MATHEMATICS

Paper 0580/12
Paper 1 (Core)

Key messages

All calculations will be simple; if a calculation is arrived at that would need a calculator, it is almost certainly wrong.

Check all answers to see if they are sensible for the context of the question.

General comments

While the response to this first non-calculator paper was generally very good, many were doing long calculations for multiplication and division that were often incorrect and took up too much time, resulting in many cases of rushing later in the paper.

Where diagrams are in questions, answers were often unrealistic for the situation. While ‘not to scale’ indicates lengths and angles should not be measured, the data given is quite close to the lines and angles shown or worked out.

While blank pages may be used if needed, it is strongly advised that question reference is made to work on them.

Comments on specific questions

Question 1

Nearly all could correctly write the number in figures, but a few had the incorrect number of zeros, usually 2000 or 200 000. A few gave 25 000.

Question 2

(a) Most candidates gave the correct percentage, but common errors were 70 and 700.

(b) Again, most responses were correct for the fraction but there were quite a number who gave $\frac{7}{10}$, $\frac{70}{100}$, $\frac{1}{100}$ or $\frac{0.07}{100}$.

(c) Standard form caused more problems, although those who understood the topic usually found the correct answer. There were a wide variety of answers involving a power of 10 such as 7×10^{-3}, 7×10^{2}, 0.7×10^{-3} or 0.7×10^{-1}. It was also common to see 7^{-2}.

Question 3

Listing the factors of 18 was well done but missing out 1 or 18 was quite common. Some thought they had to give 18 as a product of prime numbers, often resulting in $2 \times 3 \times 3$.

Question 4

(a) This was very well done with only a few candidates giving 10 000 or 30 for the answer.

(b) Most understood cube root. The answer of 9 was often seen. Writing 3^3 as the final answer demonstrated understanding but it was not the required answer.

(c) This regularly asked question was answered very well but some candidates gave 0 or 7. A few cases were seen of 7^1 and $\frac{1}{7}$.

Question 5

(a) While many gained the 2 marks, there were a significant number of candidates who added diagonal lines. While there were some attempts to erase these, it had to be clear to score. Some responses showed a lack of understanding of symmetry with lines from all vertices or just a rectangle in the middle of the shape. While good freehand was condoned, some of the responses clearly showed lack of concern about quality while others, usually ruled, stretched their mid-points to beyond a reasonable tolerance.

(b) Rotational symmetry was understood by most candidates and the results were again encouraging. There were various incorrect choices of the square to shade and the top, right-hand corner was a particular case. A few did not read the question carefully, deciding that there should be more than 1 square shaded, usually 2 squares.

Question 6

Some candidates had a good understanding of reciprocal. While most responses gained some credit, a significant number did not reach the final value of the reciprocal, leaving the answer as $\frac{100}{25}$ or $\frac{1}{0.25}$.

Just changing 0.25 to a fraction was a common error, as was $\frac{1}{25}$.

Question 7

This question was well done. It was rare for 7 to be added before multiplying it by 2, but many candidates gave −18 instead of 18 for the first calculation.

Question 8

There were a good number of correct answers, in which it was clear that the majority had shown some working to change the numbers to decimals. Some were not clear about the value of π (3.14 was sufficient accuracy for comparison) and placing π before 3 was often seen. Others took π as 0.314, making it the smallest. An error was to regard 34% as 34 and so it was often seen as the largest item while, more significantly, $\frac{1}{3}$ and $\frac{3}{10}$ were confused, with $\frac{1}{3}$ often written as the smaller value.

Question 9

There was a very good response to adding on a time period, although a few gave a finishing time which was before the film started. Some confusion was evident about which system for time was intended and unfortunately those working in the 12-hour system often did not give the essential pm. The common error of thinking there were 100 minutes in one hour was seen a number of times, resulting in an answer of 20 05.

Question 10

(a) The area could be done by counting squares or using the formula for the area of a trapezium or separate triangle and rectangle. Most correct answers seemed to come from counting squares. Most incorrect answers were either 22 or 28, the latter simply the area of a rectangle, 7×4.

(b) Those who had correctly answered part **(a)** usually managed the shading correctly since they could see that 10 squares were 50% of the area. Some misread the question by shading inside and outside the shape while a significant number did not attempt any shading.

Question 11

(a) Those who realised that the calculation in the box gave all the figures in the answer, usually gave a correctly positioned decimal point. Many however attempted a long multiplication calculation, ignoring the information given to them in the question. Those who did such work took up far too much time and more often than not got an incorrect answer.

(b) Many of those who spotted the way to answer part **(a)** were successful here. Even then, quite a few had the decimal point incorrect with responses of 1.95 and 195. Even promising attempts at long division resulted in incorrect answers or stopped at 19.

Question 12

(a) The vast majority of candidates followed the method of the example to an easy calculation for the correct answer, although 450 was seen. However there were a number of candidates who added 29 to 21 and gave the result 40. Some referred to the example, but did not replace the 13 for 21, while some candidates multiplied the values in the brackets.

(b) This was answered poorly by many candidates, with a significant number not attempting it. The most successful method was to subtract the areas of two rectangles to give the shaded area. Just a few saw that the example at the top of the page gave the answer to this. However, there were some successful calculations by splitting the end into two or three rectangles. Most did know that they had to multiply by 100 once they had the area but there was no independent mark for that.

Question 13

Less than half of the candidates knew the conversion factor to change litres into cubic centimetres. While some did not know that they had to multiply by a multiple of 10, most incorrect answers were 800, 80 or 800 000. A small number thought they had to divide by a multiple of 10 so 0.8 and 0.08 were seen.

Question 14

(a) Most candidates recognised 5 faces on the prism, but 6 was a very common response for the number of edges since the hidden edges were not included. Also quite often 4 faces and 6 edges was seen.

(b) Many recognised that the length *BC* could be found by halving the base, thus forming a right angled triangle. Usually that resulted in the 2 marks but some did not show that the 5 had to come from $\sqrt{25}$ and so left the working at $3^2 + 4^2 = 25$. Those who tried to work with $6^2 - 4^2$ could not achieve any marks since $\sqrt{20} \neq 5$.

(c) Few candidates were able to achieve marks for this question. Many were reluctant to put the two triangles against the opposite sides of the square base and although one below was possible, the other one then would not fit on the grid. Some had no triangles at all, while others had incorrect size triangles. Two rectangles below the given base often gained marks but quite often these rectangles were 6 by 4 or 6 by 6 ones when two of those would not fit on the grid. While most made an attempt at a net there were some who tried to draw a 3-D shape or put triangles on top of the given base.

Question 15

(a) A clear majority of candidates knew the type of triangle with 3 equal sides. However, a significant minority did not realise the markings on the 3 sides indicated that they were equal and consequently, or from how the triangle looked, gave the response isosceles.

(b) It was rare for those who got the mark in part **(a)** to fail to get the correct value for angle *y*. Others often gained those 2 marks as they still gave angle *DBC* as 60°. Of the two reasons, many gained the mark for angles on a straight line added to 180°, although omission of one of the key words, 'angles', 'line' and '180' lost that mark. The final mark was often lost by referring to sides being equal, already shown in the diagram, rather than angles, which was the required first step to find angle *y*. References to interior and exterior angles were not enough alone.

Question 16

(a) While a few did not know the standard words used to describe correlation, almost all did have the correct answer. A very small number gave 'negative' while some tried other words, which were not acceptable.

(b) The description was well done by the vast majority, although some did just repeat the word 'positive' here. This did need a statement interpreting the situation indicated in the diagram. Some suggested that while one increased, the other decreased.

Question 17

(a) While there were some successful calculations to find the gradient, many did not realise that their result was *m*, the coefficient of *x* in the equation. Often a correct calculation of $\frac{1}{2}$ became 2 in the answer, while calculating the gradient to be $\frac{2}{4}$ and putting that in the equation was not accepted. Some just gained a mark for +3, recognising the intersection point on the *y* axis, although this mark was not awarded without an attempt at the first part of the equation.

(b) While many seemed to recognise where a continuation of the line would meet the *x*-axis, having the incorrect answer, (0, −6) was more often seen than the correct way round. Some correct answers were found from working out *x* from $y = 0$ in the equation but that depended on part **(a)** being correct. Quite a number did recognise that the second coordinate was zero, but couldn't work out the correct value of the first coordinate. Other common incorrect answers were (6, 6), (4, 5) and (7, 8).

Question 18

(a) The straightforward substitution into the equation was done very well. The main error was where $x = -1$ and $x = 1$ but also some seen at $x = -6$ and $x = 6$.

(b) Plotting of the points and drawing the curve was quite well done with the full 4 marks being scored by many. The main error was where $y = 3$ and -3 had to be plotted which needed to be clearly between two grid lines and not on either of those lines. The curve needed to go through the correct points and have no clearly ruled sections. Some lost the curve mark by crossing either or both of the lines $x = -1$ and $x = 1$. Regardless of the shaded gap in the table, some joined the two sections of the curve.

(b) Many realised the line was halfway between 8 and 10 and so drew a correct ruled line between $y = -8.8$ and $y = -9.2$. Some could not accept drawing a line that was not along a grid line. The line had to go to the extent of the grid and this was often not the case with some only drawn in one section of the graph. A few drew $y = 9$ or $y = -11$.

(c) Few candidates answered this question correctly, most responses indicated an answer from the equation and not from their graph. Some missed the minus sign from the answer and 108 from 12×9 showed no understanding of the question.

Question 19

(a) All 4 numbers were seen by many candidates but 15 was often missed as some did not appreciate the difference between the two inequality symbols. Others included 7 or gave all numbers, not just the odd ones. An often error was to just give one value.

(b) Many candidates concentrated on correcting the question rather than criticising the solution that Pip gave so gave responses such as 'the circles should not be shaded'. A full solution had to show that both ends of the range needed the signs to indicate less than or equal to. Just giving the correct inequality was minimal, but for the 1 mark it was accepted.

Question 20

Around half of the candidates gave the correct bounds. A common error showing a lack of understanding of the different inequality symbols was the upper bound of 635.4. Other incorrect responses were 635 with 640, 630 with 640 and 635 with 636. A few gained just 1 mark for the correct answers reversed.

Question 21

(a) Nearly all realised the values had to be substituted and then the terms multiplied, resulting in most gaining the 2 marks. Some gave the value 10 for 5^2 but the main problem was dealing with the fraction. Many did not realise a multiplication of a third is equivalent to a division by 3 and so a decimal value of the fraction was seen resulting in an inaccurate answer. Working out 25×6 or dividing 6 by 3 first generally resulted in both marks gained.

(b) Changing the subject of the formula was a problem for most candidates. X was often seen in the denominator and more common was the use of the square root symbol in the transformation of the formula since some thought w^2 had to become w.

Question 22

The subtraction of fractions was quite well done but errors were seen at various stages. Most changed the mixed number to the correct improper fraction but $15 \times 1 + 7$ did not always give 22. The obvious common denominator of 15 was often not used and some errors resulted when for example 75 was chosen, with some getting 65 from 5×15. A few reached the fraction $\frac{10}{15}$ but did not cancel to its lowest terms or if they did it was incorrect, for example $\frac{5}{3}$.

Question 23

(a) While the tree diagram was completed well by most candidates there was clearly some misunderstanding of the topic. Some had branches with whole numbers entered rather than fractions or decimals less than 1. Many gained 1 mark for $\frac{9}{10}$ on the first branch but then had $\frac{9}{10}$ and $\frac{1}{10}$ reversed on the second branches. $\frac{2}{10}$ rather than $\frac{9}{10}$ was often seen.

(b) Some of those scoring correctly on part **(a)** gained marks here but most either added instead of multiplying or multiplied incorrectly, $\frac{2}{10}$ or $\frac{1}{20}$ were examples but other incorrect results were also seen.

(c) Many candidates recovered on the final part and the expected number was quite well done. However, many gave an answer of 3, 30, 3000 or even 1000 or 600. Unfortunately, some misinterpreted the question and gave the answer as a probability instead of number of batteries since $\frac{300}{3000}$ was seen a number of times.

Question 24

Many candidates lost a mark on this question as they did calculations with a value of π, ignoring the instruction to give answers in terms of π. While a mark for $2 \times \pi \times 7$ was gained, some did area instead of circumference, even though both formulas are listed. Taking the perimeter of the square as x or $2x$ were seen and even those reaching an answer of $\frac{14\pi}{4}$ lost a mark for not cancelling or changing to a decimal.

Question 25

The similar triangles question was well understood and most candidates gained the mark. However, it was a show that question meaning the clear method had to be seen. Just to say it was two times bigger or that 5 + 5 = 10 so 7 + 7 = 14 were not sufficient. Those who didn't understand the topic often manipulated the numbers, 24 – 10 = 14 for example.

Question 26

While most candidates were clearly familiar with simultaneous equations, this question was not done well by many. The main problem was not the method used so much as poor manipulation of directed numbers. Errors in the signs, subtracting one side of the equations while adding the other side was seen regularly after a promising start on the elimination method. Those choosing substitution usually gained the first mark and often the second, but correct working through where fractions were involved was very rarely successful.

A very common error following success with elimination was to have $26t = 13$ but then to give $t = 2$. Some did gain a mark for correctly substituting their incorrect value into an equation to find the other variable. However, many values were usually too complex to successfully work out a sensible value for the other variable.

MATHEMATICS

Paper 0580/22
Paper 2 (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 be able to apply mathematical skills in a wide variety of situations. Candidates are advised to work on their non-calculator skills to ensure the most efficient and easiest calculations are used. Candidates are advised to ensure that they show their method, even for simple operations, in case they make an arithmetic error.

General comments

The paper was found to be more challenging than last year with candidates scoring across the full mark range. In general candidates presented their work well, with few instances where the answers could not be read clearly. There was no sign of candidates being unable to complete the paper in the time allocated.

Candidates need to focus on efficient arithmetic strategies for a non-calculator paper as this was a weak point for quite a few candidates. There were a number of questions where students attempted to perform calculations in the same way that they would with the assistance of a calculator, and it was apparent that greater familiarity with non-calculator methodologies would have been beneficial.

In questions where a diagram is required, it was evident that a few candidates were not well equipped and freehand lines, drawn in ink rather than pencil, were occasionally seen.

Candidates are advised in all questions to check their answer makes sense for the context of the problem. For example, in **Question 8(b),** reaching an answer of 360 and not realising that was greater than the total number of games.

Comments on specific questions

Question 1

This was very well done with only a few candidates multiplying 22 by 9 and forgetting to include the zero.

Question 2

Most candidates answered this question correctly, with the most common incorrect answers being 3 h 38 min or 3 h 22 min, rather than 2 h 38 min.

Question 3

Candidates found this question challenging. Those not giving the correct shape usually gave another quadrilateral, the most common being rhombus, parallelogram or trapezium. Some candidates gave shapes that were not quadrilaterals such as a triangle.

Question 4

(a) Most candidates answered this correctly. Where mistakes were made, it was typically reaching the common incorrect negative answer –360 or forgetting to square the value of p or squaring it incorrectly.

(b) This part was usually answered correctly, although some candidates forgot to square root or stopped at $\sqrt{400}$ without simplifying. A small number were hindered by making arithmetic slips in evaluating $3200 \div (2 \times 4)$ or only divided 3200 by either 2 or 4, rather than both.

Question 5

This question was generally well answered, with most candidates correctly being able to convert the lengths to a consistent unit, the most common choices being metres or centimetres. Many correctly placed three of the lengths in the correct order. Common errors included the incorrect conversion of 32mm to 0.32cm or 0.0032m and less frequently, but regularly seen, the conversion of 0.03m to 30cm instead of 30mm. Many found the conversion of 0.00002km the hardest.

Question 6

Most candidates were able to correctly obtain the required area. It was common to see the formula $\frac{15+9}{2} \times 8$ for the area of a trapezium used, however splitting the shape into a rectangle and a triangle was also a common approach. Where errors were seen, this commonly included incorrect substitution into the formula for the area of a trapezium, including the use of 10, or substitution of values into the incorrect position within the formula, often using adjacent sides rather than parallel sides for the two sides to add. Errors in arithmetic meant that a small minority of candidates had a correct method, but an incorrect answer.

Question 7

Many candidates correctly identified the inequality required, though some mixed up the meaning of the unshaded circle and the shaded circle. Consequently, a common incorrect answer was $-3 \le x < 4$. A few candidates wrote 3 rather than –3.

Question 8

(a) It was rare to see an incorrect answer to this question, however a very small number of candidates made place value arithmetic errors when adding 0.3 and 0.25, resulting in 0.28.

(b) Many candidates correctly multiplied the probability of winning by the number of games. A very small number made an arithmetic error performing that multiplication or a place value error or instead of multiplying they divided 0.3 by 120.

Question 9

This question was well answered with only a few candidates attempting to calculate the exact answer. Candidates should be encouraged to check that the square root sign goes below the fraction line when necessary. $\frac{\sqrt{200}}{8}$ was often seen in working instead of $\sqrt{\frac{200}{8}}$; however, most candidates recovered this error with a correct evaluation. Common errors included rounding one of the values incorrectly, which was usually truncating 1.95 to 1 or truncating 9.92 to 9 and very occasionally rounding the denominator to 9.

Question 10

Most candidates achieved some success with this question with many candidates scoring full marks. It was very common to see both interior angles, 120 and 150, found correctly whilst the next stage of finding the number of sides was less well answered. A small number struggled with the arithmetic due to not simplifying their calculations before multiplying, for example $\frac{4}{12} \times 360$ was sometimes worked out as $\frac{1440}{12}$, a much harder calculation, often resulting in arithmetic errors. Of those who correctly found 120 and 150, the most successful candidates then used the easiest approach of finding the exterior angles, 30 and 60, and dividing 360 by each of these to find the number of sides. Far more common, and much less successful, was the use of the formula $\frac{180(n-2)}{n}$ = interior angle.

Question 11

(a) Many completely correct answers were seen with well-drawn, ruled and shaded diagrams. For those who did not gain 2 marks, the majority obtained 1 mark for correctly calculating that 85% of the items were sold on the website, either by showing a correct height on the bar or showing 85%, or equivalent, in their working. Some bars were drawn at 84 or 86 and without any working, could not be awarded any marks. The most common error was to omit the 15% of the items that were sold in the shop from the top of their bar. A small minority of candidates drew a bar with an incorrect width or omitted the shading. Some candidates were unable to evaluate the calculation $\frac{17}{20} \times 100$ correctly.

(b) This was well attempted with most candidates giving fully correct answers. The most successful candidates chose a method to make the arithmetic easy i.e. not including all the zeros in the calculation, and either used the calculation $3.5 \times 40 \div 100$ or $3.5 \times \frac{2}{5}$. Candidates who attempted to calculate 0.4×3.5 were less successful, usually having a place value error such as an answer of 14 or 0.14. Throughout parts **(b)**, **(c)** and **(d)**, many candidates decided to re-write given values to include all the zeros e.g., 3.5 million as 3 500 000 or used standard form. Therefore, it was frequent to see an incorrect number of zeros or a slip in the number of zeros part way through a calculation, which resulted in place value and arithmetic errors.

(c) This part was also well attempted. Nearly all started by subtracting 6 from 7.5 and some left that as their answer or gave a multiple of that such as 15% or 150%. Some who started with $7.5 \div 6 \times 100$ forgot to subtract 100 to find the increase. Some struggled with the calculation $\frac{15}{6} \times 100$. The most successful approach was to find 150 then divide by 6 either with a division calculation or by cancelling $\frac{150}{6}$ to $\frac{75}{3}$ or $\frac{50}{2}$ then 25. Another successful approach seen was to convert $\frac{1.5}{6}$ to $\frac{15}{60}$ then to $\frac{1}{4}$ or to convert directly to $\frac{1}{4}$. A common incorrect answer seen was 20%, using 7.5 as the original amount.

(d) This was the most challenging part of the question. Those who understood that it is a reverse percentage problem, usually went on to obtain the correct answer. Some set up the correct statement $\left(1 + \frac{30}{100}\right)x = 52$ but were then unable to process it correctly, making either algebraic or arithmetic errors. Some reached $\frac{5200}{130}$ or $\frac{52}{1.3}$ but were unable to evaluate these correctly. Common errors gaining no marks were to find 30%, 70% or 130% of 52 million.

Question 12

(a) Fully correct answers were less common in this question, primarily because of inefficient methods or sign errors. Candidates who used 24 as their common denominator, chose a more efficient method than those who used 384, for example. The vast majority of candidates seemed to prefer to use a method of cross multiplication, rather than considering using a common denominator to reach $\frac{5x}{8}$. Some candidates tried to use a similar approach with all three fractions, which went wrong more frequently. A common incorrect answer was $\frac{13x+4}{24}$ which was a result of the following error $\frac{6x}{24} + \frac{9x}{24} - \frac{2x+4}{24}$ followed by $\frac{6x+9x-2x+4}{24}$. Of those without arithmetic or sign errors, many had problems writing their answer in its simplest form.

(b) The majority of candidates had an attempt at factorising, with many correct answers being seen. However, there were some slips in the attempts to factorise where a sign error was made, the two most common incorrect answers being $(3x + y)(a + 4y)$ and $(3x - y)(a - 4y)$. Other errors commonly seen were writing 4 in place of 4y or x in place of a. There were some attempts that were only partially factorised, such as $3x(a+4y) - y(a+4y)$.

Question 13

Many candidates gave the correct answer to this question. There were also many who were awarded 3 marks as they were unable to evaluate the final answer, leaving it in root form usually $\sqrt{\frac{108}{48}}$, $\sqrt{\frac{36}{16}}$, $\sqrt{\frac{9}{4}}$ or $\sqrt{2.25}$. Some did not cancel π but instead used approximations of π such as 3.14, resulting in a calculation that was even harder to evaluate. Most candidates were correctly able to write the formula for the volume of a cylinder and nearly all went on to substitute the height of 16 into it. However, for the volume of a sphere, many used r^2 instead of r^3 or evaluated 3^3 incorrectly as 9.

Question 14

(a) Most candidates found angle *BCD* correctly and many provided a correct geometrical explanation for this answer. The most common incorrect values stated were 110, 45 and 90.

The most common errors were in the explanation:

- Some candidates described opposite sides, rather than opposite angles, as summing to 180°.
- Other candidates stated that the opposite angles were equal to 180°, without referring to the sum.
- A small number omitted the word ‘cyclic’ when describing the quadrilateral.

(b) (i) Most candidates realised that angles *BDC* and *BEC* were in the same segment and therefore equal, and many went on to find angle *DBC* correctly. A small number incorrectly thought that angle *ADC* rather than angle *BDC* was equal to 45°.

(ii) Most candidates used the alternate segment theorem correctly to find angle *DCG,* this was more often the correct answer but occasionally, a correct follow through from part **(b)(i)**. The most common incorrect answer seen for this part was 45°.

Question 15

(a) The majority of candidates correctly identified the coordinates of point *B*, although some took the vector $\overrightarrow{BA}$ as being $\overrightarrow{AB}$, leading to a common incorrect coordinate for point *B* of (–9, –11). Others subtracted the coordinates of point *A* from the vector, resulting in an incorrect answer of (–1, –13).

(b) (i) Similarly, most candidates were able to correctly answer this question, although a number made sign errors or arithmetic errors which led to an incorrect final answer. A common error was to add the coordinates resulting in $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$. Another common mistake was to find vector $\overrightarrow{AC}$ for which they gained 1 mark. A strategy which would have helped in all parts of this question would have been to draw a sketch of the points and many of these errors may have been avoided.

(ii) Many candidates answered this correctly. The best non-calculator strategy to answer this question was to find $|\overrightarrow{BA}|$ using smaller numbers and then multiply this by 3 but this approach was very rarely seen. A small minority of candidates simply worked out $3\overrightarrow{BA}$ and left that as their answer. The most common mark to award for this question was M2, from correctly writing $|\overrightarrow{EF}| - \sqrt{(-15)^2+(-36)^2}$. A large number made numerical errors in evaluating 15^2, 36^2, the sum of these, or in their attempts to square lots of values to try to reach the square number 1521 with a significant number leaving the answer as $\sqrt{1521}$.

Question 16

(a) This was one of the most challenging questions on the paper with a significant number of candidates finding the range, rather than the interquartile range. Candidates who chose to calculate the positions of the upper quartile and lower quartile were the most successful, provided they remembered to use $n + 1$ rather than n in their calculations. Those that made this error, resulting in 3.25 and 9.75 for the two positions then made things even harder by using linear interpolation to find a quarter of the way between 38 and 40 and three quarters of the way between 38 and 51. More commonly, candidates made errors such as subtracting the positions 10.5 – 3.5 and either giving the answer 7 or then using the 7th position to find the median and giving that as their answer.

(b) This question was generally answered well. In this part, candidates needed to recognise that the situation required calculation of a probability without replacement so the denominators should be 13 and 12. A common error was to forget that the packets could be in either order and so omitted the multiplication by 2, which still scored 2 marks. In a small number of cases, candidates had incorrect working, including some where they were adding fractions and others who obtained answers which were greater than 1. Those who chose to work out $\frac{4}{13} \times \frac{9}{12}$ as $\frac{4}{13} \times \frac{3}{4}$ or $\frac{1}{13} \times \frac{3}{1}$ were more successful in reaching the final accuracy mark.

Question 17

The most successful candidates completed this question in two stages, by expressing the recurring decimal as a fraction and then adding the resulting fraction to $\frac{5}{9}$. The most common error seen in this method involved multiplying 0.28 by successive powers of ten and then subtracting incorrectly due to not making the recurring decimal element cancel e.g., 28.8.. – 2.88… = 25.92. Those not awarded any marks for the conversion were usually misunderstanding the notation of the recurring decimal, treating it as $0.\dot{2}\dot{8}$ becoming $\frac{28}{99}$ or just 0.28 which then became $\frac{28}{100}$ or they simply wrote $\frac{0.28}{1}$. There were many who left their answer unsimplified, some containing a decimal within a fraction e.g., $\frac{7.6}{9}$, $\frac{83.6}{99}$, $\frac{684}{810}$. A small minority attempted a completely decimal approach, but this was rarely successful.

Question 18

(a) For those candidates who knew the exact value of cos 60, this question was answered well. A smaller number of candidates chose sin 30 = $\frac{AB}{18}$ instead. Most showed full working leading to 9, as required. A small number of candidates then simply wrote AB = 9, which could not gain the marks on its own since this was easy to work backwards to reach. For those who reached AB = 9, most candidates were then generally able to access the Pythagoras work required to reach CD, showing clear method. A small number of candidates did not show sufficient working to support their final answer of 10. A small number of candidates incorrectly used BC = $\frac{17}{2}$.

(b) There were many correct answers for this question however, there were several non-responses. Candidates often correctly found the length of BE, but it was quite common for this value to be used as if it were the length DE when finding the perimeter, so $45 + 9\sqrt{3}$ was a common wrong answer. There were a range of correct methods seen for finding length BE. One of the more common methods was to use Pythagoras' theorem on triangle ABE. The disadvantages of this approach were that the arithmetic was harder (squaring 18) and $\sqrt{243}$ needed to be converted to the form $k\sqrt{q}$. Consequently, errors were sometimes seen at that stage in the working. Others used simple trigonometry, which led more directly to $9\sqrt{3}$ but required knowledge of sin 60 (or equivalent). A number of candidates did not write their answer in the required form, leaving $9\sqrt{3}$ as either $\sqrt{243}$ or $\frac{18}{2}\sqrt{3}$.

Question 19

This question was well answered. The most common errors were to shade $A \cap B \cap C$, $A \cup B \cup C$ or $A \cup B \cap C'$.

Question 20

(a) A majority of candidates were able to obtain the correct answer of $14\sqrt{3}$, and a smaller proportion of candidates gave a partially simplified answer of $7\sqrt{12}$ which was awarded the special case mark. The most successful candidates wrote each of 300 and 48 as a product of two factors, one of which was a square number, as their starting point. Some candidates were able to write $\sqrt{300}$ and $\sqrt{48}$ as $10\sqrt{3}$ and $4\sqrt{3}$ respectively but made an arithmetic error in adding these.

(b) The majority of candidates recognised that they should multiply by $\frac{2-\sqrt{7}}{2-\sqrt{7}}$ and there were a high proportion of fully correct answers. Very occasionally, candidates could be seen to add $\frac{2-\sqrt{7}}{2-\sqrt{7}}$ or multiply by $\frac{2+\sqrt{7}}{2+\sqrt{7}}$ or $\frac{\sqrt{7}}{\sqrt{7}}$. More commonly, a mark of 2 was awarded for a result not in its simplest form often $\frac{18-9\sqrt{7}}{-3}$ and more rarely $-6+\sqrt{63}$ or $\frac{3(\sqrt{7}-2)}{1}$. Some candidates started correctly, but then made errors in multiplying out the brackets, and others made errors when attempting to simplify $\frac{18-9\sqrt{7}}{-3}$, often just cancelling one of the numbers in the numerator by 3, –3 or making a sign error. Consequently, common incorrect answers were $-6-3\sqrt{7}$ or $6-3\sqrt{7}$.

Question 21

(a) The majority of candidates gave the correct coordinates. Incorrect answers usually included 5 or 3, such as (0, 3), (0, 5), (–3, 0) and (5, –3). Some found the coordinates of where the graph crosses the *x*-axis i.e., $\left(-\frac{3}{5}, 0\right)$.

(b) This part was well attempted by many. Almost all were able to find the gradient of *AB* is 2 and most of those then correctly found the gradient of the perpendicular as $-\frac{1}{2}$. For some this was as far as they went, or they found the equation of a line through either *A* or *B* with a gradient of either 2 or $-\frac{1}{2}$. Those who correctly found the midpoint usually went on to complete the question correctly, but other errors that occurred included substituting (11, 3) instead of (3, 11) or making a mistake in the manipulation of the equation $11 = -\frac{1}{2}(3) + c$ to find the value of *c*. Some candidates substituted using the original gradient of 2 to find the *y*–intercept, even when they had found the correct perpendicular gradient which they then used in their final answer.

Question 22

(a) Most candidates realised that they needed to differentiate and then equate to zero meaning that at least 2 marks were scored. However, a large number only included the first two terms, $3x^2$ and $2x$, omitting the –1, presumably thinking that the *x*-term differentiated to zero rather than to a constant. Most who reached the correct quadratic were able to solve it to reach $x = -1$ although working was not always clear. Having reached $x = -1$, some made sign errors and obtained the incorrect *y*-coordinate as $(-1)^3 + (-1)^2 - (-1)$ was often calculated as $-1 + 1 - 1$. There were a few misconceptions about what needed to be equated to find a stationary point: some used $\frac{d^2y}{dx^2} = 0$, others set $\frac{dy}{dx}$ equal to values other than zero or tried to make use of the *x* coordinate of the other stationary point.

(b) Whilst a fair number of candidates managed to score both marks, the quality of sketching the cubic curve was very variable. Many scoring 1 mark managed an acceptable cubic curve but without a minimum in the correct quadrant. Those scoring no marks either did not attempt a sketch or had a curve with only one, or more than two, turning points or sketched a cubic where the coefficient of x^3 is negative. It did appear that several treated this part as being separate to **Question 22(a)**. The lack of connection to the work in **Question 22(a)** was also apparent for some when they did not have a minimum in the 4th quadrant, or even a stationary point at approximately $\left(\frac{1}{3}, -\frac{5}{27}\right)$ which they were given. Others took more of a plotting approach to their sketch, with points labelled and scales on their axes which did lead to challenges in trying to get a good curve to fit the points. The best sketches seemed to draw the curve first, then label after.

(c) This question was the most challenging question on the paper. Whilst some realised the importance of $-\frac{5}{27}$ and 1, most candidates did not attempt to give an answer as an inequality, when they were asked for a range of values. Among those who did give inequalities some incorrectly gave strict inequalities, but the most common error was to give a double inequality for the wrong range, stating where there was more than one solution rather than fewer than 3 as asked for, i.e., $-\frac{5}{27} \le k \le 1$. A small number did not score as they used *x* rather than *k* in their answer. Most had very little idea how this part related to their stationary points, many listing integer values that they thought satisfied the question.

Question 23

(a) This was well attempted with most candidates scoring full marks. Those who did not get 2 marks were usually able to score 1 mark for either x^3 in the numerator or less commonly, a denominator of 8. Working out $4^{\frac{3}{2}}$ was difficult for candidates without the use of their calculator to help.

(b) This part was problematic for many candidates. Those who realised that they had to convert all the terms into the same base were often able to go on to gain all the available marks. The most successful candidates usually chose the easiest base of 2, although 4 and 16 were both used correctly. Others started by changing the left-hand side to $8x$ but were unable to make progress from there as it often did not then become $(2^3)^x$. Many incorrectly changed the left-hand side to 8^{2x}. Some candidates gained 1 mark for giving one power that would be useful in a solution, such as converting 16^x to 4^{2x} or to 2^{4x}. Further marks were not possible for many as they often did not convert all terms to the same base. There were many who made an error multiplying out the bracket $2(x + 3)$ or did not have a bracket. Consequently, a common incorrect equation often seen was $4x - x = 2x + 3$ rather than $4x - x = 2(x + 3)$.

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. The majority of candidates completed the paper and made an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should encourage candidates to show formulae used, substitutions made, and calculations performed. Attention should be paid to the degree of accuracy required in particular questions. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer. Candidates should also be reminded to show all steps in their working for a multi-stage question and should be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. Candidates should use their calculator efficiently, though it is still advisable to show the calculation performed as transcription and miscopying errors can occur.

Comments on specific questions

Question 1

This question was generally answered well, although the varied incorrect answers seen, suggest that a number of candidates did not appreciate that the simple calculation of $3\frac{1}{4} \times 12$ could be performed on their calculator. Common errors included 3.25, 36 and 15, with a small number using 7, 52 or 365 in their calculation.

Question 2

This question was generally well answered with the majority recognising the two calculations required. Common errors included 5.88, 5.9 or 6 cups, and change of \$3.7 or £3.8.

Question 3

(a) This part was generally very well answered with the majority giving an answer within the allowed tolerance. Common errors included 30, 57 and 147.

(b) This part was also generally very well answered with the majority able to write down the correct mathematical name. Common errors included obtuse, reflex and right angle.

Question 4

(a) This part was generally very well answered.

(b) This part was generally very well answered.

(c) This part was generally well answered, although 31 was a common error.

(d) This part was generally well answered, although 36 was a common error.

(e) This part was generally very well answered.

Question 5

(a) This part was generally poorly answered. A significant number did not appreciate that an expression was required, and gave an equation such as $n = dt$ or $t = dt$. Other common errors included d/t, t/d, $d + t$, $7dt$ and $7 + d + t$.

(b) This similar part was also poorly answered. Again, several equations were seen, such as $p = x + y$ and $t = p - x + y$. Other common errors included $y - x$, $(p - x)(p + y)$ and pxy.

Question 6

This question was generally well answered, with the most successful method used being a reverse flow method. Common errors included 4, –20, often from using the incorrect equations of $n + 10 \times 5 = 30$ or $5n + 10 = 30$.

Question 7

(a) This part *was* generally well *answered*, although h and c were common errors.

(b) This part was not as well answered, with vertically opposite and parallel being common errors.

Question 8

(a) This part was generally well answered, although $n - 7$ was a common error.

(b) This part was generally very well answered.

(c) This part was reasonably well answered. Common errors included $n - 7$, $24 + 7n$ resulting from using $A + (n - 1)d$ with $d = 7$, or giving a purely numerical value.

Question 9

This question was generally well answered. Common errors included 131, and 231 from finding the volume using $3 \times 7 \times 11$.

Question 10

(a) This part proved to be challenging to candidates and was a good discriminator, with a significant number were able to score full marks. Using the mean value given to find the value of C proved the most difficult part. Common errors included $B = 15$ and $C = 29$, $B = 6$ or 16 by not appreciating that there were 10 values, arithmetic errors when using the mean to find C, and a small number using the incorrect statistical form to find the values.

(b) This part was generally very well answered. A variety of correct and equivalent statements were seen, with the most common being, 'no number is repeated'.

Question 11

(a) (i) This part was generally very well answered, although common errors of 9.5 and $9.5 \div 0.8$ were seen.

(ii) This part was generally reasonably well answered. Common errors included bearings of 78, 98, 258, and 9.5 cm.

(b) This part was generally poorly answered, with few candidates able to find the reverse bearing. Common errors included $360 - 127$, $180 - 127$ and $180 + 53$.

Question 12

This question proved difficult and demanding and was a good discriminator, although a small number were able to score full marks. Many found the angle for Sun as 185° but were unable to continue correctly. Those who attempted to use percentages were rarely successful.

Question 13

This question was reasonably well answered, with the majority doing the necessary working in stages. The first stage to find \$2000 = 1230 euros was usually correct, but errors often occurred in the second stage converting this to krona. Another common error was that, despite the question stating 'give your answer correct to the nearest krona', many left their answer as 14137.93.

Question 14

(a) This part was generally reasonably well answered, although a partial factorisation was a common error.

(b) This part was generally well answered, although several algebraic errors were seen. The majority were able to score the method mark by expanding the brackets correctly. However, the collecting of like terms to simplify their expression often led to errors, in particular $10m - 5 + 3m + 21$ became $10m - 3m + 5 + 21$ and then $7m + 26$.

Question 15

(a) This part was reasonably well answered. Common errors included $95 \div 2.15$, $95 \div 135$ and 95×2.25.

(b) This part was generally poorly answered with few candidates able to perform the correct conversion. The most successful method was from candidates who knew the conversion factor and calculated $8 \times \frac{18}{5}$. Common errors included $\frac{8 x 1000}{60 x 60}$, $8 \times \frac{5}{18}$, and 0.0008×60. A significant number only attempted to convert the distance leading to answers of 0.0008, 800 and 8000.

Question 16

(a) This part was generally very well answered, although the common errors of $480 \div 2$ and $480 \div 7$ were seen.

(b) (i) This part was generally well answered. Common errors included partially simplified ratios such as 14 : 21 and 4 : 6.

(ii) This part proved difficult and demanding for many candidates and few correct answers were seen. The most successful method seen was $2^{450} : 2^{452}$ changed to $1 : 2^{452} \div 2^{450}$, then $1 : 2^2$ and finally 1 : 4. Common errors included $2^{225} : 2^{256}$, 225 : 226 and a variety of incorrect ratios.

Question 17

(a) This part was generally well answered, although 6 was a common error.

(b) This part was reasonably well answered, although common errors of 2 and 20 were seen.

(c) This part was well answered. A variety of incorrect answers were seen, although candidates were more successful in simplifying the *a* variables. Common errors included a^2b^5, $a^{10}b$, $2a - 5b$ and $a^2 + b^{-5}$.

Question 18

(a) This part was generally well answered, with the majority able to use the formula for compound interest correctly. Common errors included using simple interest, subtracting the principal, and premature rounding which led to an inaccurate answer. Another common error was that despite the question stating, 'give your answer correct to the nearest $10', many left their answer as 15116 or 15116.54 .

(b) This part was again generally well answered, with the majority able to use a valid formula to calculate the percentage increase. Common errors included 630 − 560 = 70% and using $\frac{560}{630}$ which led to 89% or 11%.

Question 19

(a) This part was generally reasonably well answered, although not all candidates appreciated the three mathematical words used in the question: product, prime and factor. Common errors included answers such as $9 \times 9 \times 25$, and $3^4 + 5^2$.

(b) This part was generally found more difficult, with many candidates not appreciating that their answer to part **(i)** could be used. Common errors included 45^2, 5×405, and $27^2 + 36^2$.

Question 20

(a) This part was generally well answered, although a significant number drew an image of a rotation with correct orientation but using an incorrect centre.

(b) (i) Many identified this part as a translation. Translocation, transition and transformation were common incorrect attempts along with those who chose an incorrect type of transformation. Vectors were commonly seen, often correct but some lost marks by using coordinates or a fraction line in their vector and others reversed either numbers or signs.

(ii) The majority of candidates were able to identify the given transformation as an enlargement, but not all were able to correctly state all three required components. The identification of the centre of enlargement proved the most challenging with a significant number omitting this part, and (0, 0), (3, 5) and (–5, 3) being common errors. A small but significant number gave a double transformation, usually enlargement and translation. Less able candidates often attempted to use non-mathematical descriptions.

(c) This question proved difficult and demanding and was a good discriminator, although a small number were able to score full marks. Few candidates appreciated that a trigonometrical method was required to calculate the given angle. Those who recognised and used the tangent ratio were usually successful, although a small number lost the accuracy mark by giving their answer as 26.5. Common errors included measuring to get 26 or 27, angles such as 30, 60, 45 and 90, and attempting to use an area formula.

Question 21

(a) This part was generally well answered with most using the $(5 - 2) \times 180$ method. As this was a 'show that' question, full working is required and so answers such as 3×180 and 108×5 are deemed insufficient.

(b) (i) This part was reasonably well answered with most appreciating that the 5 given angles had to be summed to find the required expression. Common errors included arithmetic errors when simplifying, attempting to use $(n - 2) \times 180$, assuming each angle was 108, and writing down an equation rather than an expression.

(ii) This part was reasonably well answered although a number were unable to attempt this part as they did not have an expression or equation in part **(i)**. Common errors included equating their expressions to 360, 180 or 0, and going from expressions such as $10x + 45$ to $10x = -45$ or $10x = 45$.

MATHEMATICS

Paper 0580/42
Paper 4 (Extended)

Key messages

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

Work should be clearly and concisely expressed and intermediate values within longer methods should not be rounded with only the final answer rounded to the appropriate degree of accuracy.

Candidates should show full working with their answers to ensure that method marks are considered when full marks have not been given.

General comments

This was the first assessment of the new syllabus for 2025, and candidates generally found the paper accessible, and all had enough time to complete the paper. There were many excellent scripts in which candidates demonstrated an expertise with the content with solutions that were well presented. A much smaller number of candidates were less familiar with aspects of the syllabus and struggled with some of the content. Graphs and diagrams were usually completed accurately and most candidates had access to and used the required geometrical instruments. Most candidates worked to sufficient accuracy in the multi-stage calculations with only a few prematurely rounding values. The question paper includes a list of formulas which candidates should refer to where appropriate. A few candidates appeared not to use this list and misquoted formulas such as the curved surface area of a cone or the cosine rule.

The topics that proved to be more accessible were prime factors, algebraic manipulation, scatter diagrams, interpreting scale drawings, standard form, transformations, compound interest, estimated mean and histograms. The more challenging topics were within those questions that required some interpretation and reasoning e.g., **Questions 5**, **6** and also harder sequences involving fractional and exponential *n*th terms, gradient from a tangent, position vectors and harder multi-step mensuration.

Comments on specific questions

Question 1

Almost all candidates gave a correct answer to this question, with some offering both prime factors, 2 and 7.

Question 2

Most candidates simplified the expression correctly, giving their answers in one of the two acceptable forms. Some started by attempting to factorise and unsimplified answers such as $y(4y + 3 – y + 2)$ and $2y(2y + 1) + y(3 – y)$ were seen.

Question 3

Many candidates shaded the appropriate two small squares. Some found this challenging, often shading two squares to give a pattern with just one line of symmetry and sometimes a pattern with no line of symmetry.

Question 4

A large majority of candidates demonstrated a good understanding of using a calculator and gave the correct answer. Occasionally, candidates gave their answers to the nearest whole number or to an accuracy greater than one decimal place.

Question 5

This question proved to be more of a challenge for candidates. Those that identified the correct dimensions of the first rectangle usually went on to give the coordinates of *C* and *D*. A few made slips with the numeracy which led to errors with one or more of the four values. Some candidates attempted to use Pythagoras to find the distance between two points or to find a gradient but were unable to use it to make any progress. Some credit was given for partially correct answers which were quite common.

Question 6

Many candidates demonstrated a good understanding of basic pay and overtime pay and had no difficulty in finding the correct pay for the week. Almost all of the others made some progress, usually finding the basic pay of \$480, but then struggled when finding the pay for the extra hours. Common errors included finding the increase in the hourly pay of \$3.60 and then forgetting to add it on to the basic pay. Others were not sure on how to apply the 30% with some calculating 30% of \$480 or 30% of 45.5 hours. Some managed to calculate the total pay of \$85.80 for the extra hours but then added this to the number of hours. A few applied the hourly rate for the extra hours to all 45.5 hours. Some candidates confused the problem with compound interest and calculations such as $12\left(1+\frac{30}{100}\right)^{5.5}$ were seen.

Question 7

(a) Most candidates completed the scatter diagram correctly. A few made slips in plotting one point, usually plotting the point with an incorrect height. A significant number made no attempt to plot the remaining four points.

(b) Almost all candidates were able to identify the correlation as positive. Most errors involved describing the correlation as negative or describing the relationship as directly proportional. Candidates were not expected to describe the strength of the correlation.

(c) Almost all candidates drew an acceptable line of best fit. The common errors included lines that were not ruled or were out of tolerance at either end or, in some cases, the lines were too short.

(d) Many candidates were able to give an estimate of the mass by using their straight line of best fit. The few errors seen involved misreading the scale.

Question 8

(a) Almost all candidates found this part very straightforward and converted the correct measurement using the given scale. A few measured the line and gave it as their answer. In a few other responses the scale was applied incorrectly and in just a few others the line was measured incorrectly but the measurement was scaled correctly.

(b) A large majority of candidates demonstrated good construction skills. Diagrams were clearly drawn with arcs used to identify the position of the lighthouse. A small number of candidates erased their arcs having found the position of the lighthouse. Some candidates who forgot to use the given scale were able to show a correct technique, albeit using incorrect lengths of 4.4 cm and 3.3 cm. A few candidates appeared to miss the information in the question that the lighthouse was to the east of the boats.

Question 9

(a) The majority of candidates were able to write the number in standard form. A few made errors including giving a power of 3 instead of -3, rounding to 7.1 without showing a more accurate answer and giving an answer of 7.09×10^{-5}.

(b) The vast majority gave a correct response. Most candidates worked with the standard form number, squaring the 4 and doubling the power of 10 before adjusting the answer to standard form. Those candidates that started by converting to an ordinary number tended to make more slips in their working. Giving the final answer as 16×10^8 was the most common error. Other errors involved forgetting to square the 4 and adding 2 to the power of 10 instead of doubling.

Question 10

(a) (i) Most candidates had a good understanding of reflection and answered this part well. Those that drew the line of reflection were usually successful in drawing the image although a few then drew the image with the wrong orientation. The errors usually involved reflection in a horizontal line other than $y = 1$ or reflection in $x = 1$.

(ii) The vast majority gave a correct translation. In a small number of cases candidates translated triangle *A* by the incorrect vector with one correct component e.g., $\begin{pmatrix} -6 \\ -1 \end{pmatrix}$. A few candidates translated only two vertices correctly resulting in an image that was not congruent with triangle *A*.

(b) This was well answered by the majority of candidates. Almost all candidates named the transformation as a rotation. Identifying the correct centre of rotation proved more difficult than identifying the angle and direction of rotation. Candidates should always use coordinates to define the centre, rather than a column vector, which is incorrect. A small number of candidates gave two transformations usually rotation followed by a translation and in these cases no marks were awarded.

Question 11

(a) The vast majority of candidates were able to calculate the value of the investment. Some continued by subtracting the principal and gave the interest as their answer. A few others spoilt their method by adding 1500 to the value.

(b) Many candidates demonstrated a good understanding of compound interest and calculated the correct rate of interest. Most opted to start with a principal *P* and an investment value of 2*P* with a smaller number opting to use values such as 100 and 200 respectively. Having set up a correct starting equation some struggled to rearrange it correctly. A few misunderstood the question and reverted to using the investment value from the previous part, e.g., $1842.59 = 1500\left(1+\frac{x}{100}\right)^{11}$.

Some opted to use a trial-and-error approach to find the rate of interest, but this often led to an inaccurate answer.

Question 12

Many candidates calculated the total surface area correctly. The most common error was to find the area of the curved surface and omit the area of the base.

A minority of candidates used Pythagoras' theorem to find the vertical height of the cone and then incorrectly used this value in their area calculation. A small number of candidates used a value of π of 3.14 or $\frac{22}{7}$ both of which gave an inaccurate answer. Candidates should use the value of π on their calculator or 3.142.

Question 13

Some candidates found this question challenging, but almost all were able to make some progress. A minority of candidates found the next term in each sequence, rather than the *n*th term.

A number of candidates found correct expressions for the *n*th term of all three sequences.
Many used a method of differences for sequence *A* which gave a common third difference of 6 and so could be identified as a cubic sequence. Some made arithmetic errors when finding the differences, so did not reach a common difference.

Many identified that the term-to-term rule for sequence *C* was $\times 2$ and often knew that this meant that the *n*th term would involve 2^n. The most common form for the correct answer was $4 \times 2^{n-1}$ but some candidates attempted to simplify this to 8^{n-1}. Some candidates attempted the first, second and third difference of the sequence C and then made no further progress.

Sequence B was found to be the most challenging, with many candidates looking at differences between the fractions rather than considering the linear sequences in the numerators and denominators separately. Those who considered the numerators and denominators separately often reached a correct expression, although common errors were $n - 11$ rather than $11 - n$ in the numerator, or an answer of $\frac{n-1}{n+1}$ which appeared to be an attempt to form a term-to-term rule.

Question 14

(a) Almost all candidates gave the correct answer of 17. A few made errors with the two negatives $-4 \times -3 = -12$ and then $5 - 12 = -7$.

(b) Most candidates interpreted $f(3 - 2x)$ as $5 - 4(3 - 2x)$ and went on to simplify the expression correctly. For some, dealing with the negative values led to errors and $5 - 12 - 8x$ was a common error leading to $-7 - 8x$.

(c) Most candidates had no difficulty in obtaining the correct inverse function. Some made errors including leaving the answer in terms of *y* or incorrect signs when rearranging. Some gave an ambiguous final answer such as $5 - x/4$ rather than the full division line, $\frac{5-x}{4}$. A few did not understand the inverse function notation and gave a reciprocal answer, $\frac{1}{3-2x}$.

Question 15

(a) The vast majority of candidates demonstrated a good understanding of the mean of grouped data and obtained the correct answer. A few made slips, usually with one or more of the of the interval midpoint values. Incorrect methods usually involved the use of the class widths instead of midpoint values and, in a small number of cases, dividing the total by the number of intervals instead of 80. Some candidates made the error of giving their answer to 2 significant figures as 1.6 and not showing a more accurate value in their working.

(b) The majority of candidates drew accurate histograms. The most common error almost always resulted from an incorrect calculation for the frequency density. Some divided all the frequencies by the smallest class width, some divided the frequencies by the upper bounds of the intervals, and some multiplied the midpoint values by the total frequency.

Candidates are advised to use a ruler when drawing the bars as freehand drawings can result in inaccurate vertical and horizontal lines on the histogram.

Question 16

(a) Most candidates had no difficulty in deducing that the horizontal line on the graph represented an acceleration of 0 m/s^2. Some common incorrect answers were $\frac{8}{10}$ or 0.8, $\frac{10}{8}$ or 1.25 and 8.

(b) Many candidates obtained answers within the required range from correctly drawn tangents and correct working. Some tangents were less accurate and had a gap between the ruled line and the curve, others were drawn at different points slightly off from the time of 7.5 seconds and some did not touch the curve at time 7.5 seconds. The lack of accuracy sometimes resulted in gradients that were outside of the acceptable range. There were other errors in finding the gradient, resulting from misreading one or both scales. A common error for the gradient was to give an answer of 0.93 from 7 divided by 7.5, using the coordinate values of the point at 7.5 seconds.

(c) Many candidates applied a correct method to obtain an answer within the specified range. Most opted to calculate the area of a rectangle and a triangle. However, some made errors in one or both shapes, sometimes a numerical slip and sometimes using an incorrect dimension. Very few attempted to use the formula for the area of a trapezium. Some candidates calculated a correct distance and gave that as their answer, forgetting they needed to calculate the average speed.

Some did not appreciate that the distance could be found by the area under the graph between 15 seconds and 30 seconds.

Question 17

(a) Many candidates with a correct answer in this part had annotated the diagram with a North line at *C* and indicated other angles at that point, usually 35° going anticlockwise from North to *CA*. A common incorrect answer was 322°, the reflex angle at *C*. Another incorrect answer seen was 73°, the angle going anticlockwise from North to *CB*. Some candidates either added or subtracted 180° from one of the given angles and a small number attempted to use trigonometry to find an angle.

(b) Most candidates recognised that they should apply the cosine rule to find the length *AB*. They usually showed substitution of the given values into the form of the cosine rule, given in the list of formulas, with working leading to a value with four or more significant figures, to demonstrate that they had evaluated it correctly. In questions requiring an answer to be shown to a specified degree of accuracy candidates are expected to find a value to a greater degree of accuracy than the given answer, in this case to 2 or more decimal places. Some candidates gave 59.3 as their most accurate answer and were not awarded the accuracy mark. Some candidates made extra work for themselves by using the implicit angle form of the cosine rule, $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$, which required more stages of working to convincingly show the required result and this often led to errors. A small proportion of candidates attempted to apply either the sine rule or Pythagoras' theorem.

(c) The key to success in this question was to note that the question stated that angle *BAC* was obtuse. Many candidates used the sine rule to find angle *BAC* but often used the acute angle 80.5° rather than the correct obtuse angle of 99.5°. Those candidates who used the sine rule to find angle *ABC* first usually then found angle *BAC* correctly using the sum of angles in a triangle. Candidates often added 145 to their angle *BAC* to give the required bearing as the answer although some used an incorrect method to find the bearing and others simply gave angle *BAC* as the answer. Many scored partial credit in this question, but fewer gave a fully correct answer using the obtuse angle *BAC*.

Question 18

(a) Many candidates made a correct start by factorising to $2(9a^2 - 49)$. Fewer candidates then recognised $9a^2 - 49$ as the difference of two squares and completed to fully factorise the expression. Those that did not spot the difference of two squares frequently factorised to $2(3a - 7)^2$. Some started by treating it as a quadratic and obtained an answer such as $(6a + 14)(3a - 7)$.

(b) Many candidates had a good understanding of how to expand the three brackets and a majority gave a correct expansion. After expanding two brackets, most chose to simplify to three terms before dealing with the final bracket. This led to some slips and errors such as $-x + 8x = -7x$ were often seen. With the final expansion having more terms to deal with, candidates were more likely to slip up, usually with incorrect signs, incorrect powers or the occasional numerical slip.

Question 19

A good majority of candidates found the two correct solutions. Some made errors with the rearrangement of the equation, losing the negative sign, which led to the two common answers of 66.4 and 293.6. Some of those with a correct value for cos(x) obtained one correct value, usually 113.6, and an incorrect second value such as 66.4 or 293.6. Candidates that drew a sketch of the cosine curve often used it to good effect. It was clear that some candidates did not check the cosine values of their answers on a calculator.

Question 20

The key to success in this question was realising that the lower bound of the mass and the upper bound of the volume were required. Those that were able to identify the two correct bounds almost always went on to give the correct lower bound of the density. Many of those with incorrect calculations often used both lower bounds. Some had the correct idea but were unable to identify one or both bounds needed. Some used 7700 or 7900 and 1220 or 1260 for their bounds and others used the given values before trying to adjust for bounds after the division. Some candidates showed the division volume ÷ mass.

Question 21

A small majority of candidates demonstrated a good understanding of vector geometry and gave clear working to find the correct expression for the position vector of E. For many of the others, a variety of errors were seen. A few obtained a correct unsimplified expression for $\overrightarrow{OE}$ such as $\mathbf{m} + \mathbf{n} + \frac{5}{9}(\mathbf{m} - \mathbf{n})$ and either gave it as their final answer or made a slip when collecting like terms. Others did not reach an equivalent stage having made errors in deriving either $\overrightarrow{AE}$ or $\overrightarrow{BE}$. Typical errors included mismatched directions such as $\overrightarrow{AE} = \frac{4}{9}\overrightarrow{BA}$ or incorrect use of the ratio such as $\overrightarrow{AE} = \frac{4}{5}\overrightarrow{AB}$. Some candidates were able to give a correct vector expression, usually for $\overrightarrow{OB}$. Attempts at a vector for $\overrightarrow{AB}$ were sometimes correct but often the direction was incorrect, e.g., $\overrightarrow{AB} = \mathbf{m} - \mathbf{n}$. Some attempted a vector route for $\overrightarrow{OE}$.

Question 22

Many candidates understood that the points of intersection of the line and the curve are found by solving the equations simultaneously. Candidates almost always chose the efficient option of setting up an equation in x and usually simplified correctly to a three-term quadratic equation. Candidates were required to show correct working to obtain the solutions and often showed clear substitution of the values for a, b and c into the quadratic formula to gain method marks. The most common error here was to write $(-5)^2$ as -5^2 and then write down solutions from the calculator without showing the correct value, 25. Candidates giving only solutions from their calculator without showing all the working as requested in the question did not score full marks. Many candidates gained the marks for the correct solutions rounded to 2 decimal places, but many others lost the accuracy marks due to premature rounding of their x values to 1 or 2 decimal places. Some used the quadratic equation of the curve to find the corresponding y values instead of using the simpler equation of the line. A significant number of candidates were not able to recall how to approach this type of question and instead attempted to use differentiation, attempted to solve $2x^2 - x - 3 = 0$ or omitted the question completely.

Question 23

This proved challenging and fully correct solutions were in the minority.

Successful candidates took one of three approaches to finding the area of the tunnel cross-section before multiplying by 800 to find the volume. Many found the area of the major sector and added this to the area of the large triangle containing the obtuse angle 157 at the centre. Others aimed to add the area of the semi-circle and the triangle to the area of two small sectors with equal acute angles of 11.5 at the centre. Candidates using the first and most efficient approach were often successful, although some lost accuracy by rounding prematurely and a few omitted to add the area of the triangle. In all approaches, most candidates demonstrated correct use of Pythagoras' and/or trigonometry to find an angle in their right-angled triangle, however some candidates began by assuming that the base of the large triangle was 3m or 5m or used the height of the triangle as 1.5 instead of 0.5. Many candidates used $0.5 \times 2.5 \times 2.5 \times \sin157$ to find the area of the large triangle but others who used $0.5 \times$ base $\times$ height of a right-angled triangle often omitted to then multiply this by 2. Similarly, those candidates intending to add two small sectors to the semi-circle sometimes omitted the second sector. These omissions were often made by candidates who did not set their working out in a clear and concise manner. Candidates who identified the tunnel as part of a cylinder almost always concluded their solution by multiplying by 800 to find the volume. A minority multiplied by 3m as well as, or instead of, multiplying by 800. A significant number of candidates did not recognise the need to calculate an angle to work with sectors and triangles and instead assumed the cross-sectional area was for example 3/5 of the circle. Other candidates attempted to use the volume of a sphere. As a result, the number of fully correct responses was in the minority.