 5 into an expression. Some gave the next term of 3125 as their answer.

Question 15

This question was answered very well. The main error was to perform the operations in the incorrect order, so adding before multiplying. Some did not know how to write two fractions with a common denominator and often just added the numerators and denominators together.

Question 16

(a) The reading was usually given accurately, although answers of 12.8 or 12.9 were sometimes seen. Some read the scale incorrectly as 12.84.

(b) The two points were usually accurately plotted although some candidates reversed the coordinates.

(c) The line of best fit was usually accurately drawn. Occasionally they were too steep and a few were not ruled.

(d) Most candidates gave the correct answer whilst a few gave 'positive' as their answer.

Question 17

Many candidates confused $y = 3$ and $x = 3$ so instead of having two parallel vertical lines, there were two parallel horizontal lines. However the line $y = x + 3$ was often drawn correctly, although some plotted the line $y = x - 3$. The instruction was to shade the unwanted regions but many shaded the region they intended as their answer. Often the incorrect side of a line was identified, particularly the region $y \leqslant x + 3$ which many thought was the region above the line rather than below it.

Question 18

(a) (i) Few candidates were familiar with this notation so that most either gave some of the elements from the set or gave an answer of 2 or 3.

(ii) Most candidates did not understand the term 'subset' so there was a wide variety of answers such as 'x is an integer and $x \neq 0$', '2, 3, 4, 5', 'x is a positive integer' and '1, 2, 3, 4, 5, 6'.

(b) $(A \cup B)'$ was often shaded correctly with the common incorrect area shaded being $(A \cup B)$.
$(C \cap D') \cup E$ was often shaded incorrectly by usually omitting either $C' \cap D \cap E$ or $C \cap D \cap E$.

Question 19

(a) The common incorrect answer was 0.2, although many did answer this part correctly.

(b) The most efficient method, and the one that was more likely to lead to the correct answer, was to work out the area of the rectangle 10 × 70 and to add the area of the triangle $\frac{1}{2} \times 20 \times 6$. Other methods, using in particular 10 × 50, then adding the area of the trapezium, led to more errors in working. Most candidates did not show their areas on the diagram which may have helped them.

Question 20

(a) The two most common errors were writing the expression as direct proportionality or as inversely proportional to the square root. In order to gain full credit candidates had to find the value of k and then write the expression using this value of k which many did not do.

(b) The biggest challenge for many candidates was rearranging the equation to make x, or at least $(x + 1)^2$, the subject.

Question 21

(a) The common error was to work out the determinant as 25 or −25 from 15 + 10 or −15 – 10. Some candidates did not apply the rule correctly for finding the inverse matrix and the numbers were often in the wrong places, by swopping the wrong diagonal, for example.

(b) Candidates who could multiply matrices usually gained at least partial credit. Some multiplied column by row to reach an equation such as $-20 + y = 46$ for example.

Question 22

The most common method was to find the volume of the cylinder and subtract the volume of the cone. This should then be divided by the area of the circular end to give the depth of water inside the cylinder. The main errors seen were either to use the wrong formula for either the volume or to add together the two correct volumes instead of subtracting them. A few candidates found the depth in the cylinder but then did not add on the depth in the cone, 4.8 cm.

Question 23

(a) Many correct responses were seen. The most common incorrect answers were 10 with 20 and 0 with 40.

(b) Fewer correct responses were seen in this part. The most common error was to divide each frequency by 10 so giving heights of 1.9, 1.6 and 0.8.

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. Candidates generally showed their workings and gained method marks.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. 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. Candidates should also be encouraged to think whether their answer makes sense in relation to the question set.

The standard of presentation was generally good. However many candidates 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) (i) The vast majority of candidates correctly completed the bar chart. A small number of candidates did not draw a bar.

(ii) Nearly all candidates correctly identified that December was the month with the most goals scored. A very rare error was to write the number of goals (26) instead of the month. Candidates who wrote both month and number of goals were given the benefit of the doubt and gained full credit.

(iii) The majority of candidates correctly added the number of goals for all five months and reached the correct total. Common errors were addition mistakes, not using a calculator to double check, or omitting the 10 goals from February and therefore reaching a total of 72.

(iv) Most candidates showed understanding of the term mean and divided their total from **part (a)(iii)** by 5 to reach the correct answer. Some candidates confused mean and median, with a few incorrect answers of 15 seen.

(b) (i) Candidates showed good understanding of working with money with the vast majority of candidates gaining full credit. Good answers showed all working out with very few errors seen in adding or multiplying.

(ii) Again in this part candidates showed good understanding of working with money with nearly all candidates correctly finding the change. The common error was calculating the change from only one programme.

(iii) Successful candidates showed full working for the percentage of tickets sold. Many candidates gave their answer as 86% rather than 85.7% per cent or more accurate. A few less able candidates made the question more difficult and found the percentage of tickets not sold by subtracting first.

(iv) Candidates found working out the time more challenging. Despite the correct answer given by more than half of the candidates, many attempted to add 14 55 and 1 50 as numbers rather than times and the incorrect answer of 16 05 was seen very often. Other common errors were incorrect format of the correct time, e.g. 16 45 pm, 4 45 without the pm or 16 h 45 mins (length of time given rather than time of day).

(v) Calculating the average speed proved to be the most challenging part of this question. Despite the vast majority of candidates able to correctly quote or use the Speed, Distance, Time formula, less than half of the candidates gained full credit as the time used was often given as 1.12 hours, 1 h 12 mins or 72 mins rather than the required value of 1.2 hours. Candidates were able to gain method marks for a division involving 66 km and a 'correct' time. However to gain full credit the speed had to be given in km/h. Therefore candidates who divided by 72 mins but did not then multiply by 60 only gained partial credit. Many less able candidates understood they had to work out distance divided by time but many used the time of day as 5 hours or 6.12 hours in their calculations.

Question 2

(a) (i) This question was very often not attempted. Incorrect responses included drawing a radius, arc and tangent, and some chords extended beyond the circumference. Segments were rarely seen but a shaded in region was not accepted as a correct chord as it was unclear if the candidate knew if the line was the chord or the shaded region.

(ii) Only a very few candidates gave the correct response. The most common incorrect reason given was that it was a right angle or in a right-angled triangle. Some stated 'the angle on the diameter is twice the angle at the circumference' or 'angle subtended by a diameter' which are not acceptable answers. Descriptions must be as given in the syllabus and in this case it is 'angle in a semicircle is 90°'. A frequent incorrect response was 'angles in a semi-circle add up to 90°.'

(b) Only the most able candidates correctly calculated the surface area of the cube. There was a variety of incorrect responses to this question; the answer seen most often was $8 \times 8 = 64$. Other incorrect responses included $8 \times 6 = 48$ or $8 \times 8 \times 8$, while others involved π in their calculations.

(c) (i) Calculating the volume of the cuboid was well answered by the majority of candidates, this part being the most successful part of this question. However correct working was seen spoiled by dividing or multiplying by 2. Some candidates attempted the surface area again. The units mark was often obtained regardless of the numeric answer. Incorrect responses were usually cm or cm^2.

(ii) Many candidates correctly completed the net. Others were able to draw a net of a cuboid but of the wrong height. Correct nets but with the lid missing were quite common. A large proportion of candidates showed that they did not understand the term 'net' of a shape, as many responses showed an attempt at a 3D shape. Of those who understood the concept, many found drawing a completely correct net challenging. The faces next to the given rectangle were most often drawn correctly but very often only two of them. Many had the right number of faces but not the correct dimensions. 3×4 faces were seen often instead of the 2×4 faces.

Question 3

(a) (i) Candidates showed good use of a protractor to measure the angle accurately. However many less able candidates had difficulty in knowing which scale to read from the protractor with a common incorrect answer of 83° seen.

(ii) Candidates who gave the correct angle in **part (a)(i)** generally gave the correct type of angle as obtuse.

(b) This part was the most successfully answered of this question with the vast majority of candidates correctly subtracting 56 and 85 from 180. The most common incorrect answer was 56 as candidates thought that angle *y* was the same size as the angle marked 56 on the diagram. Candidates should be reminded that the words 'NOT TO SCALE' means they have to perform a calculation to find the missing angle rather than compare it to other angles on the diagram.

(c) Successful candidates used the angle properties of an isosceles triangle and angles on a straight line to correctly find the size of the angle marked *z*. Good solutions showed each step of their calculations, subtracting 18 from 180, dividing by 2 and then subtracting from 180 again. Many candidates gave partial solutions by subtracting and dividing by 2. Less able candidates however often started with subtracting from 90° or subtracting 18 from 180 but then not halving their answer. A common incorrect answer was 18° which was found by repeating $180 - 162$.

(d) Calculating the size of an interior angle of a regular octagon proved to be the most challenging part of this question. Good solutions came from one of two common methods. Method 1: find the total of the interior angles $(8 - 2) \times 180 = 1080$ and then divide by 8. Method 2: find the size of the exterior angle $360 \div 8 = 45$ and then find the interior angle $180 - 45 = 135$. Successful solutions showed each step of the calculations. There was a wide variety of errors made on this question. A common error was not knowing how many sides an octagon has (6 and 10 the common incorrect number of sides used). Equally common was $360 \div 8 = 45$ only. Less able candidates often worked out $180 \div$ number of sides.

Question 4

(a) Many candidates found it challenging to convert the worded number into figures. One very good method used (rarely): 400 000 + 18 000 + 72 laid out in a column method to obtain the correct answer. Others wrote four hundred and eighteen as 40 018. The most common errors were a missing '0', or '80' for '18'. Common incorrect answers were 480 072, 40 018 072, 401 872, 41 872, 408 072.

(b) This question was well answered by most candidates with partially correct responses omitting 1 or 16. Some candidates wrote 2^4 or all the even numbers up to 16. A small minority gave 3 and/or 6 as a factor of 16. Very few candidates confused multiples and factors, with a list of multiples of 16 rarely seen.

(c) This question was correctly answered by the majority of candidates. Some gave more than one answer with credit not earned if any were incorrect but 31 and 37 gained full credit. 33 and 39 were the most common incorrect numbers given. Some listed all the odd or even numbers between 30 and 40 and some gave a prime number which was outside of the required range.

(d) (i) Nearly all candidates demonstrated good use of their calculators to reach the correct answer. Occasional errors tended to be caused by misreading the number to be square rooted.

(ii) Again nearly all candidates demonstrated they could use their calculator accurately to find the cube of 18. An occasional error seen was using the wrong power.

(iii) Again candidates demonstrated good use of their calculators. Common incorrect answers were 0 or 7.

(e) Most candidates were able to gain partial marks on this question with the best solutions gaining full credit showing all steps of their calculations. 1 mark was often awarded for 320 or 2 marks for $\frac{8}{15}$. Many candidates however stopped at one of these points and did not complete the question to find the fraction of money left. The majority of candidates were able to find 120 and 200 from a correct method but did not gain any credit until they added these values. Only the most able candidates used a method that did not involve the 600 and just added the fractions before subtracting from 1. A small number worked out $600 - 120 = 480$ then found $\frac{1}{3}$ of 480, often resulting in $\frac{8}{15}$ or $\frac{7}{15}$.

(f) The correct LCM was found from a variety of different methods. Most common was finding 15 and 27 as the product of their prime factors and then multiplying the common factors to reach 135. The method of listing factors was seen less often, but when seen it was done correctly. The majority of candidates were able to gain at least partial credit. One mark was often given for a multiple of 135, usually 405, or for 3×5 and $3 \times 3 \times 3$ and/or $3^3 \times 5$ as the answer. 3 was often seen as an incorrect answer, the HCF.

(g) This question was well attempted with the correct product of prime factors frequently seen. Partial credit was often awarded for the correctly completed division into primes (using table/ladder or tree) or for a correct product equal to 432, 3×144 being the most popular. A common error occurred when candidates attempted a prime factorisation in a table/ladder or factor tree and missed out the last factor.

(h) Calculating the value of this investment proved to be the most challenging part of this question. Many candidates correctly quoted the formula for compound interest with the most able candidates substituting and calculating the correct value of the investment. Many less able candidates calculated simple interest. A significant number of candidates used the year by year method and sometimes this led to inaccuracies due to rounding or arithmetic errors. Some candidates subtracted 4000, giving the interest as the answer. Others added 4000 and a small number of candidates misread the principal amount as 400.

Question 5

(a) (i) 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. Less able candidates could correctly identify the transformation as rotation but did not include the centre, or only gave the degrees without the correct clockwise direction. A common error was to describe two transformations, a rotation followed by a translation.

(ii) Candidates found describing the enlargement more challenging. Most candidates understood that it was an enlargement but many candidates did not know how to describe the reduction in size and therefore gave answers like, de-enlargement or reduction rather than just enlargement. Only the most able candidates correctly gave the scale factor as $\frac{1}{2}$ with -2 or $\div 2$ being common incorrect answers. The centre of enlargement was often not given although candidates who drew lines connecting vertices of the two shapes often were able to give the correct centre of enlargement.

(b) (i) Candidates were more successful at translating the triangle by the given vector than they were at describing the transformations in **part (a)**. The correct image was drawn by the majority of candidates. However many less able candidates translated the triangle in the wrong directions, often 6 down and 2 right.

(ii) Candidates were less successful at reflecting the triangle in the line $y = 1$. Good solutions often saw the line drawn and then the correct image. Some candidates drew the line $x = 1$ and reflected in that line to gain partial credit. Some candidates did not read the question carefully enough and reflected the wrong triangle, often their answer to **part (b)(i)** or triangle *B* or *C*.

Question 6

(a) This question required candidates to find the equation of a given straight line. Successful candidates were able to correctly calculate the gradient and then use the y-intercept to give the correct equation. However only the most able candidates could find the gradient. Most candidates attempted to find the gradient using two sets of co-ordinates. However many used incorrect (x, y) co-ordinates, e.g. (3.2,15). Others chose correct co-ordinates, sometimes with triangles drawn on the graph, but did not quote the correct formula, often using change in x / change in y. Most candidates, having found the wrong gradient, used their equation to find the y-intercept rather than reading it from the graph. Others used their incorrect gradient to form an equation in the form $y = mx + 2$ for partial credit. Many less able candidates omitted the x from their final answer.

(b) (i) Finding the gradient from the equation of a line was the most successful part of this question. However, only around half of the candidates correctly identified the gradient of the line. Common incorrect answers were $3x$, $x = 3$, positive, negative, –4.

(ii) Finding the co-ordinates of the point where the line crosses the y-axis proved to be the most challenging part of this question. Many candidates used a co-ordinate on the line given in **part (a)** so (0, 2) was seen often. Those who found the gradient in the previous part usually went on to achieve this mark as well, although (0, 4) was seen frequently.

(c) Drawing the graph challenged all but the most able candidates. Candidates who constructed a table often went on to gain full credit. A common response was a straight line drawn going through (0, 1) but usually of positive gradient. Many less able candidates did not attempt this part.

Question 7

(a) (i) Most candidates were able to correctly draw the horizontal and vertical lines of symmetry. However a significant number of candidates then also drew the two diagonals of the rectangle.

(ii) Finding the area of the rectangle was successfully answered by the majority of candidates. Common errors were to find the perimeter instead of the area or to divide by two following multiplication.

(b) Calculating the percentage profit proved to be the most challenging part of this question. A variety of methods were used successfully with the most common being finding the profit for one flag and then dividing by the cost price and multiplying by 100. The most common error from this method was dividing by the selling price instead of the cost price. Another common error was to divide the values given in the question $\left(\frac{15}{21} \times 100\right)$.

(c) (i) Candidates demonstrated good understanding of probability in all three parts of **(c)**. Many candidates chose to give their answers as decimals or percentages but did not give them to the required degree of accuracy. Candidates who gave their answers as fractions generally were correct. Candidates who chose to give their probability as percentages must remember to include the percentage sign.

(ii) Again candidates showed similar understanding of probability. Some less able candidates found the probability that the flag was blue rather than not blue.

(iii) Finding the probability that the flag is red proved to be the most successful part of this question. Most candidates gave their answer as fractions $\frac{0}{30}$ although candidates did not have the difficulty of the previous two parts if they chose to write it as a decimal or percentage.

(d) Calculating the height of the larger rectangle proved challenging for many candidates who simply looked at the difference in the lengths of the two triangles (2.4 – 1.8 = 0.6) and added that to the height of the smaller rectangle (1.2 + 0.6 = 1.8). Candidates who showed some understanding that they were required to find a scale factor or proportional change were more successful. Most candidates found the scale factor by comparing the two rectangles ($\frac{2.4}{1.8}$ = 1.33…) and then multiplied the height of the small rectangle by their scale factor. However this method did lead to some errors due to premature rounding; candidates often rounded their scale factor to 1.3 instead of leaving it as a recurring decimal.

(e) Good solutions to this question required the correct application of Pythagoras' theorem. Candidates who recognised this generally did so correctly showing all steps in their calculation, including squaring, adding and square rooting. Few candidates subtracted instead of added after squaring. Some candidates gave an answer to only 2 significant figures. A significant proportion of the candidates did not recognise that Pythagoras' theorem was required and many less able candidates simply added or subtracted the two given lengths and some candidates calculated the area of the triangle or simply multiplied the lengths together.

Question 8

(a) (i) Most candidates were able to gain full credit in this part. The common error was to measure inaccurately.

(ii) Candidates found measuring a bearing challenging and only around half the candidates were able to give the correct bearing. There was a variety of incorrect answers but 280 was the most common from 360 – 80, i.e. anticlockwise from North. Another common error was answers around 260, misreading the question and measuring the bearing of *A* from *B*. Others had clearly worked from (a line drawn) South to reach 260 or 100. A few less able candidates gave a length for their answer, usually 11 cm.

(iii) Most candidates were able to gain one mark for *C* being placed the correct distance from *B*. However only the most able candidates could also measure the correct bearing and place *C* in the correct position.

(iv) Candidates who constructed correct arcs usually went on to draw a correct line gaining full credit. Most candidates realised that they needed to draw some arcs, but not all were sure where from. Some knew they needed to bisect something but bisected an angle. There were a number of responses which showed a set of arcs above the line *AB* with no attempt to draw a line.

(b) The correct answer was often seen but sometimes reversed. There were many varied incorrect responses, including [130 140], [134 136], [135 140], [134.5 135.4].

(c) This part was well answered. The common incorrect answer given was 0.59 by candidates who added the given probabilities but did not subtract from 1.

(d) All candidates attempted this question with nearly all successfully giving the temperature as –2°C. The most common incorrect answers were 2 or 12 from 7 – 5 and 7 + 5.

(e) This part was well answered with candidates successfully finding the new cost after a percentage increase. The best solutions used a multiplier and worked out 14×1.12. However an equal number of successful solutions were seen by calculating the 12% and then adding to the $14. An incomplete method was seen often with 1.68 found but not added to 14.

(f) Most candidates were able to find the number of boats from the information given in the question. Most candidates showed full working to lead to the correct answer. Incorrect responses commonly seen involved 200 being multiplied by $\frac{25}{9}$. Others showed random calculations using the values in the question. For example $25 - 9 = 16$ then $200 - 16 = 184$ or $\frac{16}{25} \times 200$. It is important that candidates recognise the need to show full working out. This question highlights a common method of working which scores no marks unless the correct final answer is found.

$$\begin{array}{rcl} 25\text{ b} & \longrightarrow & 9\text{ m} \\ 200\text{ b} & \longrightarrow & x\text{ m} \end{array}$$

This method scores no credit in its current form. If the candidate is then able to give the correct answer then they score full credit but if they do not reach the correct answer then there is no indication of what they are dividing or multiplying by so is not an indication of method.

Question 9

(a) (i) Nearly all candidates were able to give the correct next term.

(ii) Fewer candidates were able to successfully give the rule for continuing the sequence. Candidates may have thought that this was more complex than simply writing down 'add 3' or '+3' and many attempted to write the nth term or gave the answer as '$n + 3$' or '$3n + 26$'.

(b) (i) The correct answers were seen most often with solutions showing the substitution into $n^2 + 5$ with $n = 1$, 2 and 3. The most common incorrect answers involved sequences going up by 5 each time, often 5, 10, 15 or 6, 11, 16.

(ii) This 'show that' question proved to be the most challenging part of this question. Candidates found it difficult to fully show why 261 was in the sequence with many candidates only gaining partial credit for a partial solution. To earn full credit candidates could show that 261 was the 16th term of the sequence by solving $n^2 + 5 = 261$ with all the required intermediate steps. Alternatively they could show that 261 was the 16th term of the sequence by substituting 16 into the nth term and showing all intermediate steps. Another method was to list all terms of the sequence up to 261. This was rarely seen and had to be totally correct to earn full credit.

(c) The correct nth term was found by the most able candidates who often found it using the general formula of $a + (n - 1)d$, substituting $a = 27$ and $d = 6$. Some candidates used the correct formula and substitution but then expanded and simplified incorrectly. Most candidates showed that they could see that the sequence was increasing by 6 but few candidates were able to give the correct nth term; $n + 6$ and $+ 6$ were common incorrect answers. Some partially correct solutions of $6n$ and $6n + 27$ were seen.

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should also continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer and the loss of the accuracy mark. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. 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) This part was generally answered well with nearly all candidates able to interpret the pictogram and state Friday as the correct day when most skirts were sold. A very small minority gave Tuesday as the answer, which was the day for the least number sold.

(ii) This part was also generally answered well. Common errors included 2.5 or $2\frac{1}{2}$ from the correct number of symbols without using the key, or 15 by miscalculation.

(iii) This part was generally answered well. Common errors included answers from $40 + 25$ or 1.5 from not using the key.

(b) The majority of candidates understood the overall method required but only a minority scored full credit. This was mostly the result of poor notation for the intervals of time. Acceptable answers for a period of time are 58.5 hr, 58 hrs 30 mins. A number of candidates were able to score partial credit for 9 hr 45 min. Many errors were made in calculating the number of hours the shop was open each morning and afternoon with many stating the morning interval as 3.30 instead of 3 h 30. The most common error was to write the total number of hours each day, 9 hrs 45 mins, as 9.45 and then proceed to multiply this by 6, thinking they were working with decimals, not minutes.

(c) This part was reasonably well answered with many candidates gaining full credit. Working was often set out clearly. A very common error was to just multiply the 38 and 25 by 11.40, not multiplying by the number of people, hence obtaining 718.2. Some candidates multiplied by 6 or 7 at the end as they did not realise they already had the weekly figure. A few candidates, having calculated correctly, rounded to 2303 without showing the exact answer.

(d) This ratio question was challenging for some candidiates, due to the given value, 48, being the number of blue T-shirts rather than the total number. A very common error was to find $5+4+1=10$ and then calculate $\frac{48}{10}\times 4=19.2$. Answers of 48 from $19.2+24+4.8$ were common. Those candidates who appreciated the context of the question and started their method by $\frac{48}{4}=12$ were generally successful.

(e) Many candidates found this question challenging and it proved to be a good discriminator. A good number calculated the total selling price and scored the first method mark for \$842.5 and many earned the second mark for the profit \$342.5 but then were unable to work out the percentage profit. Common errors included $\frac{500}{842.5}$, $\frac{342.5}{100}$, or $\frac{500}{342.5}$. Candidates who used the $\frac{342.5}{500}\times 100$ method usually gained full credit. Those who used $\frac{842.5}{500}\times 100$ often scored partial credit, forgetting to subtract 100.

Question 2

(a) This part was generally answered well although some numerical errors were made in the individual calculations. As each part was an exact amount of money the answers should not have been rounded.

(b) (i) A significant number of candidates were able to find the area of this composite shape based on two rectangles joined together. However, this question was not generally answered well, even though the working indicated that most candidates know how to find the area of a single rectangle. Common errors included multiplying the four given values as two separate pairs, for example, $5.3\times 1.8+2.4\times 3.2$ hence finding the area of overlapping rectangles. Even when the diagram was split into two rectangles, errors were made in finding the dimensions of their rectangles; often just halving the given sides rather than apply the necessary subtraction. Less able candidates just multiplied or added all the given numbers.

(ii) A good number of candidates were able to gain full credit either with the correct answer or by correctly following through from their previous incorrect area. Common errors included just calculating $500\times 8=4000$ or $500\div 8=62.5$ but not using their area, and $12.9-8$.

(c) This part was generally answered well although common errors included incorrect measurement of the given rectangle and incorrect application of the given scale.

(d) This part was answered reasonably well. Common errors included incorrect substitution into the correct formula with adjacent sides being added rather than the parallel sides. Some candidates split the diagram up into a rectangle and triangle but often made errors in calculating the height of the triangle or forgot to halve for that area. Less able candidates again just multiplied or added all three given numbers together,

(e) This part was generally answered well and many correct answers were seen. Common errors included the use of $2\times\pi\times 80$ or $\pi\times 40^2$ with a variety of other incorrect formulas seen.

Question 3

(a) (i) This part was generally answered well and many correct answers were seen. Common errors included the omission of 1 and/or 18, listing the factor pairs, and using prime factor decomposition and stating the answer as $2\times 3\times 3$.

(ii) This part was generally answered well with 36 being the most common correct answer, although common errors included 25, 40, 6, 6^2, 7 and 7^2.

(iii) This part was generally answered well although common errors included 91, 93, 95 or a number out of the given range.

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

(ii) This part was generally answered well.

(c) The majority of candidates were able to gain full credit. Common errors included not rounding their answer to 2 decimal places, 2.32, 2.326, 232.6. Another common error was to omit brackets when entering the calculation into the calculator and hence the incorrect answer of 7.232 or 7.23 was often seen.

(d) (i) This part was generally answered well with the majority of candidates able to find the HCF of 36 and 90, and many others managing to gain partial credit for giving a common factor 2, 3, 6 or 9 as the final answer or for finding the prime factors of each number. Many chose to find the prime factors of 36 and 90 using a double table method. This often led to the LCM given as the final answer. Candidates should perhaps be encouraged to use separate factor tables to avoid this error.

(ii) This part was not answered as well as the previous part. A small but significant number of candidates gave the answers to **part (d)** reversed. Common errors included 540, 720 and 3240.

(e) (i) This part was generally answered well although common errors included 0.042, 4200 and 0042.

(ii) This part was not generally answered well, although many candidates managed to gain partial credit for answers with figures 889 such as 889 000. A significant number made errors changing the standard form numbers. Other common errors included changing 889 000 incorrectly to standard form, often as 8.89×10^{-5}. No working and 8.9×10^{5} as the answer was seen sometimes.

Question 4

(a) (i) Many candidates answered this question well, carefully adding the ten extra results in the tally column and then accurately completing the frequency column. The most common errors came from not reading the question carefully and only completing the frequency column for the given tallies or completing the frequency column for only the 10 pieces of extra data. Other errors included only completing one of the two columns, writing the frequencies as sums, and small slips in placing the extra data in the wrong rows.

(ii) This part was not generally answered well and the common errors included the incomplete answers of 0 to 5 and 5–0. A very common error was the incorrect answer of 6, found from the range of the frequencies ($12 - 6 = 6$).

(iii) This part was not generally answered well, although most candidates knew that the median required finding a middle value. The best responses involved recognising that the 25th and 26th values could be found in the 4th row of the frequency column and thus, 3 glasses of water. Other candidates used a correct but rather long method of writing out all 50 results in numerical order and again finding the average of the 25th and 26th values. However there were many incorrect responses that usually involved finding the median of the 6 numbers in either the frequency column or the number of glasses column or the median of the 12 numbers in both of these columns. Other errors included candidates finding the wrong statistic, usually the mean.

(iv) Although a number of candidates answered this part correctly, there were many candidates who possibly did not read the question carefully enough. Common errors included using the number of glasses,leading to $\frac{4}{50}\times100 = 8$, an answer of 8 from the frequency, or leaving the answer as $\frac{8}{50}$.

(v) Whilst some candidates found the correct probability and wrote it as a fraction in its lowest terms, many were unable to find the correct frequency from the table of students drinking *fewer* than 2 glasses of water. Common errors included $\frac{12}{25}$ from $\frac{8+6+10}{50}$ (two or less glasses) and $\frac{3}{25}$ from $\frac{6}{50}$ (two glasses).

(b) This part was generally answered well with many candidates correctly showing that they could deal with the unit conversion and interpret all of the information given in the problem. Most candidates were able to gain partial credit for either a correct conversion, usually 2 litres to 2000 ml, or for $250 \times 5 = 1250$. The most common errors seen included 1 litre = 100 ml or using only 1 glass.

(c) Candidates found this question on bounds challenging. Common errors included $1.4 \leqslant w < 1.6$, $0.1 \leqslant w < 1.5$, $1.495 \leqslant w < 1.505$, and $1450 \leqslant w < 1550$.

(d) This part was generally answered well with a good number of candidates showing use of the correct formula, $\pi r^2 h$, and being able to find an accurate volume of the glass. However, a small yet significant number could only be awarded partial credit because they used inaccurate values for π. Common errors included using 7 cm for the radius rather than 3.5 cm, using an incorrect formula for the volume, finding the surface area of the cylinder, and calculating $15 \times 7 = 105$.

Question 5

(a) (i) This part was generally answered very well with many candidates able to draw an accurate triangle with clear and accurate arcs. Common errors included the omission of or erasing the required construction arcs, drawing inaccurate arcs resulting in inaccurate lengths, drawing both sides as 5 cm or 7 cm, and constructing the perpendicular bisector of *AB*.

(ii) This part was generally answered well. Common errors included reading the protractor incorrectly and giving answers such as 130° or 40°, incorrectly assuming angle *ACB* was a right angle and using trigonometry to find angle *B* rather than measuring it, measuring the wrong angle, giving the sum of the angles as 180°, and finding the perimeter of the triangle, usually as 21 cm.

(b) (i) This part was answered reasonably well with a good number of candidates successful in finding angle *PQS* correctly. Common errors included 123°, incorrectly assuming that angle *PSR* was 90°, using triangle *PSR* as equilateral, the misconception that angles *PQS* and *QSR* were alternate and incorrect use of the angle notation.

(ii) This part was generally answered well but with a fewer number of candidates successful in finding angle *PSR* correctly. Common errors included answers of 66° after finding angle *PSQ* but omitting to add 32°, answers of 90° and the incorrect use of 360° rather than 180°.

(c) (i) This part was generally answered very well. Common errors included $180 - 63 = 117$ and $360 - 63 = 297$.

(ii) A significant number of candidates found this question challenging and it proved to be a good discriminator. Those who recognised the use of trigonometry were usually successful although a small yet significant number were unable to rearrange their formula, or lost the accuracy mark due to premature approximation.

Question 6

(a) The table was generally completed very well with the majority of candidates giving the three correct values. However the point at $x = -1$ was more challenging with a large proportion of candidates dealing with the negative sign incorrectly within the x^2 term and giving $y = 7$.

(b) This was well answered by many candidates with accurate, smoothly drawn curves. Most others gained partial credit, usually for one point being plotted out of tolerance, or for just plotting the points without drawing the curve through them or for joining the points with ruled lines.

(c) This part on using the graph to solve the given equation was well answered. There were many correct answers with candidates reading the values off accurately from their curve. A few candidates misread the scale and a few candidates did not answer this part. Some candidates tried to solve the equation algebraically, which was not the required method and was rarely successful.

Question 7

(a) (i) This part was generally answered well with the vast majority of candidates able to write down the next term in the given sequence. Common errors included 37 and 22.

(ii) This part was generally answered well although candidates should be advised to distinguish between giving a term to term rule and finding the *n*th term. Common errors included 5, $n-5$, $37-5n$, 'subtract minus 5', add 5 and $-5n$.

(b) A significant number of candidates found this question challenging and it proved to be a good discriminator. Only the more able candidates could substitute correctly into this quadratic sequence. Many related it back to the sequence in the previous part, giving answers such as 47, 42, 37 and substituting 32, 27 and 22 into the expression. Others chose a starting number and then added 2 for the following terms. There were also many algebraic answers involving n^2 and n, notably n^2+n, n^2+2n, n^2+3n.

(c) (i) This part was generally answered well with the vast majority of candidates able to complete the table, either by drawing further patterns or recognising that they increased by 4 after counting the lines in the given patterns. Less able candidates struggled to find the number of lines in the patterns which were not drawn. A common error was to assume that the pattern would increase by 6 each time.

(ii) This part was generally answered well. Many candidates knew the $a+(n-1)d$ rule but this was sometimes spoilt by incorrect expansion and simplifying, leading to $4n\pm10$ or $4n\pm7$. Common errors included $n+4$, $2n+4$, $6n$, $n+6$ and a number of numeric answers.

(iii) A significant number of candidates found this question challenging and it proved to be a good discriminator. Few candidates were able to give a clear response here. The explanation required that the number of lines was referred to rather than ambiguous statements about numbers and patterns. Some did refer to even numbers but did not link this to the number of lines. The most common misconception was that the number of lines should be divisible by 4. Some ignored the instruction that no working was required and gave responses involving calculations.

Question 8

(a) (i) This part was generally answered well with the majority of candidates demonstrating that they could give a co-ordinate in the third quadrant. Common errors included (2, –5), (–2, 5), (2, 5) and (–5, –2).

(ii) This part was not generally answered as well. Common errors included sign errors such as $\begin{pmatrix}3\\-2\end{pmatrix}$, $\begin{pmatrix}-3\\-2\end{pmatrix}$, and incorrect vectors such as $\begin{pmatrix}-7\\-8\end{pmatrix}$ and $\begin{pmatrix}-5\\-5\end{pmatrix}$.

(b) (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. Candidates should understand that the correct mathematical terminology is required. The identification of the centre of enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (2, 3) and (1, 1) being common errors. Those who drew rays connecting the points on the triangles were the most successful at finding the centre of enlargement. The scale factor also proved challenging with –2 and $\frac{1}{2}$ being the common errors. A small number gave a double transformation, usually enlargement and translation, which can gain no credit.

(ii) This part was generally answered well although a common error was to draw a triangle of the correct size and orientation but in an incorrect position. Candidates should remember that once they have chosen a point on the triangle and translated it, the other points on the triangle's image need to be relative to the original. Other common errors included drawing one vertex at (4, –2).

(iii) This part was generally answered well although common errors included rotations drawn from a variety of incorrect centres, often (1, 1) and rotating through 180°.

Question 9

(a) (i) This part was generally answered well with the majority of candidates demonstrating a good understanding of substitution and dealing with negative numbers. Common errors included 34, $40-2-3=35$, $58-2-3=53$ and $58-23=35$.

(ii) This part on changing the subject of the given formula proved to be more challenging. The most common error was an incorrect first step of $c-2b=5a$. A variety of other algebraic and transposition errors were seen. Less able candidates often tried to calculate a numerical answer for *a* using values from the previous part.

(b) This part was generally answered well with the majority giving the correct factorisation. Common errors included $(x+4)$, $x(3+12)$, $3(x+12)$, $3(x+9)$, $15x$ and 15. Another common error was to treat the expression as an equation, either $3x=12$ or $3x+12=0$, leading to $x=\pm 4$ as an answer.

(c) This part was generally answered well with the majority giving the correct expansion. Common errors included spoiling their expansion by combining terms, giving a final answer such as $2x^2y$ or $2x^3y$, multiplying $x\times x$ as $2x$, and answers such as $y=\dfrac{x}{2}$.

(d) A significant number of candidates found this question challenging and it proved to be a good discriminator. Many candidates did not appreciate that an algebraic approach was needed. The more able candidates could often give a well presented and succinct method and answer. Those who started with the initial equation of $n+2n+2n+3=58$ usually reached the correct solution. Less able candidates often left this part blank or adopted a trial and improvement strategy using numbers, which was rarely successful. Common errors included $58\div 3=19.3$, incorrect initial equations of $2n=58$, $6n=58$, $2n+3=58$, and the use of n^2 and/or n^3.

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key messages

This paper requires candidates to have a good knowledge across all of the key areas, number, algebra, shape and space and probability and statistics and candidates should be prepared to answer questions across the whole syllabus. Some candidates were clearly well practiced in some, but not all, of these areas.

Candidates generally showed an appropriate amount of working to support their answers, which is important if they make an error and wish to gain method marks.

Candidates should ensure that they read the questions carefully and are mindful of miscopying numbers both from the paper and their own work.

General comments

This paper covered a wide range of topics and many candidates were able to evidence clear understanding across the syllabus.

Candidates were able to complete the examination within the given time and even when there were questions they found more challenging, candidates usually made a reasonable attempt at answering them or moved on to other questions they were able to answer.

The standard of presentation was generally very good. In particular, for the questions that specifically asked for clear working to be shown, namely **Questions 1(i)**, **5(e)** and **9(a)**, candidates had generally made an effort to show every step of their solutions.

Candidates should make sure they answer the question asked. For example in **Question 1(h)** it was the interest rather than the total value that was needed, and **Question 9(d)** required an answer in a specific form.

Overall there were some excellent responses seen with a good level of knowledge and skills evidenced by many candidates.

Comments on specific questions

Question 1

(a) Almost every candidate was able to correctly convert the given fraction to a decimal.

(b) Apart from the rare error when cancelling down, almost all candidates were able to correctly write the given fraction in its lowest terms.

(c) Most candidates understood that the word 'of' required them to find $\frac{5}{8}\times 128$. Errors seen included finding $128-\frac{5}{8}$ or $128\times\frac{8}{5}$.

(d) The candidates who were most successful in finding all eight factors of 24 had usually worked methodically, evidenced by giving the factors in relative size order or in pairs such as 1, 24, 2, 12, 3, 8, 4, 6. The most common error was the omission of one or both of the factors 1 and 24. In addition a few candidates misread the question and expressed 24 as a product of its primes.

(e) Many candidates correctly found the highest common factor, 12. Others found a smaller common factor such as 6, 4, 3 or 2 and gained partial credit. The most common error was to find the lowest common multiple and answers such as 216 and 2592 were seen.

(f) Only a small proportion of candidates were able to answer this question correctly and gave a variety of correct responses such as π, $\sqrt{11}$ and $4\sqrt{5}$. A few other candidates gave irrational numbers but they were outside of the required range. Most candidates did not know what the word irrational meant and gave fractions or prime numbers as their answer.

(g) A majority of candidates answered this part correctly. The most common incorrect answers seen were 25 and 0. Other errors seen included those misinterpreting the power zero as $25\% = \frac{1}{4}$ or $25^\circ = \frac{25}{360}$.

(h) Many candidates demonstrated a clear understanding of compound interest evidenced by finding the total value of the investment \$8998.29. However, not all candidates read the question carefully and as a result not all went on to give the interest, \$598.29, as required. Candidates who gave an accurate final answer had generally used $8400 \times (1.035)^2$ rather than a year by year approach. Common errors included those that did not use the multiplier $\left(1 + \frac{3.5}{100}\right)$ but used incorrect multipliers such as $(1 + 3.5)$, $\left(1 - \frac{3.5}{100}\right)$, $\left(1 \times \frac{3.5}{100}\right)$, 3.5 or 1.35. In addition a significant number of candidates gave the answer \$588 by finding simple interest.

(i) Many candidates set their fractions out clearly and showed all the steps of working required to gain full credit. Some candidates left their answer as a top heavy fraction rather than writing it as a mixed number. A common error seen, however, was $2\frac{1}{3} = 2 \times \frac{1}{3} = \frac{2}{3}$ rather than $2 + \frac{1}{3}$.

Question 2

(a) (i) Candidates who rewrote the given list of numbers in numerical order were generally successful in selecting the middle two numbers, 3 and 4 and hence a median of 3.5. Those correctly selecting 3 and 4 but performing no, or an incorrect, further calculation gained partial credit. It was reasonably common to see errors or omissions in the ordering of the list or candidates selecting the middle two numbers 4 and 5 from the unordered list or finding the wrong statistic such as the mean.

(ii) Most candidates found the mode correctly. Some candidates found the wrong statistic, most commonly the mean.

(iii) Most candidates found the range correctly. Common incorrect answers included not evaluating $7 - 1$ or finding the difference between the first and last numbers of the unordered list.

(b) (i) Whilst some candidates completed this question successfully, many candidates were unsure how to deal with the numbers. Many did not recognise that, for example, if there were 6 words with 5 letters in each, 30 letters were used. The most common incorrect answer came from $\frac{(3+1+5+8+6+2)}{6} = 4.17$ but a variety of others errors were seen including: $\frac{94}{6}$, $\frac{94}{21}$,$\frac{94}{100}$, $\frac{25}{21}$, $\frac{21+25}{12}$ and $\frac{21}{6}$. There were also a number of arithmetic errors seen but where candidates showed their method it was often possible to award partial credit.

(ii) Many candidates correctly interpreted the information in the table to give the correct probability either as a fraction, decimal or a percentage. Some candidates misread the question and found the probability that a word had exactly 4 letters $\left(\frac{8}{25}\right)$. As with the previous part, there was a wide variety of errors including $\frac{3}{6}$, $\frac{16}{21}$, and $\frac{15}{21}$.

(c) (i) The majority of candidates completed the table correctly. It was evident that candidates had worked out, either by calculating $24 \div 6$ or $360 \div 90$, that each book was represented by 4° on the pie chart. A small number of candidates did not attempt to complete the table and the responses of others showed that they did not understand that the pie chart angle for each sector is proportional to its frequency and that the total angles are required to add up to 360°.

(ii) The pie chart was generally completed accurately and most candidates who had completed the table correctly gained full credit. A few candidates drew the radii free hand when they should be ruled.

Question 3

(a) Most candidates recognised that the triangle had been reflected. The word reflection was required and 'mirrored' was not acceptable. Only a minority gave the line of reflection as $y = -1$. A significant number of candidates wrote about reflecting the triangle and then translating it but a single transformation was specifically asked for.

(b) Most candidates recognised that the triangle had been rotated. As in **part (a)**, there were candidates who wrote about rotating and translating the triangle. To gain full credit a complete description needed to include the type of transformation as rotation, the angle and direction of rotation and the centre of rotation. Whilst some candidates gained full credit, the majority were able to pick up at least one mark.

(c) Most candidates were able to translate the triangle correctly. Some candidates gained partial credit for translating the triangle correctly in one of the two directions. Common errors were triangles which had moved by $\begin{pmatrix} -3 \\ -2 \end{pmatrix}$ or had moved so that one of the vertices was at (–2, –3).

(d) A good proportion of the responses showed fully correct rotations. In addition a number of candidates gained partial credit for rotating the triangle through 180° albeit about an incorrect centre. Other candidates either rotated the triangle through the wrong angle, changed the shape of the triangle or did not offer a response.

Question 4

(a) A minority of candidates gained full credit and the majority scored 2 marks. Most understood the question required the flight time needed to be added to the start time, plus 2 hours to allow for the time difference between the two countries. Nearly all candidates calculated the correct flight time as a decimal (5.33...hours), but most were unable to convert this to 5 hours 20 mins. Candidates usually interpreted 0.33 hours as 33 minutes or 0.3 hours as 30 or 3 minutes. The method for adding their time to the start time earned a second mark in most cases.

(b) This was answered very well with a large majority gaining full credit for converting the currency. A common error was to multiply the amounts and a few subtracted them.

(c) Most candidates calculated the correct percentage increase. A few found the old price as a percentage of the increased price and subtracted from 100. Others found the actual increase but did not know how to proceed.

(d) The majority of candidates gained full credit. A few candidates scored just the method mark for finding the value of one part, namely 4.

Question 5

(a) The majority of candidates gained full credit. Most others collected the *x* terms correctly but common incorrect answers were $4x - y$, $4x + y$ and $14x - 3y$, resulting from sign errors.

(b) Some candidates found this part challenging. Many gained full credit but others were not able to rearrange the expression following correct substitution of the given values. Some subtracted 35 and 75 the wrong way around, perhaps reluctant to introduce the required negative answer. Less able candidates evaluated 3×5^2 as $15^2 = 225$. Other errors included reaching $20a = –40$ but giving an answer of 2 or $-\frac{1}{2}$.

(c) (i) Candidates nearly always solved this simple equation correctly. A few gave the answer as 2 or –5.

(ii) A large majority gave the correct solution to this equation. Errors usually involved incorrect positive or negative signs when collecting like terms across the equals sign or arithmetic errors.

(iii) This part was answered very well, with a large majority gaining full credit. Most chose to expand the brackets then collect like terms. A few forgot to multiply the constant term in the bracket by its coefficient but were still able to retrieve the second method mark for correctly re-arranging their terms.

(d) This part proved more challenging and whilst some candidates gained full credit many misconceptions were seen. Many started by attempting to expand the bracket. Those that expanded it correctly often did not then re-arrange the formula correctly. Others expanded $5(p + 2)$ as $5p + 2$ and attempted to re-arrange from here. Many other errors involving signs, moving terms and inappropriate cancelling of the 10 and 5 were seen.

(e) The majority of candidates solved the simultaneous equations correctly. Working was clearly set out and most opted to use the elimination method. Common errors included multiplying only two of the three terms when attempting to make coefficients of *x* or *y* equal and mixing addition and subtraction of terms when trying to eliminate the *x* or *y* terms. When candidates did choose to use the substitution method, most were able to rearrange one of the equations and correctly substitute into the other.

Question 6

(a) (i) A minority gave the correct bearing. Many varied incorrect answers were given. Common errors included 65 and 295 from measuring some of the angles found at point *B*. A significant number gave no response. Some candidates found the distance between the towns in centimetres, the requirement of **part (a)(ii)**.

(ii) Nearly all candidates measured the distance accurately and used the scale to convert it to the actual distance correctly. Only a few gave the distance without scaling up.

(iii) A minority of candidates were able to locate the correct position of point *C*. Many were able to plot *C* along a bearing of 064° from *A* but not 028° from point *B*.

(b) Few candidates gained credit for this part on finding a reverse bearing. Most candidates simply subtracted 245 from 360. Those who were successful had often drawn a diagram to help them visualise the problem. A significant number gave no response to this part.

(c) (i) A small majority knew that *P* was west of *Q*. Many wrote *P* and *Q* in reverse order or gave an answer that involved *R*.

(ii) This part was not well answered. Only a minority were able to calculate an interior angle of a regular decagon. Both methods were used successfully with more opting to find the exterior angle first. Having found an exterior angle was 36° using 360° ÷ 10 some could not proceed further. The most common incorrect answer was 150°, usually seen with no accompanying working; candidates having measured the angle in the diagram from the previous part. A few thought a decagon had 12 sides.

Question 7

(a) (i) The simplest way to answer this question was to find $2(24+32)$ and a minority of candidates were successful in using this method. Most other candidates found the missing lengths of 14 and 15 and were successful in added the lengths of the six sides together. A significant number of candidates gave the common incorrect answer of 83 from simply adding the four given lengths together. Candidates who did not find the perimeter correctly but who found either the 14 cm or 15 cm lengths were awarded partial credit.

(ii) Many candidates answered this correctly. Most split the shape into two rectangles and added together the area of each. A few chose to find the area of the whole and subtract the missing rectangle. Some candidates did not know how to find the area and a variety of wrong methods were seen including adding the areas of two overlapping rectangles using the given lengths, or multiplying all the sides together or adding together the squares of all the sides or using their answer to **part (a)** in a calculation.

(b) (i) Almost all candidates knew that angles on a straight line add to 180° and gave the correct answer.

(ii) Almost every candidate recognised that either *v* and *w* were alternate, or that *w* and 128° added to 180°, and could give the correct answer. The most common errors were to work out $180° - 63° = 117°$ or to misread the question and give the value for *y*.

(iii) Again, most candidates were successful in this part. A follow through mark was available and applied if the values of *v* and/or *w* were incorrect in the previous parts.

(c) Candidates answered this question very well with many obtaining the correct answer by breaking down the question into parts. Almost all candidates kept the full accuracy within their workings and were thus able to obtain 12.4 exactly. A common incorrect answer of 6.4 arose from adding up and equating the given lengths. Some candidates also incorrectly tried to find *h* by equating the surface areas whilst others thought the cuboids were similar and tried to use scale factors.

(d) This question was also answered very well with most candidates obtaining the correct answer. Some candidates made arithmetic slips but where they showed correct working they were awarded partial credit. A few candidates attempted to use Pythagoras' theorem in this question, incorrectly assuming that the triangles were right-angled.

Question 8

(a) (i) The majority of candidates completed the table correctly for $x = 3$. However, a significant number of candidates made an error when $x = -1$. The table could be completed without a calculator, but if a calculator is used, candidates need to remember to insert brackets, as many worked out $-1^2 - 2 \times -1 = 1$ rather than $(-1)^2 - 2 \times -1 = 3$.

(ii) This graph was relatively easy to plot, as all the *x* and *y* values were integers, and candidates were consequently very successful. Graphs were expected to be parabolic in shape and those that were ruled were not considered to be smooth. A minority of candidates had curves that didn't go through their points.

(b) (i) Almost every candidate gave the next term correctly as 27.

(ii) The majority of candidates gave the rule for continuing the sequence as 'add 6', or equivalent. Candidates who wrote $n+6$ or gave a formula for the *n*th term did not score as this was not asked for.

(iii) Some candidates were able to give a correct expression for the *n*th term of the sequence. Some of the expressions that candidates gave were very complex but nevertheless correct. Ideally candidates should simplify by collecting the like terms within their expression. The most common incorrect answer was $n+6$. Many candidates gave a number as their answer. The most common were 33, as the term after 27 and 51 which was perhaps because candidates misread the *n*th term for the ninth term.

Question 9

(a) Because this was a question requiring candidates to show that an estimate of the answer is 20, all working needed to be shown. A minority of candidates knew exactly how to answer this question, showing all four numbers rounded to 1 significant figure within the calculation and subsequent working, that is $\frac{10+30}{0.4\times 5}=\frac{40}{2}$. Common rounding errors included 9 for 9.78 and 0 for 0.381 as well as candidates who rounded all numbers to, for example, 2 significant figures or all to 1 decimal place. Other candidates did not read the question carefully and worked out the exact answer to the calculation and then attempted to round their answer to 1 significant figure.

(b) Candidates were generally accurate in their ordering of the four given numbers. The best approach was to convert the two fractions into decimals and then the four numbers could be more easily compared. Candidates who did this conversion gained partial credit provided the numbers were evaluated to enough decimal places to be able to compare them.

(c) Whilst some candidates gave the correct upper and lower bounds for the length of the pencil, it was clear that many were unsure how to approach this question. A common error was to give the two answers to 2 significant figures, for example, 9.7 and 9.9. Other common incorrect answers included 9.79 and 9.81, 8.8 and 10.8. Some candidates gave the correct lower bound but gave the upper bound as 9.84 or 9.8499999.

(d) This question proved to be quite challenging, partly because the answer written as a decimal came out to be very small. Some candidates were able to correctly evaluate the sum but did not put it in standard form or attempt to round it. Others either rounded correctly or put the number in standard form. However a minority of candidates gained full credit.

MATHEMATICS

Paper 0580/41
Paper 41 (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 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 answers written to an appropriate accuracy.

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

General comments

Many candidates seized the opportunity to demonstrate their understanding of a wide range of mathematical concepts as they were able to make an attempt at all of the questions.

The majority of candidates indicated their methods with clarity. In the 'show that' questions the best solutions had a step by step style with just one equals symbol per horizontal line.

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

Most candidates followed the rubric instructions with respect to the values for π although a few used $\frac{22}{7}$ or 3.14, which may give final answers outside the range required. Some candidates lost accuracy marks by not giving their answers correct to at least three significant figures, and there were a number of candidates losing accuracy marks by approximating values in the middle of a calculation.

The topics that proved to be accessible were: finding a percentage reduction, reverse percentage, straight forward compound interest, Pythagoras' theorem, recall and use of the cosine rule, interpretation of a cumulative frequency diagram, use of a frequency table to find mean, median, mode and range, forming and solving a linear equation, forming and solving simultaneous equations, solving a quadratic equation, using correct notation for inequalities and spotting patterns to continue different types of sequences.

More challenging topics included: selection and use of a relevant circle theorem, ratio, more complex application of exponential growth, similar shapes, application of trigonometric ratios to 3-dimensional shapes, average speed, unstructured interpretation of a histogram to find an estimate for the mean, forming an equation connecting speeds, distances and time, factorising a quadratic equation where the coefficient of x^2 is not 1, finding probabilities of two events.

Comments on specific questions

Question 1

(a) Candidates generally found p using the straight line and then used the angle sum of a triangle to find q. Very few candidates used the exterior angle of the triangle to give $q = p - 55$.

(b) The candidates who knew that the four angles summed to 360° often successfully reached the correct solution. There were a significant number of scripts where $5x - 10 = 360$ was followed by $5x = 350$ and a number of candidates omitted the angle x from the initial equation.

(c) Fewer candidates were successful in this part as 180 and 360 were used incorrectly. Of those who reached the correct value, most used $(72 - 2)\frac{180}{72}$ rather than the sum of the exterior angles. Some candidates found the sum of the interior angles.

(d) This question differentiated well as only the most able candidates found all five angles correctly and many struggled to find more than two or three. Candidates who could apply some circle properties of angles were compensated by the follow through marks.

(e) This question demanded very careful thought from candidates in order to state the correct relationship between the given angles. The most common error was to assume that the given quadrilateral was cyclic and as a consequence the given angles summed to 180. Other misconceptions were the given angles summed to 360, or were equal, or that the obtuse angle $AOC = 2 \times$ angle ABC. Some candidates who recognised the correct relationship went on to make a sign error when expanding $360 - (3x + 22)$.

Question 2

(a) The more able candidates immediately saw that 2 parts = 600 and easily reached the correct solutions. A significant number of candidates understood the ratios and attempted to form an equation involving $\frac{9}{16}$, $\frac{7}{16}$ and 600 but were often unable to complete the problem successfully. By far the most common incorrect solutions came from $\frac{9}{16} \times 600$ and $\frac{7}{16} \times 600$ as the two values.

(b) This question was usually correctly answered. Both methods of finding 11% directly from $\frac{24.2}{220}$ or finding 89% first were well used.

(c) There were many varied attempts to solve this problem. The incorrect methods were to treat 63 as 25% of the price, find 75% of 63 or increase 63 by 25%. However many candidates did understand that 63 represented 75% of the original price and then arrived at the correct solution.

Question 3

(a) Most candidates successfully answered this question. Some reached the correct solution by working year on year rather than using the compound interest formula. The two common errors were to use the simple interest formula or to find the interest earned instead of the value of the investment.

(b) (i) Many found this to be more challenging and only the most able candidates interpreted the question correctly to write down the correct formula and use it to reach the solution. Many merely added or subtracted percentages of 882. Another common error was to use $882(1 - 0.05)^2$.

(ii) This was another challenging question that was attempted by most candidates but not always with success. The most able candidates wrote down the correct equation and used trials to exceed 1100 or 1.247. Many did not read the question carefully and omitted to give the number of complete years.

Question 4

(a) (i) This question was generally well answered with many candidates using a correct formula for the curved surface area of a cylinder. A number of candidates calculated the volume, a few others added the area of a circle and a few found the area of the rectangle with the height and diameter as its dimensions.

(ii) Almost all candidates gained full marks by multiplying their area by the $0.85 per square metre.

(b) (i) This was a straightforward 'show that' question and many candidates showed every necessary step to earn full marks. The challenge in this type of question is to show each step clearly as well as not using the value given. A number of candidates did not show the division or the multiplication by 3 if it was needed. A few candidates did substitute the given value into the formula for the volume of a cone and this approach did not earn any marks.

(ii) The slant height of the cone was to be found using Pythagoras' theorem and most candidates carried this out correctly. A few candidates used Pythagoras' theorem but did not treat the slant height as the hypotenuse. Some less able candidates did not recognise the need for Pythagoras' theorem and used a volume approach or even gave the slant height as the value being shown in **part (i)**.

(iii) This part was found to be more straightforward than the two previous parts as all candidates had to do was to substitute into a given formula. Most candidates gained the mark whilst a few used the radius of the given sphere instead of that of the cone.

(c) Mathematically similar shapes are usually found to be challenging and this question was no exception. The fact that two areas were given did make this question a good discriminator with many candidates treating the area scale factor as the linear scale factor. Some of these candidates multiplied the given volume by this factor and others cubed this factor to find the larger volume. Credit was given for the candidates who found the square root of the area factor and many of these candidates did then correctly complete the question by cubing this square root and multiplying it by the given volume. A small number of candidates lost one mark by rounding values during the working, thus not reaching the exact answer.

(d) This part was also challenging as three-dimensional trigonometry is not a simple situation. The candidates who recognised the correct angle between an edge and the base usually went on to score full marks, using the tangent ratio. Some candidates used Pythagoras' theorem and then used the sine ratio and occasionally gave an answer out of range as a result of rounding during the working. A few other candidates used the sine rule or the cosine rule in a non-right-angled triangle, which was more work for only a maximum of three marks. A number of candidates omitted this part.

Question 5

(a) This was probably the most challenging question on the whole paper and yet the concept of average speed was not thought to be difficult. The most able candidates could show their ability here by setting up a correct calculation using total distance divided by total time. A few of these candidates gave an answer to only two significant figures. The most frequent error was to treat average speed as the average of the speeds and this was seen on many scripts.

(b) This question instructed candidates to use the cosine rule and was generally successfully answered especially by candidates who started with the explicit formula for an angle, although a few found one of the other angles in the triangle. Many who used the formula for a side were also successful but the challenge using this approach is to use order of operations and to collect terms correctly.

(c) (i) Bearings questions often prove to be quite challenging and this part showed that some candidates have a good knowledge of bearings whilst others appear to have little experience of this topic. The responses to the question were quite varied with a mix of correct answers and a range of incorrect ones with little evidence of how they were worked out. A number of candidates omitted this part.

(ii) The comments to **part (i)** also apply to this reverse bearing question.

(d) This part was testing knowledge about the shortest distance from a point onto a line. The question went a little further as it asked for the position of the nearest point on the line and not the shortest distance. The more able candidates answered the question well using either the cosine or the sine ratio. A number of candidates did find the shortest distance perhaps not quite understanding the situation. Marking the point on the diagram was a very helpful way to understand this question.

Question 6

(a) (i) Almost all candidates correctly gave the median from the given cumulative frequency diagram.

(ii) Most candidates found the interquartile range correctly. A few gave the answer of 25, from a half of 75 – 25.

(iii) Almost all candidates found the correct number of candidates by correctly reading the cumulative frequency graph and then subtracting from 200.

(b) (i) Most candidates gave the correct range from the frequency table of discrete values. A few gave an answer of 1 to 50, instead of 49.

(ii) The mode was almost always correctly stated.

(iii) Most candidates gave the correct median although a few overlooked the frequencies and found the median of a list of just six values.

(iv) The total of the products of the values and their corresponding frequencies was almost always correctly answered. A few candidates again ignored the frequencies and found the total of the six values in the list.

(v) Candidates who gave the correct answer to **part (iv)** generally calculated the mean correctly. Quite a few of these candidates lost the mark by giving the answer to 220 ÷ 15 as 14.6.

(c) Interpreting the given histogram to calculate an estimate of the mean was a challenging question. There were many fully correct answers and most candidates gained some marks by giving correct frequencies or by using mid-interval values. The errors seen were largely either treating the frequency densities as frequencies or by using half of the interval widths instead of the mid-values.

Question 7

(a) The most efficient solutions either started with the number of oranges or formed a suitable equation relating 21, x, and $x + 2$ to the cost. Some candidates mixed the units and subsequently found it difficult to solve their equation. A common error was to omit brackets and write $21x + 21x + 2 = 420$. Another common misconception was for candidates to start with $x + x + 2 = 4.2$ leading to $x = 1.1$.

(b) Virtually all candidates correctly formed the initial equations and then efficiently solved to find the cost of a protractor. The main method correctly used to find the cost of one protractor typically involved equating the coefficients of p or r. A significant minority of candidates correctly made r or p the subject of one equation and substituted to correctly find the other value. The main error seen was to incorrectly convert cents to dollars. A small proportion of candidates formed the equations but then could not solve. A very small number of candidates attempted to solve the equations without algebra.

(c) (i) The features of the best solutions to this question were as follows:

- A clear initial statement of $\frac{12}{x}+\frac{6}{x-1}$.
- Careful manipulation of the fractions with one equals sign per horizontal line.
- Accurate rearrangement of their algebraic expressions.
- Clear symbols (powers, +, –).

Some candidates did not form the initial equation and appeared to be working backwards from the given result. A relatively common error was to work with more than one equals sign per line which often resulted in algebraic expressions that were not equal regarded as equal by the candidate. The best solutions were concise and clear from line to line. Some solutions were less clear due to mixing elements of correct working with an equation, for example by writing $x - 1$ next to some or all the terms.

(ii) It was evident that a significant number of candidates used their calculator function to solve $5x^2 - 23x + 12 = 0$ and then attempted to work backwards from their solutions, $(x - 0.6)(x - 4)$ being a common incorrect answer.

(iii) Candidates who had correctly factorised in **part (c)(ii)** were able to use this to give the correct solutions. Many other candidates answered correctly using the quadratic equation formula or the solve function on their calculator.

(iv) Many candidates found this part challenging. This required an interpretation of their numerical solutions in the context of the original question information.

Question 8

(a) Both of these simple probability questions were very well answered.

(i) Most candidates recognised the probability of an even number as $\frac{4}{5}$.

(ii) The most common incorrect answer was $\frac{1}{5}$ presumably because some candidates were not sure about the status of the number 2.

(b) (i) Some candidates scored full marks in this part after writing out a clear method for the probability of 3 and 2, and 2 and 3. Many correct solutions made use of tree diagrams to aid calculations. However there were many scripts that demonstrated a complete lack of understanding of this topic.

(ii) Candidates often struggled with this question and many less able candidates omitted it completely. Again only the most able candidates demonstrated their understanding with a clear method leading to the solution but many others were unable to make much progress. A few attempted to use a sample space, often incomplete, or a tree diagram to help in the solution but in many cases these did not lead to either correct working or the solution.

Question 9

(a) Many candidates correctly stated the three inequalities. The main error was to mix x with y in particular for $x \leqslant 8$. Instances of using strict inequalities did occasionally occur, as did using the inequality symbols the wrong way around.

(b) Many candidates stated the correct inequality showing that by division the correct result was reached. Some incorrectly worked with equality or strict inequality and there were many attempts at working with numerical values which gained no credit.

(c) The best solutions had clear ruled lines along with an indication of the required region. There were virtually no cases of unruled lines or lines that didn't cover a sufficient part of the grid. Some candidates misinterpreted the rectangular grid joining (0, 0) to (15, 10) in their attempt to draw $y = x$. A common error was to omit the line $2x + 3y = 30$ despite the instruction to use all four inequalities. A small proportion of candidates drew all four lines correctly but then shaded an incorrect region.

(d) (i) This proved challenging for many candidates. Some candidates were able to correctly answer this part by going back to the original question information. Common incorrect answers included 3, 8, 15, 10 and 4, 6.

(ii) The clearest solutions indicated the substitution of points from their region in $4x + 6y$. A common error was to ignore the region on their diagram and just work out the number of passengers in 7 large cars. Candidates had difficulty in relating the co-ordinates of a point on the graph to the number of large and small cars. Very few candidates checked more than one point with many just giving a numerical value with no supporting evidence. A significant number of candidates substituted into $2x + 3y$ rather than $4x + 6y$.

Question 10

(a) The majority of candidates were familiar with this style of question. The values for the 5th term were frequently all correct. A small proportion of candidates did not know how to find the *n*th term for any of the sequences and left this part blank. For the linear sequence, the expression for the *n*th term $n - 4$ and $4n + 5$ were incorrect answers seen. Candidates generally recognised the second sequence as a quadratic and most answers were of a quadratic form, although not always correct. To find the formula for the quadratic many candidates did not spot the pattern in the terms and used the method of differences. Some candidates did not see the pattern of cubes in the third sequence. A significant number of candidates did not recognise the power of 2 in the final expression. The formula for this final sequence was frequently not attempted.

(b) Most candidates were familiar with the Fibonacci sequence and often got the first and second sequences correct. In the final sequence a common error was to regard the initial term as –1 whilst other candidates could not decide if the sequence started at +2 or –2.

(c) (i) Very few candidates could find an expression involving *p* and *q* for the next term with many leaving this part blank. Most answers when given were numerical and when an algebraic expression was attempted this was usually incorrect (e.g. $\frac{p}{q}, \frac{q}{p}, \frac{11p}{18q}, \frac{18p}{29q}, \frac{(p+11)}{(q+18)}$).

(ii) This was often correct as a continuation of the original sequence. The main error was for candidates to try and work out the seventh term often after giving the sixth term as their answer in **part (c)(i).**

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 familiar and unfamiliar contexts 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 answers written to an appropriate accuracy.

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

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

Solutions were usually well-structured with clear methods shown in the space provided on the question paper.

There were a number of candidates demonstrating an expertise with the content and showing excellent skills in application to problem solving questions.

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

Most candidates followed the rubric instructions with respect to the values for π although a few used $\frac{22}{7}$ or 3.14 which may give final answers outside the acceptable answer range.

A small number of candidates lost unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving their answers correct to at least three significant figures. This was most evident in **Questions 4(b)(i)(a)**, **4(b)(i)(b)** and **9(a)**.

The topics that proved to be most accessible were currency and percentages, standard statistical analysis and calculations, solving equations, standard trigonometry in general triangles, functions, drawing a graph and exponential rate of increase.

The most challenging topics were transformation geometry, using LCM to solve a problem, solid geometry and use of statistics to justify a statement.

Comments on specific questions

Question 1

(a) (i) This was well answered by most of the candidates, with only a few not giving answers in the lowest terms. Some answers were given as $\frac{5}{11}:\frac{6}{11}$ which was not acceptable although answers in the form 1: *n* or *n*: 1 were awarded the mark.

(ii) Most candidates scored at least 2 marks here for reaching 207 360. Some did not convert to standard form as required and a few gave inaccurate answers such as 2.1×10^5 without showing a more accurate value.

(b) (i) This was well answered by the vast majority of candidates. The two common errors made were to divide 18 540 by either 22 or 13.

(ii) The concise method involved the multiplication of $0.85 by 1.6, but many correctly found 60% of $0.85 and then added. A few candidates found 60% and left the answer as $0.51. A common error was to equate 0.85 with either 60% or 40%.

(c) There were many fully correct answers seen to this part. Most candidates were able to convert either the selling price or the cost price into the appropriate currency but did not then use the correct denominator in the percentage calculation. Most did, however, earn a method mark by showing a correct subtraction to find the difference in costs.

(d) Most candidates set up a correct formula to deal with compound growth, and in general, they applied this successfully. Some, however, did not and used, either (1×0.087) or $(1 - 0.087)$. A few candidates correctly calculated the earnings for 2027, $414 414, but did not subtract $195 600 from this to give the required answer. A number of candidates incorrectly used a 'simple interest' calculation to find the interest for one year and then multiplied this by 9.

Question 2

(a) (i) Most candidates found the median correctly.

(ii) The interquartile range was generally well answered, although some made errors in reading the quartiles accurately, particularly with the upper quartile. The most common error was to subtract 20 from 60 to get 40 and then read the 40th value from the graph.

(iii) Most candidates were successful in finding the 20th percentile. The common error was to read off at 20 to give an answer of 36 rather than working out 20% of 80 for the reading.

(iv) This part was well answered. A few candidates gave non-integer answers or forgot to subtract their reading at 66 seconds from 80. A few did not read the value accurately.

(b) (i) There were many correct answers seen. A few candidates knew what to do but made slight errors in the readings. Some gave cumulative frequencies for the three values rather than frequencies and a few appeared to give frequency densities or even cumulative frequency densities.

(ii) The estimate of the mean was generally well answered and most scored full method marks even if they had incorrect frequencies in **part (b)(i)**. The more common errors involved division by 100 or 5 and using the class widths rather than the mid-interval values in $\sum fx$.

(c) (i) Very few candidates understood that the upper quartile represents 75% of the data. There were a variety of incorrect attempts at calculations using estimated values with frequencies.

(ii) Only a small number of candidates scored both marks. Many tried to compare e.g. medians, upper quartiles, etc., with limited understanding of what was meant by variation of data. Those who used the interquartile range often scored one mark for a correct comparison but usually did not reference the boys' interquartile range of 20 or spoiled their answer by mentioning other incorrect statistics e.g. median in addition in their comments.

Question 3

(a) (i) Almost all candidates gave the correct answer. A small number subtracted the co-ordinates leading to an incorrect answer of (2, 2.5).

(ii) This was answered well with most candidates scoring full marks. Those who calculated the gradient correctly but made an error in calculating the constant term almost always earned two marks by giving their answer in the form $y = 1.25x + c$. A few gave an incorrect gradient either by using $\frac{x}{y}$, or making a sign error. Others made an error in substituting the co-ordinates of *A* and *B* and a few made an error in finding the value of *c* following a correct substitution.

(b) (i) Many candidates answered this part correctly. Those who did not sometimes subtracted the vector $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ from $\begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 5 \\ 8 \end{pmatrix}$ and others gave $\begin{pmatrix} 1 \\ 3 \end{pmatrix}\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ or $(13)\begin{pmatrix} 5 \\ -2 \end{pmatrix}$. Some candidates omitted this part.

(ii) Many candidates found this part challenging. Some wrote down the 2×2 matrix which gives the required rotation but either gave an incorrect matrix or set up the multiplication in the wrong order. Few of those not using the matrix method attempted to draw a sketch to establish the positions of the points *A* and *B* after the rotation. A small number gave the correct co-ordinates following a 90° clockwise rotation which was given some credit.

(iii) There were few completely correct answers. Not many candidates attempted a diagram and, of those that did, few were accurate enough to obtain the correct co-ordinates.

(iv) As in the two previous parts candidates also found this part challenging. Many understood that a matrix multiplication was required but most put the transformation matrix in the wrong position for the multiplication. It was also quite common to see the original co-ordinates placed into a 1×2 matrix rather than a 2×1 matrix. A common feature in the last three parts was for candidates to write down an incorrect answer without showing any working. There were also a number of omissions.

(c) There was a mixed response to this part. Many correctly gave the single transformation as an enlargement, although some gave a rotation. The most common error when describing the transformation was to give a scale factor of 2. Only a small number gave more than one transformation.

Question 4

(a) (i) This part was well answered by most candidates. Some found the volume of a sphere rather than a hemisphere. A few gave answers outside the acceptable range, usually after using an inaccurate value for π. Candidates should use either the calculator value for π or 3.142.

(b) (i) (a) Answers were mixed for this part. Many attempted a surface area calculation instead of a volume. A number used the sides 10 and 5.2 as the base and height of the triangular face. Many who used Pythagoras' theorem to find the length of *CD* showed insufficient working and/or gave an inaccurate length of 8.5 cm and this resulted in a volume outside the required range.

(b) This part was answered well with many scoring full marks. The most common error was to lose accuracy in the final answer by using a premature approximation for *EC* or *BE*. Of those who did not earn full marks, many were able to use a correct method to find the length of either *BE* or *EC* to earn partial marks.

(ii) There were a number of errors made in this part, with some candidates attempting to use their answer from **part (b)(i)(b)** in this calculation. Other candidates considered only the triangle *BEG* and did not consider the concise method using the right-angled triangle *BDG* which would simplify the working considerably. Candidates using the cosine rule in triangle *BEG* often gave inaccurate answers, again because of premature approximation of the lengths *BG* or *BE*.

Question 5

(a) Most candidates completed the table correctly. Some made a sign error when calculating the value of y at $x = -1$ leading to an incorrect value such as –0.5.

(b) Although this was a difficult graph to draw, the standard was generally high with many candidates plotting all 11 points accurately and producing a good curve. There were some mis-plots, the most common being to plot the point (0.5, 0.1) at (0.5, 1). Some incorrectly joined up the two branches of the curve across the y-axis.

(c) The vast majority of candidates realised that they had to give the x-values where their curve crossed the x-axis and earned both marks. A number of candidates gave the values as –3 and –0.3, the x-values for which the curve is to the left of the y-axis. A few candidates reversed the correct x-values in the inequality.

(d) Candidates found this part very challenging with only a small number giving the correct answer. Many did not give an integer as the answer. The most common incorrect integer answer was 6 which arose as a result of not considering the lower part of the graph.

(e) (i) Most candidates identified the equation of the suitable straight line as $y = 3x + 1$ either by writing the equation down or drawing the correct line. A small number drew an incorrect line through (0, 1). Those with the correct line usually gave an answer within the acceptable range although a few gave the y co-ordinate of the point of intersection.

(ii) It is necessary to eliminate the fractions from the given equation and some candidates found this challenging. The most efficient method is to multiply both sides of the equation by $2x^2$ and those that chose this method often produced the correct equation in the form necessary to be able to compare the coefficients. Those that multiplied both sides by x^3 or $2x^3$ or multiplied through in stages or put the left-hand side over a common denominator often made at least one error. This part was sometimes omitted.

Question 6

(a) (i) This was answered very well with most candidates scoring full marks. A small number made a mistake in recalling the cosine rule, such as omitting the 2 or making a sign error. There were a few who did not evaluate the expression correctly after a correct substitution.

(ii) Most candidates also answered this part correctly. Some candidates gave the correct implicit form for the sine rule but made an error when transposing into the explicit form. A few candidates made an error when substituting into the sine rule which usually involved using $AC = 8$.

(b) (i) Most candidates quoted the formula, area = $\frac{1}{2}ab\sin C$ and substituted correctly to earn the first method mark. A small number attempted to use area = $\frac{1}{2} \times \text{base} \times \text{height}$ but often wrote down the height as $\frac{1}{2}(x + 4)$ without justifying this by using $\sin 30°$. Most candidates worked successfully through their working although many lost the accuracy mark by omitting brackets or, less often, a zero. Those earning full marks often used a method of removing the fractions by multiplying both sides of their equation by 4 before multiplying out the brackets.

(ii) Most candidates quoted the correct formula for solving quadratic equations and also made the correct substitutions. There were some sign errors seen and a small number of candidates who did not draw either the division line or the square root sign long enough. The calculation was usually carried out correctly but many candidates gave the negative value as –10.1. There were a few who gave both final values to one decimal place. A few clearly used the equation solver facility on their calculators and either showed no working or contrived working.

(iii) Almost all candidates added 4 to their positive value in the previous part. A small number attempted unsuccessfully to calculate DE without using a value of x from the previous part.

Question 7

(a) (i) This part was well answered. The only error seen occasionally was to give the answer 1.

(ii) Most of the candidates applied the functions in the correct order and scored full marks. Others started well but $27^{\frac{1}{3}} = 9$ was common. Some rounded the index fraction $\frac{10}{30}$ to a decimal such as 0.33 and this led to an inaccurate answer.

(iii) Many candidates started correctly but made errors in manipulating the algebra usually with the negative sign. Some left their answers in terms of f(x). There were a few answers of $\frac{1}{7-2x}$.

(b) This part was very well answered. A few wrote the function 'g' in their working and some wrote $\frac{10}{x}(2x+1)$. Of those who correctly formed the equation, the only common error was to write $8x + 1 = 10$ rather than $8x + 4 = 10$ when removing the fraction.

(c) The majority of candidates were able to write the sum of the two algebraic fractions and then to simplify it. Most of these candidates obtained the correct numerator and the common denominator in their working. For some, errors were seen in the simplification of this fraction and it is important in algebraic manipulation questions like this that the final answer is correct and always given in its simplest form.

(d) This part proved more challenging. More able candidates often gave the correct answer without any working and others used more complicated method such as logs which is beyond the syllabus but is acceptable. Incorrect methods included dividing 19683 by 27.

Question 8

(a) (i) This part was well answered. There were occasional sign errors giving answers such as $\frac{m+7}{5}$ or $\frac{7-m}{5}$.

(ii) Many candidates answered this well giving either of the two forms of the correct answer $\sqrt{\frac{y^2-h}{2}}$ or $\sqrt{\frac{h-y^2}{-2}}$. Some found the algebraic manipulation challenging. Sign errors were quite common and operations were often carried out in the wrong order e.g. $2p^2$ was often followed by square root and then division by 2. Others gave an otherwise correct final answer with a short square root sign not enclosing the denominator of the fraction.

(b) (i) This part was often correct and if not, the answers given were usually $\begin{pmatrix} 5 \\ 0 \end{pmatrix}$ or the matrix $\begin{pmatrix} 0 & 0 \\ 0 & 5 \end{pmatrix}$.

(ii) There were many correct answers and also a number of errors in this part. Sometimes values were reversed or signs were incorrect. Others added or multiplied the co-ordinates of A and B and some answers were given as 2 by 2 matrices.

(iii) This part proved challenging for many candidates, although the most able answered this well. Marks were often gained for the radius or the length of AB but the main difficulty for some was in evaluating the angle subtended by the arc and often a value of 45° was used. Those who were successful used the cosine rule with triangle AOB, or used trigonometric ratios with right-angled triangles. Many were able to gain method marks for use of the correct formula for arc length but some used the formula for sector area. Several final answers in otherwise correct solutions were slightly incorrect due to premature rounding within the calculation.

Question 9

(a) Most candidates attempted to find the speed by dividing 7.6 by the time for Car *A* to complete one lap in order to find the speed and many went on to give the correct answer. There were some who did not work to a sufficient degree of accuracy when converting the time into hours, so division by 0.04 or 0.044 was seen quite frequently. The most straightforward method is to divide 160 seconds by 3600 and, holding the result of this on the calculator, divide this into 7.6.

(b) (i) Candidates found this part very challenging, with very few giving the correct answer. The small number who identified that the most efficient method involves finding the LCM of 160 and 145 usually obtained the correct answer. A very small number of candidates received some credit by writing down multiples of 160 and 145. The rest were unable to make much progress with any alternative methods that were significantly longer and more difficult. However, many earned a method mark by calculating the speed of car *B*.

(ii) Although having an incorrect answer to the previous part, many candidates gave the correct method for calculating the distance that car *A* had travelled at the time they had calculated. So, it was very common to see the answer to **part (a)** multiplied by the answer to **part (b)(i)**. In most cases the time was given in hours, or given in minutes and then divided by 60 but some left the time in minutes.

MATHEMATICS

Paper 0580/43
Paper 43 (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 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 answers written to an appropriate accuracy.

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

General comments

The standard of performance was generally good with most candidates attempting all questions. Some candidates showed working with stages that could be easily followed. In other cases, candidates omitted some stages or did not show calculations at all. For some candidates, improving presentation would help, as there were instances where candidates miscopied their own figures.

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

Some candidates lost marks by approximating values prior to the final answer. This was apparent, for example, in **Question 4** with cosine and sine values being written to just two figures. The requirement for accuracy to two decimal places in **Question 10** was often missed.

The topics that proved to be accessible were ratio, percentage decrease, compound interest, basic algebra techniques, change of subject, transformation geometry, plotting points and drawing curves, finding the mean of grouped data, interpretation of a cumulative frequency curve, using the sine rule and simple functions.

More challenging topics included average speed, tangent and gradient, area of a quadrilateral, bearings, angles in circles, sectors, surface areas and volumes of similar solids, generating and solving a quadratic equation, vector geometry and inverse functions.

Comments on specific questions

Question 1

(a) (i) Many correct answers were seen from candidates of all abilities. Some did not read the question carefully enough and calculated the number of males. A few mistakenly divided the 342 by 11 instead of 3.

(ii) Although the simple approach would have been to find 3 parts as a percentage of 11 parts, many chose to use their calculated answer from the previous part. Many did so correctly but those with an incorrect answer did not achieve a correct answer to this part. Several candidates did not give an answer correct to three significant figures or more.

(b) The vast majority of candidates had a good understanding of percentage discount and many correct answers were seen. Roughly equal numbers opted to calculate 85% of the price as did 15% of the price. Some who calculated the discount then forgot to subtract it from the price or did so incorrectly. A small number treated this as a reverse percentage question.

(c) Although this proved more challenging, a significant number understood the method for calculating a reverse percentage. Those that recognised that 79.50 was 106% of the original number of candidates almost always went on to obtain the correct answer. Some had not taken enough care when reading the question and answers of 75, the previous cost of membership, were common. Reducing, or increasing, 79.50 by 6% was a common error.

(d) This proved to be more demanding than the other parts and this was reflected in the number of incorrect responses. More able candidates generally reached the correct answer. Calculating the total time for the journey produced many errors with the calculated time of 2.25 hours added to the given time of 2 hours 24 minutes to give an incorrect total, usually one of 4 hours 49 minutes or 4.49 hours. Many of the less able candidates calculated the speed for the first part of the journey and found the average of the two speeds.

(e) Candidates had a good understanding of compound interest with most using the formula to obtain the answer. Some carried out year-on-year calculations which sometimes led to inaccurate answers either due to premature rounding or use of an incorrect number of years. A number of candidates treated the question as if it involved simple interest.

(f) Many candidates correctly identified the lower bounds of the two variables and went on to calculate the lower bound of the distance. The most common error was evaluating the distance from the given values and then finding the lower bound of that distance.

Question 2

(a) (i) Candidates were asked to show $3a + 5b = 170$ and $a + 2b + 3b + 10 + 2a = 180$ was the required starting point. Many correct answers were seen, although several started from $3a + 5b + 10 = 180$.

(ii) Again, many correct answers were seen with some starting from a partially simplified expression as in **part (a)(i)**.

(iii) Candidates had a good understanding of simultaneous equations and most were able to solve them correctly. The elimination method was commonly used but a significant number used a substitution method which tended to produce more arithmetic slips due to the introduction of fractions.

(iv) When the answer to **part (a)(iii)** was correct it was common to see a correct answer for the smallest angle. Some did not appreciate what was required and simply identified the smallest angle by giving an answer of $2a$.

(b) Almost all candidates were able to solve this equation. Most errors stemmed from incorrectly dealing with $–12 + 3$, usually given as 9.

(c) Most candidates understood the steps involved in rearranging the given equation and many correct answers were seen. Dealing with the negatives produced most of the errors; some were just lost in the rearrangement while others did not change when moving terms across the equation.

Rearranging $8x – 2y = 5x – 3$ to $2y = –3x – 3$ and rearranging $– 2y = –3x – 3$ to $y = \frac{-3x-3}{2}$ were just two of the typical errors.

(d) More able candidates had no difficulty in working with the indices and most achieved the correct result. Less able candidates were more likely to apply the rules of indices incorrectly. Most errors involved the coefficient of 27 and it was common to see 27 multiplied by $\frac{2}{3}$. In a few cases, candidates applied only part of the power, either squaring or cube rooting and omitting the other.

(e) Those candidates that realised that factorisation was required to simplify the fraction usually did so without error. Where errors were seen it was common to see $(x – 5)^2$ used for the denominator. Many of the less able candidates did not appreciate the need for factorisation and it was common to see the x^2 terms being cancelled.

Question 3

(a) The vast majority of candidates completed the table correctly. Calculating the value of y as 3 for $x = –1$ was the most common error.

(b) Many candidates plotted the points correctly and drew an acceptable curve. Plotting (–3, –3) at (–3, 3) was sometimes seen but missing plots or incorrectly plotting at (1.5, –1.9) and (2.5, 9.4) were more common. Very few joined up the points with ruled lines and, if seen, usually occurred in the first and last segments of the curve.

(c) A good number of correct solutions were seen. Some candidates did not appear to understand that they were looking for the points of intersection of the curve with the x-axis. Many of the incorrect responses gave solutions that were not close to their points of intersection, such as –1, 2 and 5. A higher proportion of candidates made no attempt.

(d) A majority of candidates were able to draw an accurate tangent and many went on to calculate its gradient correctly. In a lot of cases, tangents were not touching the curve, crossed the curve or were drawn at the wrong point. Misreading the scales was a cause of many of the errors in calculating the changes in x and y. Numerical slips were also seen, largely because of the negative values used. Some less able candidates made no attempt at this part.

(e) Only a minority of candidates gave the correct value of the integer k. Writing $k = 21$ was by far the most common error with candidates seemingly ignoring the fact that the equation had to have three solutions. Several non-integer solutions were seen.

Question 4

(a) Although good solutions were seen many candidates found this challenging as there was no diagram showing the post. Many drew sketches but not all were labelled correctly. The majority of correct responses used the tangent ratio with a small number using the sine rule. A high proportion of candidates made no attempt.

(b) A majority of candidates showed their working clearly and obtained the correct value for the angle. Some started with $107^2 = 132^2 + 158^2 – 2 \times 132 \times 158 \times \cos A$ and then rearranged it incorrectly trying to obtain an expression for $\cos A$. Others had a correct statement of the cosine rule for an angle other than A and some stated the cosine rule incorrectly. A small number gave the final answer as an integer.

(c) Candidates were more successful when using the sine rule and a greater number of correct responses were seen. As in the previous part, errors were seen when rearranging the rule to obtain an expression for $\sin CAD$.

(d) Fully correct answers were in the minority although some candidates earned partial credit for a correct method for the area using their incorrect angles from the previous two parts. Those candidates using $\frac{1}{2}ab\sin C$ were generally more successful although some slipped up by using angle CAD instead of angle ACD. Some candidates used the sine rule to calculate AD and then used the angle CAD. Several candidates attempted to calculate a correct perpendicular height for each triangle but did so by assuming the height bisected the base. A high proportion of candidates made no attempt at a response.

(e) This part proved challenging and only a minority found the correct bearing. Some candidates found the reverse bearing from C to A. Many of the other attempts showed no obvious pattern to the errors that were seen.

Question 5

(a) (i) The median was stated correctly by the vast majority of candidates. Misinterpreting the scale on the horizontal axis was common and 46 was the common error. A few candidates gave the cumulative frequency of 30 for the median value.

(ii) Again, many correct answers were seen. Misreading the scale and giving the cumulative frequency were the common errors again.

(iii) Although many candidates obtained the correct value for the interquartile range, fewer correct answers were seen than in the previous parts. As well as similar errors to those in the previous two parts, some gave incorrect answers such as 36 – 62 while others gave the value of the lower quartile.

(b) There were many incorrect responses, most of which did not involve a comparison in context. Candidates were expected to comment about the greater variation in the distances travelled by the group of women. Some typical incorrect comments included 'female cyclists have a larger distribution' and 'females travelled further than males'. Other comments made reference to the strength or fitness of the female cyclists compared with the male cyclists.

(c) Many candidates had no difficulty in finding the probability. Common errors included the probability that the distance travelled was less than 50 km and, in some cases, candidates misread the vertical scale.

(d) (i) Completing the frequency table was answered well. Occasionally candidates misread the scale and this led to values close to the correct values. In some cases, the values were a long way out, giving total frequencies a lot different from 60.

(ii) Calculating the mean of grouped data was well answered with most candidates showing a clear and accurate method. If the answer to **part (d)(i)** was correct then the working usually led to the correct mean. A small minority of incorrect answers resulted from the use of either the upper bounds of the intervals or use of the interval widths.

Question 6

(a) (i) Only a minority of candidates were able to show angle *AOC* = 104° with fully correct reasons. Many showed a jumble of calculations with no angles clearly defined, either by labelling or by marking on the diagram. Some did identify the angles but their reasons were frequently incomplete or incorrect. Some incorrect statements included 'angles in a quadrilateral add to 180°', 'angle at the centre is twice the angle at the circle'.

(ii) Candidates were far more successful in this part and a majority of candidates obtained the correct answer. There was a variety of methods available to choose from and all of them were seen. Errors arose when candidates made incorrect assumptions, typically that angle *BAD* and angle *BCD* were right-angles.

(iii) This part proved more demanding and only a minority of candidates obtained the correct angle. Many did not use the fact that angle *ABD* and angle *ACD* were subtended by the same arc (or chord). Instead, some successfully worked out the angle by considering angles from various triangles and quadrilaterals. A common error was to assume that *BD* bisected angle *ABC* giving 26° as a common incorrect answer. A very high proportion of candidates made no attempt at a response.

(iv) Very few candidates were able to calculate the correct perimeter. Some attempts used the area formula instead of the formula for circumference. In a lot of cases, it seemed that the word 'sector' had been overlooked or ignored as many candidates attempted to find the perimeter of the quadrilateral *OADC*. A very high proportion of candidates made no attempt at a response.

(b) (i) More able candidates could show a clear method and almost always obtained the correct cross-sectional area. Less able candidates clearly had some idea of the different scale factors but frequently applied the wrong powers when going from volume to length to area. Common incorrect working included $36 \times \frac{2187}{648}$ and $36 \times \sqrt[3]{\frac{2187}{648}}$.

(ii) Candidates were far more successful in this part. Good responses showed clearly presented working that often led to the correct radius. Having reached $r^3 = 522.1$ some continued by taking the square root. Less able candidates could make a start but some made errors in rearranging the formula to find r.

Question 7

(a) Many correct answers were seen in this part. Reflection in either the x-axis or the line $x = -1$ were the two most common incorrect answers. Only a few responses suggested two transformations, reflection in the x-axis followed by a translation.

(b) (i) Many correct translations were seen with some candidates earning partial credit for a translation with a correct displacement in one direction. Some candidates treated the translation as $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$.

(ii) Many correct rotations were seen. Some carried out a correct rotation about a wrong centre.

(iii) Although a majority of correct enlargements were seen, candidates were generally less successful in this part. Enlargements with scale factor 2 about a wrong centre were common. In a lot of cases candidates drew the enlargement so that one of the vertices of the trapezium was placed at (–7, 0).

Question 8

(a) (i) Many correct answers were seen in this part. Common errors included the addition of the two probabilities, just giving the answer as $\frac{4}{6}$ and a few used with replacement.

(ii) Candidates were less successful in this part. Those that realised the two events in **part (a)** were mutually exclusive almost always obtained the correct answer. A number of candidates misinterpreted 'not both red' as 'both not red' and an answer of $\frac{1}{15}$ was seen.

(b) Only the more able candidates could make much progress and fully correct responses were in the minority. Some candidates attempted a tree diagram but, in many cases, the diagram did not reflect the events described in the question. A few candidates realised that obtaining three blues was mutually exclusive with the required outcome and used this approach successfully. The remaining correct responses came from those that identified the three relevant outcomes as G, BG and BBG. It was common to see candidates ignoring the probabilities of picking a blue and concentrating on the probability of a green on the first, second and third picks. This often led to the probabilities $\frac{2}{7}$, $\frac{2}{6}$ and $\frac{2}{5}$ being multiplied and in some cases added.

Question 9

(a) (i) Almost all candidates calculated the value of the function correctly.

(ii) Many correct responses were seen in this part also. Most candidates evaluated g(3) as their first step and then substituted its value into the function h(x). Common errors usually involved answers of 0 or 3. Few attempted the composite function hg(x) as a first step and when seen it was often incorrectly given as $3^x(9 - x^2)$.

(iii) Although many correct answers were seen the incorrect answer $9 - 2x^2$ was extremely common.

(iv) The composition of two functions, fg(x), was more challenging but a majority of candidates answered this part well. Errors frequently occurred in simplifying $2(9 - x^2) - 3$, either forgetting to multiply the square term by 2 or dealing with the negative terms incorrectly. Some gave their final answer as $2x^2 - 15$. Many of the less able candidates took the composition to be a product of the two functions.

(b) Finding the inverse of a linear function was well answered. Sign errors were common when rearranging the terms, particularly from less able candidates. A number of candidates did not earn full credit as they left an otherwise correct answer in terms of y. Some others gave the answer as the reciprocal of $2x - 3$.

(c) This was generally well answered with most candidates expanding $5(2x - 3)$ and following through to a correct answer. Common errors usually involved either incorrect expansion of the bracket, usually $10x - 3$, or occasional slips in the rearrangement.

(d) Candidates found this part challenging and only a minority were able to obtain the correct solutions. Most candidates opted to expand and simplify their terms whilst some opted to rearrange the equation to the form $(2x - 3)^2 = 25$ and then square root. This left straightforward algebra to find the solutions. Expansion and simplification of $9 - (2x - 3)^2$ produced many errors as it often appeared as $9 - 4x^2 - 12x + 9$ and in some cases as $9 - 4x^2 - 9$.

(e) Success in this question was largely dependent on the algebraic step of moving from $h^{-1}(x) = -2$ to $x = h(-2)$. This was rarely seen and only a small minority obtained the correct answer. The log function was used in a very small number of cases with limited success. Several candidates treated the inverse function as the reciprocal function. A high proportion of candidates made no attempt at a response.

Question 10

This proved to be challenging for many candidates and this was reflected by a minority of correct responses. Most recognised that they needed to eliminate the fractions but were not able to do so correctly. Common errors at this stage included multiplying only one side of the equation by the common denominator. Some opted to write the two terms on the left as a single fraction, quite often successfully, before cross-multiplying. Expansion of the resulting brackets often caused difficulty and it was common to see $x(x + 1)$ expanded as $x^2 + 1$. Rearrangement of the resulting terms often included errors with the signs and reaching the correct three-term quadratic equation was rare. When candidates did reach a three-term quadratic fewer errors were seen in their attempts to solve it. Some of those with a completely correct method tended to give both answers correct to three significant figures, perhaps having forgotten the instruction asking for two decimal places.

Question 11

(a) (i) A majority of candidates were able to give the correct vector. Some did not allow for directions and $8\mathbf{b} + 4\mathbf{a}$ was a common incorrect answer. A few candidates gave the reverse vector. A significant number of candidates made no attempt at a response.

(ii) Candidates were more successful in this part. Some did not simplify their answer as required and seeing $\frac{3}{4}8\mathbf{b}$ was quite common. A significant number of candidates made no attempt at a response.

(iii) A small majority of candidates were able to give the correct vector. Again, some did not allow for directions and $6\mathbf{b} + 2\mathbf{a}$ was a common incorrect answer. A high proportion of candidates made no attempt at a response.

(b) Candidates who were successful in the earlier parts tended to be more successful in finding a vector for B to C which usually led to the correct ratio. As in previous parts, some candidates did not allow for directions of vectors. When answers were incorrect it was difficult to award part marks as candidates did not clearly identify the method or routes they were using. This part had the highest proportion of candidates that made no attempt at a response.