MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required. Candidates should be reminded of the need to read all questions carefully, focussing on instructions and key words.

General comments

The paper was accessible to many candidates, with the majority attempting all questions. Candidates must show all working to enable method marks to be awarded. This is vital in two or multi-step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks. Rounding incorrectly, not using the appropriate degree of accuracy and answering in an incorrect form let down many candidates particularly with **Questions 6** and **21**. The questions that presented least difficulty were **Questions 2**, **5**, **7(a)**, **9**, **11(a)** and **19(a)**. Those that proved to be the most challenging were **Questions 6(b)**, use of significant figures, **15(a)**, the perimeter of a compound shape, **18**, value of an investment, **19(b)**, *n*th term expression and **20**, the numbers of litres of water in a tank. Those that were very occasionally left blank were **Questions 10**, **13**, **19(b)** and **20**.

Comments on specific questions

Question 1

This question was answered well by the majority of candidates. Some candidates incorrectly wrote a percentage sign after 11.2. Candidates should check if units are needed but here there were no units required. Occasionally, the answer given was a power of 10 out, for example 112 or 1.12

Answer: 11.2

Question 2

The overwhelming majority of candidates correctly multiplied \$350 by the euro rate and very few incorrectly divided by 0.88. Candidates should decide if the amount of money in euros is going to be numerically larger or smaller than 350. As each dollar is worth less than 1 euro, the answer is going to be smaller than 350.

Answer: 308

Question 3

Most candidates knew the rule for indices and applied it correctly. Other indices seen were 7 from addition, 2.5 from division and 10 from multiplication. Occasionally an answer of $\frac{a^3}{a}$ was seen or just the number, 3.

Answer: a^3

Question 4

A large number of candidates were able to order the given values correctly. The first step is to put the values into a comparable form, for example, all in decimals or percentages, so that the order can be determined. Many scored one mark for putting three of the values in order and the common error was to place 30% last, often without the percentage symbol, suggesting that these candidates interpreted this value as 30 rather than 0.3.

Answer: 30%, $\frac{7}{20}$, $\frac{3}{8}$, 0.38

Question 5

There were many correct answers for part **(a)**, with most candidates measuring extremely accurately. A small number seemed to interpret the instruction to give their answer in centimetres as meaning they should round their measurement to the nearest centimetre, leading to an answer of 4 cm. A small number attempted to calculate the circumference. Answers that were obviously attempts to measure the diameter (7.4 cm) were also seen. In part **(b)**, many did identify the hexagon (regular hexagon was also correct). Incorrect shape names included trapezium, pentagon, heptagon, hectogon (100 sided shape) and octagon. Sexagon and hectagon are not acceptable alternatives for hexagon.

Answers: **(a)** 3.7 **(b)** Hexagon

Question 6

Part **(a)** was the better answered of the two parts of this question, with a large number of correct responses. A number of candidates were unable to round the given values, often ending up with answers that weren't near the original values, for example, 258 as an attempt to round 257 964 to the nearest thousand. Also seen were 300 000, 257 000 and 258 followed by an incorrect number of place-holding zeros. Part **(b)** was one of the most challenging questions on the paper as few were able to give the correct answer. The most frequently seen incorrect answer was 0.06, which does not have 3 significant figures as some treated the 0 in the first decimal place as significant. The answer 0.0603 was also common along with 60.

Answers: **(a)** 258 000 **(b)** 0.060

Question 7

A very large majority of candidates were able to indicate the correct line of symmetry in part **(a)**. A few others drew in extra lines, in particular a vertical line between the two vertices near the right hand end. The instruction, 'to draw the line of symmetry' told the candidates there was only one line. There were many correct answers to part **(b)** where the most common error was to shade a square so that the resulting pattern had reflective, rather than rotational, symmetry. Occasionally, the centre square was shaded as well as the correct square. The resulting pattern does have rotational symmetry but the instruction was to shade only one square so this answer did not score the mark.

Question 8

Part **(a)** was answered well by most candidates with others drawing the arrow at 0.5 and 0.1 as well as at 1. More candidates were successful with part **(b)**; the majority gave a fractional or decimal form and all equivalent probabilities were accepted as the question did not specify the form of the answer. The most common error was to give the probability that the counter was red. A small number of candidates gave values that could not be probabilities, such as 5.

Answers: **(a)** Arrow at 0.2 **(b)** 0.8

Question 9

This was answered well by most candidates. The most common errors involved problems in resolving the negative numbers correctly, for example, in part **(a)** $4 - 12 = -8$ and $12 - 4 = 8$ were seen and in part **(b)**, some candidates calculated $8 - 3 = 5$ or $8 - -3 = 11$.

Answers: **(a)** 16 **(b)** –11

Question 10

There were many correct, well drawn, accurate and precise enlargements, nearly always with ruled sides. The candidates who used lengths or counted squares to draw the enlargement, rather than drawing rays, seemed to be more successful. It was perfectly acceptable to place a correct enlargement anywhere on the grid as no centre of enlargement was specified. In a few cases, an enlargement by an incorrect scale factor was seen. A significant number did not make any reasonable attempt at drawing an enlargement, resulting in shapes that were stretched, skewed or in some cases lacking in any sort of similarity to the original.

Question 11

This was either answered very well or in a small number of cases, very poorly. Amongst the candidates who showed understanding of vectors, the most common errors were arithmetical, or errors when calculating $-3-4$ in part **(b)** so dealing with directed numbers caused problems again. The most common misunderstanding was to treat vectors as fractions, often 'cancelling down' their final answer to part **(a)**. A very small number included a horizontal line between the two components. A small number appeared to make an attempt to treat the vectors as matrices.

Answers: **(a)** $\begin{pmatrix} 12 \\ -6 \end{pmatrix}$ **(b)** $\begin{pmatrix} 3 \\ -7 \end{pmatrix}$

Question 12

Many candidates completed this efficiently, using an appropriate ratio in order to calculate the missing length. One mark was often awarded to candidates who could set up the correct ratio equation but could not always rearrange to find x correctly. Other candidates frequently found the difference between 8 cm and 12 cm, then assumed that they could simply add this value on to 14. Candidates who did not recognise the topic of similarity assumed that the triangles were right-angled as they attempted to use Pythagoras' theorem, or in a few cases, trigonometric ratios.

Answer: 21

Question 13

Many candidates used an efficient method to reach the correct solution. Some attempted to find the total of the interior angles first and in some cases went on to give the value for the interior angle. However many went on to subtract this from 360, suggesting that they did not understand what was meant by the term exterior angle. Also seen was $180 \div 15$ rather than the correct $360 \div 15$.

Answer: 24

Question 14

There were many correct answers seen for part **(a)**. The most common incorrect answer was 10 55 which was the time Shohan arrived at the library not the post office; this is a good example to show how important it is to read the question carefully. Most recognised that the next section of the graph was a horizontal line and many candidates completed this correctly. Relatively few were able to complete the final part of the graph to show his journey home. A few showed that they had correctly calculated the time but didn't complete the graph. Common errors included making the journey home last 18 minutes, or simply ending the journey at a convenient point on the x-axis, usually 11 45, 12 00 or the end of the axis. Occasionally the journey home went back in time as candidates drew a line back to home at 10 00.

Answers: **(a)** 10 25

Question 15

Most candidates realised what was required in each part, but a small number confused perimeter and area. Although there were many correct answers for part **(a)**, the common incorrect answer of 3.2 m was from only adding the given lengths and 3.7 m came from just including one of the missing 0.5 m sides. Part **(b)** was better answered in general with candidates gaining one if not both marks; a common misunderstanding was to multiply all the given lengths. Some were possibly uncomfortable working in metres and converted to centimetres and then incorrectly converted back to m^2. Some gave 1.11 from adding together the two overlapping rectangles, $1.2 \times 0.4 + 0.7 \times 0.9$. Others found 1.2×0.9 but then did not subtract the 0.5×0.5 square cut from the corner. Also seen were calculations involving 0.45 and 0.6, half of the longer sides. A few candidates used the formula for the area of a triangle. Besides method errors, arithmetic errors were seen, most often $0.7 \times 0.9 = 1.6$ or $1.2 \times 0.4 = 1.6$.

Answers: **(a)** 4.2 **(b)** 0.83

Question 16

A good number of fully correct methods were seen. Many candidates were able to correctly convert the mixed number to a top heavy fraction. It was more common for the next step to be inversion of the $\frac{9}{4}$ and multiplication, rather than the division of two fractions with a common denominator. Those who did go for the latter approach often went wrong when the incorrect $\frac{3 \div 18}{8}$ was often seen. Some candidates were rather careless with their setting out and lost marks because of this as the correct working in fractions must be shown to get the marks in questions like this. Others used shortcuts such as 'arrows' instead of rewriting the division calculation as a product and rarely were convincing enough to score full marks.

Answer: $\frac{1}{6}$

Question 17

The plotting of Leo's scores in weeks 1 and 2 at the point (28, 30), was done very well. There were a few instances when candidates gave two points, (28, 28) and (30, 30), instead of the correct single point. The majority drew a ruled line that passed through the cluster of points in part **(b)**. A large number drew their line so that it passed through the origin, which meant it deviated significantly from the required line of best fit. A small number drew a zigzag line connecting all points then continued with a straight line down to the origin. For part **(c)**, using the line of best fit to estimate a mark for Sonia in week 2, most answers were within the required range and if not, often followed through from their straight line with positive gradient.

Answers: **(c)** 22 to 26

Question 18

This was one of the more challenging questions on the paper. Many found the total simple interest of $96 but then did not go on to add that to Jan's initial investment of $800 so there were few completely correct solutions. With finance questions like this, candidates need to check exactly what they are being asked for. First, is this question about simple or compound interest? Here, it was evident that some candidates were treating this as a compound interest question. Next, is the answer the interest that has been earned or all the investment? Here the wording asks for the value of the investment which is the starting value and the interest earned added together. There were errors with the interpretation of 3% with some using 0.3 (interest of $960) instead of 0.03 as the multiplier or just using 3 giving 9600 as the interest. $3296 was a common incorrect answer from $800 \times 1.03 \times 4$.

Answer: 896

Question 19

Part **(a)** was one of the best answered questions on the paper and part **(b)** proved to be much more challenging. Most showed that they were finding the difference between terms and many used this to generate an expression involving $3n$, but there were many errors in finding the required expression. Candidates who attempted to use the nth term formula, $a + (n - 1) \times d$, frequently went wrong, usually because they misremembered the formula (often as $a \times (n - 1) \times d$) but also because of errors in substituting values. This is an obvious place for candidates to check their work to see if their nth term expression gave the right values.

Answers: **(a)** 23 **(b)** $3n + 5$

Question 20

This was one of the most challenging questions on the paper. One complication was that not all three dimensions were in the same units so conversion was needed before the volume could be calculated. Most realised the need to multiply the lengths, but few were able to complete the required conversion into the same units and then to litres. Many simply multiplied the three given values and did not convert to either all metres or all centimetres. Only a minority knew how to convert to litres. The most common mark awarded was for candidates showing some understanding of volume, but not being able to carry out the conversion of units. There were other misconceptions as a number assumed that the tank was a cylinder, often drawing diagrams to support this, suggesting that they had focussed on the word 'tank' and entirely overlooked the clear statement that the tank was a cuboid.

Answer: 900

Question 21

There were some totally correct answers to both parts but a significant number were unable to write the numbers in standard form. Most were able to complete a subtraction in part **(b)**, but many did not give their answer in the correct form in order to gain the second mark.

Answers: **(a)** 1.87×10^8 **(b)** 7.8×10^6

Question 22

There were some excellent solutions here and many candidates gained at least three marks out of the four. A number of candidates were unable to find the size of angle x correctly but were able to use their value for x (as long as their x was less than 90°) to find a follow through value for y. A common error was to assume that x was 56° as if it was a base angle of the isosceles triangle along with the given angle ACL. Some candidates gave no indication of which angles they were finding, either by using appropriate notation in their working, or by showing the angles on the diagram. Candidates would be well-advised to write on the diagram to show the sizes of any angles that they have found; this will allow them to be given credit for partially correct methods.

Answer: [x =] 62, [y =] 118

Question 23

In part **(a)**, many candidates gained at least one mark. If candidates got to $11x - 13$ but then carried on to solve $11x = 13$, they only scored one mark as this is not an equation to solve. Also, an answer of $11x + -13$ only scored one mark as the signs in front of the 13 are not fully resolved. In part **(b)**, to score full marks, the correct method must be seen as well as the values for x and y. Candidates need to check for the most efficient way to tackle simultaneous equations so that they have as little opportunity as possible to make numerical slips. Here, the simplest method to eliminate one variable is to multiply the first equation by 2 and then add the two equations. There were a number of candidates who re-arranged both equations into $x = ...$ (or $y = ...$), equated them and solved for x (or y). A few candidates used matrices but those who did proved to be more likely to make sign errors than those who opted to use an algebraic method. Many other methods, including substitution, will work but often have more opportunities for errors to be made.

Answers: **(a)** $11x - 13$ **(b)** [x =] 3, [y =] –2

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required. Candidates should be reminded of the need to read all questions carefully, focussing on instructions and key words.

General comments

The paper was felt to be a fair test of basic mathematical skills and candidates in general answered the questions with confidence and competence. There were quite a few cases where some candidates did not follow the wording of the questions, in particular **Questions 12** and **20**. Presentation and working were quite good but candidates do need to take care with writing and explanations.

Rounding to 3 significant figures is stated in the rubric but does not apply to exact answers which should be given in full. Non-exact answers to less than 3 figures will lose at least accuracy marks unless a more accurate answer is seen in the working.

Comments on specific questions

Question 1

Quite a few candidates did not understand the question and gave an estimate or a measure of the size of the angle shown. There were also many who gave either acute or reflex.

Answer: Obtuse

Question 2

Candidates found this question challenging with many not knowing the specific properties of an equilateral triangle. Ignoring the word equilateral and just giving the sum of the angles in a triangle was often seen. Angles of 90° and 45° as well as just 3 were often seen.

Answer: 60

Question 3

While this standard form question was well answered, quite a few candidates did not know that the first part of this form had to be a value between 1 and 10. This produced the common incorrect response of 23×10^3. Others did not know that large numbers, as this one, needed a positive, rather than a negative power of 10.

Answer: 2.3×10^4

Question 4

Both parts of this question were very well answered with the vast majority clearly understanding the rules for subtracting vectors and multiplying a vector by a number. Most errors in part **(a)** were due to incorrect working of the directed numbers for the first component, most often −3 from −2−1 instead of −2 − (−1). Fraction lines were rarely seen but some did not know that both answers had to result in two components. A few candidates in part **(b)** gave a single answer of $-5\frac{1}{4}$ from $7\times\frac{-3}{4}$.

Answers: **(a)** $\begin{pmatrix}-1\\4\end{pmatrix}$ **(b)** $\begin{pmatrix}-21\\28\end{pmatrix}$

Question 5

While overall the question was answered well there were many cases of candidates not knowing when to stop an algebraic expansion. Having reached the correct answer some thought a further step was necessary producing such answers as $-2x^2$, $4x^2$, $4x^{-2}$ or $4x^3$. Nearly all candidates could do at least the first part of the expansion, $6x$, but then $-2x^2$ was often the response for the second part.

Answer: $6x - 2x^3$

Question 6

This proportion question was answered well with the typical error of subtractions, 18 – 16 followed by 27 – 2 = 25 being seen but not too often. Those who did not understand what was required often tried Pythagoras' theorem and trigonometry, clearly not possible as no right angle was seen or indicated in the diagram. Few candidates worked directly from a scale factor but rather from a version of $\frac{DE}{16}=\frac{27}{18}$ rearranged, usually with success.

Answer: 24

Question 7

A majority of candidates struggled with this basic trigonometry question. Knowledge of which ratio is needed in a particular question is essential and here it was cosine, not sine as many assumed. A few started with sine and followed with Pythagoras' theorem, a perfectly correct if long method, but accuracy was usually lost in these cases. A reminder here is that inexact numerical answers need to be to 3 significant figures (although more is not penalised) so 9.9 without more accurate seen only gained one mark.

Answer: 9.85

Question 8

This substitution into an algebraic expression was very well answered. However, $5^2 = 10$ and 43 for $4b$ were seen a number of times. In questions of this nature requiring two or three calculations, candidates should show some working since it was clear that at least one of these calculations was usually correct. However, with just an incorrect answer and no working seen, no marks could be scored. For example 10 + 12 = 22 would gain one mark while just 22 did not score.

Answer: 37

Question 9

There was quite a good response to conversions between fractions, decimals and percentages but quite a lot of misunderstanding. In particular, decimals in the percentage column and 0.47 in the fractions column were seen a number of times. For those who understood what was required 2.5% and 6.0% were noticeable errors, the latter often following a correct percentage for $\frac{1}{4}$.

Answers: $\frac{47}{100}$ 25% 60%

Question 10

(a) While most were able to measure the length of the line, 9 or 9.5 centimetres were often seen. Incorrect conversion by the scale caused a mark to be lost at times. There was evidence of misunderstanding by candidates who did not measure the line and simply worked on the scale of 12 to produce an answer, for example 1200 or even 12 000.

(b) Most candidates did not know what a bearing was and an answer of 8.5 showed confusion between linear and circular measures. For those who understood bearings a reflex angle was common showing possible confusion over which way round to give the bearing. Quite a number did not attempt the bearing.

Answers: **(a)** 102 **(b)** [0]64[°]

Question 11

(a) (i) Candidates found it challenging to work out the probability and show it on the probability scale. Converting six out of the eight counters to a probability of $\frac{3}{4}$ was a challenge and also recognising the correct mark on the scale was found difficult. The most common incorrect arrow was placed at the probability of 1.

(ii) There was a better response to placing a probability of zero but there was still some confusion shown. An answer of zero was not always accompanied with an arrow.

(b) The more standard probability question was omitted by a considerable number of candidates, more than in part **(a)**. However, for those who attempted the question it was better answered than part **(a)**. The most common error was to repeat the probability of the question, 0.64, but halving 0.64 was also very noticeable.

Answers: **(a)(i)** Arrow at $\frac{3}{4}$ **(ii)** Arrow at 0 **(b)** 0.36

Question 12

A number of candidates ignored that this was simple interest and consequently used compound interest. Lack of reading the question carefully resulted in most candidates simply giving the interest of 324 as their answer. Also candidates need to look at their answer in order to see if it fits the question. Not dividing by 100 was common but the answer 32 400 was unrealistic for an investment of 1800 for 4 years.

Answer: 2124

Question 13

Candidates found this question challenging, using a conversion graph to compare prices beyond the limit of the scale. It was common to see a simple subtraction, 120 – 90. Working was essential in this question in order to score well. Those who did show a sensible conversion (using a value of at least \$5 or £5) generally found a correct comparison. However, 'internet' was still chosen quite often.

Answer: Shop with a correctly worked conversion seen.

Question 14

(a) Many candidates did not realise that the third term meant that n had to have the value of 3. Just 5^2 was seen a number of times. The other main misunderstanding was to give answers containing n, for example n^3, $3n^2$ and $5n^2$. Many did not attempt this question.

(b) Finding an expression for the nth term was found challenging. While some did reach the $6n$ part, most found it difficult to work out the constant. Common errors were to make +6 the constant rather than the multiplier of n or writing $-6n$ instead of $6n$. While unsimplified forms were acceptable, it was common to see errors in attempted simplifications.

Answers: **(a)** 45 **(b)** $6n - 10$

Question 15

This pie chart question was quite well answered but a considerable number of candidates made no attempt to work out the required angles. Generally those who did work out the angles correctly were successful in completing the pie chart. However, there were a few candidates who did not have a protractor or were just guessing at angles that reflected the relative numbers of students in each group. There were a few cases of finding percentages but most of these struggled to produce a correct pie chart.

Answer: A correct pie-chart with angles of 171°, 135° and 54°

Question 16

(a) Cubing was quite well done but many did not gain the mark since this was an exact answer so should not have been rounded to 68.9 or 68.92.

(b) Sorting out directed numbers and brackets was very well done with few errors seen in this complex calculation. While it could be worked correctly as a single calculation on a calculator, some would have benefited from showing more working out of the individual steps.

(c) Again there was a good response but it really is advisable for most candidates to work out and write down the answers to the numerator and denominator before the division. Just putting the numbers in as the question stood produced the quite common incorrect answer of 6.33...

(d) Again the calculation was well done although some did not know how to find the cube root on a calculator and three times the square root was seen. Once again, finding the two parts individually would have helped more candidates to arrive at the correct answer, especially as the two parts came to simple values which didn't even need a calculator to subtract them.

Answers: **(a)** 68.921 **(b)** −53 **(c)** 0.35 **(d)** 5

Question 17

(a) While there was a reasonable response to this product of prime factors question, clearly many candidates did not understand what form of answer was required. Writing down the factors of 56 and writing some on the answer line, not necessarily all prime factors, was common. 4 was a common factor to be included with otherwise prime factors. Even those who identified just 2 and 7 very often did not take the step to a product or just wrote 14 from 2×7. Multiple pairs such as 8×7 or 4×14 were also seen.

(b) Finding the lowest common multiple seemed more straightforward for candidates and was answered more successfully than part **(a)**. However many listed the factors of the two numbers, even identifying common factors, but not knowing how to progress to the LCM. A number managed to gain a mark from another common multiple. The confusion between HCF and LCM was also significantly evident with the answer of 14 seen besides the less obvious 2 and 7.

Answers: **(a)** $2^3 \times 7$ **(b)** 168

Question 18

(a) While many candidates knew they had to bisect the angle there were a lot of constructions without the required arcs; particularly missing were arcs on *BC* and *DC*. However, there were many who did not have lines passing through the point *C*, even joining *B* to *D*.

(b) There was a better response to the locus from *E* and most had an arc with the correct radius. However, there were an appreciable number who still find the term 'locus' difficult and a wide variety of non-circular attempts were seen. A number lost the mark by not drawing the arc the full distance inside the pentagon, although outside was not penalised.

(c) The region depended on parts **(a)** and **(b)** at least scoring. Many who had fully understood the question did score this final mark. Many thought more than one section needed shading as there were two bullet points and there was a high level of no responses to the locus.

Question 19

This simultaneous equations question was successfully answered by many candidates. The main error came from weakness with directed number manipulation when, for example, eliminating the *x*'s led to $15y - (-4y)$. This often produced $11y = 152$. There was still some confusion whether to add or subtract after multiplying the equations. A number used substitution, not the best method for this case, although occasionally correct. The vast majority who gained the two method marks went on to score full marks for this question.

Answer: $x = 10$ $y = 8$

Question 20

(a) Nearly all candidates could write down the correct co-ordinates of the point. The main error was to mix up the co-ordinates to give (2, −3).

(b) Again this was plotted correctly by the vast majority of candidates although those getting part **(a)** incorrect usually also didn't plot *B* correctly. (1, 3) and (−1, 3) were the most common incorrect plots.

(c) In contrast finding the gradient was found challenging. Partly this was due to a significant number of candidates assuming they had to find the gradient of the line from *A* to *B* instead of the question which specified the drawn line, *L*. Most chose two points on the line (although some had at least one point not on the line) but often could not work out correctly $\frac{y_2 - y_1}{x_2 - x_1}$ or reversed the numerator and denominator. More success was gained by candidates who counted squares, as the scales were the same, or by taking points in the first (positive) section. Some clearly had no understanding of what was meant by gradient and didn't end up with a single numerical value.

(d) Those few who did find a correct gradient in part **(c)** generally gained the mark for the equation. However, some did not understand that they simply needed to relate their gradient and the intercept on the *y*-axis to the values *m* and *c* respectively in the equation of the line. A numerical answer, for example −1, was quite common and many candidates left this part blank.

Answers: **(a)** (−3, 2) **(b)** *B* plotted at (1, −3) **(c)** $\frac{1}{2}$ **(d)** $[y] = \frac{1}{2}x + 1$

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

Ensure answers are given to the required accuracy and avoid premature rounding in working.
When a question states without a calculator and that you must show all your working, credit will not be given to candidates who use a calculator and do not show full working.
Care needs to be taken with writing, particularly figures which are often not clear.

General comments

The standard of candidates' responses was generally very good. The majority of candidates appeared to have had sufficient time to complete the paper.

Rounding to 3 significant figures is stated in the rubric. Non-exact answers to less than 3 figures will lose at least accuracy marks unless a more accurate answer is seen in the working. This was seen quite often in **Questions 4** and **21** where 6.6 and 2.4 were given as answers, without more accurate values being shown in the method.

Revision should include basic skills as well as the advanced topics; many candidates could not handle basic place value in **Question 13(a)**.

Comments on specific questions

Question 1

This measuring question was generally answered correctly. The most common incorrect answer was 7.9.

Answer: 7.4

Question 2

The majority of candidates gave the correct answer.

Answer: 126

Question 3

This question was generally well answered. There were some answers of 50%, presumably from $\$72.50 \div \$1.45 = 50$. The other common error was $1.45 \times 72.5 \div 100 = 1.05$.

Answer: 2

Question 4

This question was well answered by the majority of candidates. The most common error was to give the answer 6.6 rather than an answer to 3 significant figures. The answer should be fully evaluated rather than given as a fraction.

Answer: 6.59

Question 5

Many candidates knew they had to put a bracket into their answer and several were able to gain the mark. Others were unsure of how to deal with the first y and took it as the factor but then just wrote $2y$ or $-2y$ inside the bracket.

Answer: $y(1-2y)$

Question 6

This question was very well answered with the vast majority clearly understanding the rules for subtracting vectors. Most errors were due to a lack of understanding of directed numbers. For the first component, the common error was −1 from 2 − 3 rather than 2 − (−3). Only a few candidates wrote a fraction line.

Answer: $\begin{pmatrix} 5 \\ 1 \end{pmatrix}$

Question 7

Many candidates knew to draw a vertical and horizontal line and scored both marks. A significant number also added diagonals.

Question 8

Many candidates showed a good understanding of dividing in a given ratio. The most common error was to divide 72 by 5 and then by 4, giving answers of 14.4 and 18. Some gave amounts not adding to 72.

Answer: 40 : 32

Question 9

(a) Most candidates gave the correct answer. There were a small number who gave the answer 13.

(b) This part was also very well answered. The main error was 12 from 15 – 3.

Answers: **(a)** –3 **(b)** 18

Question 10

Whilst many candidates were able to give the correct simplification, there were a significant number who did not understand which sign applies to which term. A small number tried to factorise and gave their answer as $p(2-5)-q(1-3)$ or similar.

Answer: $-3p-4q$

Question 11

(a) Some candidates gave the correct answer. There appeared to be a lack of understanding of significant figures and many appeared to confuse the term significant figures and decimal places. 0.08 was a common incorrect answer.

(b) This part was less well answered with many not writing place holders, leading to 10 as a common incorrect answer; the other common incorrect answer was 10 100.

Answers: **(a)** 0.076 **(b)** 10 000

Question 12

Many candidates had followed the wording of the question and scored both marks. Candidates needed to show clear, full working.

Answer: $\frac{3}{8}$

Question 13

(a) This part was generally well answered. The most common errors were as a result of not understanding place value, as shown by answers of 5 200 007, 500 200 007, 5 207 000.

(b) This part was less well answered. Many made an attempt at using a power of 10 but it wasn't written in standard form, e.g. 81.3×10^{-4}.

Answers: **(a)** 5 000 207 **(b)** 8.13×10^{-3}

Question 14

Almost all candidates understood the term factor. Very few listed any numbers which weren't factors of 30. The most common reason for not scoring both marks was due to not listing all the factors; usually 1 and 30 were omitted.

Answer: 1, 2, 3, 5, 6, 10, 15, 30

Question 15

The majority of candidates scored both marks.

Answer: 0.27

Question 16

(a) Many candidates clearly understood the term gradient but gave the answer as 4*x* rather than 4.

(b) This part was less well answered. A common error was to give the answer 6 rather than –6. Several candidates did not attempt to answer this part.

Answers: **(a)** 4 **(b)** –6

Question 17

Many candidates appeared not to understand what was required for this question. Some scored one mark for 30.5 with 31.4 or otherwise as the 2nd value. Several gave integer answers, commonly 30 and 32.

Answer: 30.5 31.5

Question 18

(a) Many candidates were able to give the correct answer. Some clearly knew the median as the middle value but had not listed the values in order first, and gave the answer as 46.5 from 73 and 20, the middle values in the original list. Some correctly ordered the list but were unable to work out the mean of 20 and 23, giving the answer 22. A small number calculated the mean rather than the median.

(b) This part was less well answered. A common error again was not thinking about the order of the numbers and just calculating 54 – 16. Some who had correctly used the highest and lowest values wrote 95 – 7 on the answer line without resolving it.

Answers: **(a)** 21.5 **(b)** 88

Question 19

(a) Most candidates gave the correct answer.

(b) Many were able to give the correct answer and showed method. The most common error was to use 48 as one of the base angles and give the answer as 84.

Answers: **(a)** 110 **(b)** 114

Question 20

Many candidates were unable to give the correct answer. Several scored one mark for $360 \div 20$. Many did not show any method.

Answer: 162

Question 21

The majority of candidates scored full marks. The common errors were $95 \div 10$, 2.43 from the error $0 \times 5 = 5$ and 2 from $10 \div 5$, not from rounding the correct answer.

Answer: 2.38

Question 22

The majority of candidates were able to give the correct answer. Of those who did not, the majority were unable to use ratio and gave the answer 11, subtracting 12 from 23.

Answer: 9.2

Question 23

(a) Many candidates gave the correct answer. A small number reversed the co-ordinates.

(b) This part was also well answered. Those who had reversed the co-ordinates in part **(a)** generally did so in this part also.

(c) This part was less well answered than the previous parts. There were various combinations of ± 2 and ± 8.

Answers: **(a)** (5, 3) **(c)** $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$

Question 24

The majority of candidates made an attempt at this question and some scored full marks. Several scored one mark and others wrote various conversions, e.g. 108 km = 108 000 m or 1 min = 60 seconds but did not know what to do after that.

Answer: 600

Question 25

Quite a few correct answers were seen in this question, almost all from using the formula. Several gave the interest instead of the value of the investment. A small number of candidates calculated simple interest.

Answer: 5306.04

Question 26

(a) Many candidates were able to give the correct answer. A small number subtracted 7 rather than added. A small number 'simplified' $3w - 7$ to $-4w$.

(b) Again many correct answers were seen in this part. Some made numerical slips when multiplying out the bracket. Some who gave the answer as a fraction had not cancelled to its simplest form.

Answers: **(a)** 13 **(b)** 0.7

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 vocabulary, show all necessary working clearly and use efficient methods of calculation. They should be encouraged to spend some time looking for and applying 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.

Candidates should write neatly and clearly and not write over answers. If a mistake is made, they should cross it out and re-write their answer.

Candidates should remember to show full, clear working so that marks can be awarded when arithmetic errors are made or when values are typed incorrectly into a calculator. Showing basic working can sometimes seem trivial but it is essential to show where a value has come from when these kinds of errors occur. Checking answers thoroughly will help to lessen these errors and to ensure that the candidate has fully understood and answered the question.

Candidates were successful in number work, demonstrated in **Questions 4** and **14**, along with angles in **Question 16**, simultaneous equations in **Question 18** and interpreting a graph in **Question 21**.

The bounds question, **Question 8**, highlighted misconceptions as did **Question 13**, construction and loci. Answers to the capacity question, **Question 10** highlighted an area for improvement, as did **Question 22(b),** the most challenging question for candidates on the paper which involved probability with dependent events.

Comments on specific questions

Question 1

The correct answer was the one seen most often and many did this with no working needed. Candidates should have a strategy for dealing with time differences, as many resort to a subtraction sum without taking into account that there are 60 minutes in each hour rather than 100. Many subtracted 0615 from 2120, resulting in the common answer of 15 h 5 min. Just looking at the differences in hours and minutes separately resulted in answers of 7 h 5 min, 8 h 5 min and 9 h 55 min.

Answer: 8 [h] 55 [min]

Question 2

The majority of candidates knew that the triangles had equal sides and angles, as words such as ‘identical’ and ‘equal’ were extremely common. It was the minority who knew the correct vocabulary and were able to give the correct answer.

Answer: Congruent

Question 3

This was another question where candidates needed to know the correct vocabulary. The majority of candidates did know the correct term, although there were many answers which demonstrated that they did not know how to describe correlation, with descriptions such as linear, energy/time, descending, decreasing, mixed, inverse, inversely proportional, inconsistent and average. Some knew the vocabulary but decided that it was positive correlation.

Answer: Negative

Question 4

The vast majority of candidates understood the meaning of standard form and gave the correct value. Those who got it wrong usually gained one mark for the digits 736 but lost the second mark by not giving the correct power of ten. Answers of 73.6×10^6 and 736×10^5 were common, as were answers with negative powers of 10. Candidates should remember not to round or truncate prematurely, as a small number rounded 7.36 to 7.4 and if a more accurate value was not seen, could not be credited.

Answer: 7.36×10^7

Question 5

The overwhelming majority of candidates understood that multiplying out two sets of brackets each containing two terms would result in four terms, and most did this correctly. The majority could also simplify the two terms in x to gain both marks. Many gained one mark for getting at least three of the terms correct; some got them all correct but then wrote $-13x$ rather than $+13x$ in the simplification. It was fairly common to see one of the x terms without the x, resulting in, for example, $6x^2 - 14 + 27x - 63$ and the power 2 in $6x^2$ was often omitted. This may have been rectified with careful checking. A few candidates spoilt their correct answer by factorising back and writing this on the answer line.

Answer: $6x^2 + 13x - 63$

Question 6

Candidates found it challenging obtaining the correct final answer in this bearings question, but the majority of candidates made a correct start by taking 227 from 360 to find 133. Candidates should be advised to draw the North line on a point where it is not already on the diagram, as it would give a much clearer picture of the angle which is required. Many candidates did not know which angle they needed to find for the bearing and so more practice on this type of question would be advised. Many correctly found 47 but then subtracted this from 90 to give an answer of 43; others left their answer as 133, and 270 was seen in many calculations.

Answer: [0]47

Question 7

Many candidates understood what was being asked and gave the correct equation. There were just as many who gained one mark out of two and this was usually because they did not know how to put the equation together after finding the constant of proportionality, or they gave a different equation after finding the correct one. This was sometimes resorting back to using k rather than 4 or the use of 4 but within a different proportionality relationship. Candidates appear more used to being asked to find a value, as many gave a numerical value as the answer, either the constant of 4, or 0.5, the value of y after going round in a circle putting $x = 2$ back into the correct equation. Candidates should be advised to follow the standard pattern of setting out, showing the proportionality first, followed by an equation with the introduction of a constant of proportionality. It is usually those who shortcut these steps who make mistakes. Those who did not gain any marks were usually considering the wrong type of relationship, generally direct proportion or not taking the cube into account.

Answer: $\frac{4}{x^3}$

Question 8

Finding bounds is a topic which continues to highlight misconceptions. Candidates should understand that a bound should be applied before a calculation is performed on that value. The majority of incorrect answers came from those who divided 6000 by 50 and then applied a bound, or those applying the incorrect bound, usually 6500, 6005 or 6000.5.

Answer: 121

Question 9

Most candidates could work out the interest of 96 correctly and many realised that the question required the value of the total investment to gain all three marks. There were just as many who did not recognise the need to add on the original amount, thereby giving the final answer as 96. The two most common misconceptions were to add one year's interest on to 800 and multiply that by 4, and the use of compound interest, both of which did not score any marks.

Answer: 896

Question 10

The majority of candidates knew that they needed the product of the three dimensions given, and most correctly converted to the same units, most commonly metres, before multiplying. The vast majority however were unable to deal with the conversion to litres. Many did not attempt a conversion at all and left their answer as what they had calculated the volume to be, either correctly as 0.9 if working in m^3 or 90 if they had used inconsistent units to find the volume. Candidates should take care to check if the units are consistent within a question and they also need to learn conversions or have a strategy to work them out.

Answer: 900

Question 11

Virtually all candidates gave the correct value in part **(a)**. A good understanding was also shown in part **(b)** where the majority gave the correct expression for the nth term. Errors were sometimes made by substituting incorrect values into the general formula and $5n + 3$ was also seen a number of times. The most common incorrect answer was $n + 3$.

Answers: **(a)** 23 **(b)** $3n + 5$

Question 12

The vast majority of candidates scored at least two marks for solving the inequality as far as $3.75 \leqslant n < 7$. This is another example of candidates needing to understand vocabulary or read the question more carefully, as many did not go on to answer the question, which required integer values. Some only dealt with one side of the inequality, leading to $3.75 \leqslant n < 28$. A few candidates tried to solve the inequality by subtracting 15 from 28 and dividing the answer by 4, resulting in the incorrect answer of $n < 3.25$. An answer of 16, 20, 24, i.e. $4n$ was given in a number of cases. Some candidates successfully used trial and error to find all three integer values, but others using this method found one value which worked and stopped.

Answer: 4, 5, 6

Question 13

The majority of candidates understood that they needed to bisect angle *ABC* and did this accurately using compasses. More would have been accurate if they had set their compasses wider when drawing the arcs on *AB* and *BC* as many were so close to *B* that the resulting crossing arcs were inaccurate, or did not show a precise crossing point. It seemed that some measured half way along *AC* and joined this to *B* which produced an inaccurate line. The question asked for the locus of points inside the triangle, so the bisector needed to reach *AC* and some candidates lost a mark by drawing a short line. Some candidates drew bisectors from each corner of the triangle, and candidates should understand that covering all possibilities will not gain them marks for the correct answer unless they have clearly indicated which they have chosen as their answer. Others scoring no marks tended to bisect one or more of the sides of the triangle rather than the angle. Those who drew the correct line usually went on to shade the correct region in part **(b)** and some whose line was slightly inaccurate could also go on to gain this mark for the correct shading. Errors in shading included shading the whole area above the bisector, shading all outside the given locus and shading the correct region apart from the section inside their construction arcs from *B*. If candidates shade each given region then look for their overlap, it must be made clear to the examiner which is their final answer by rubbing out the unwanted region or clearly labelling the correct region; some had double shading but did not select which was their chosen region.

Question 14

Candidates demonstrated that they can accurately deal with fractions. The majority used the efficient method of inverting the second fraction, which they had turned into an improper fraction, and multiplying. Candidates should understand that in non-calculator questions, all working needs to be shown. In this question, writing $\frac{3}{8} \div \frac{9}{4} = \frac{1}{6}$ or $\frac{12}{72}$ was not enough; it was essential to see the inversion and multiplication. Some candidates made the denominators equal and showed $\frac{3}{8} \div \frac{18}{8}$ which was also acceptable. A small number made an initial error turning $2\frac{1}{4}$ into an improper fraction but correct working often followed.

Answer: $\frac{1}{6}$

Question 15

Candidates demonstrated a good understanding of dealing with algebraic fractions and the majority gained at least one mark for this question. The common denominator of $3(x + 2)$ was the starting point which most candidates found. From there the majority of candidates were able to form a numerator of $(x + 2)(x - 5) + 3 \times 6$. There were a number of candidates who tried to simplify by cancelling the two $(x + 2)$ brackets from the numerator and the denominator. Some sign errors were apparent in the expansion of the brackets in the numerator and the gathering of like terms. Candidates should ensure that they use brackets correctly when multiplying expressions containing more than one term, as it was common to see $x - 5(x + 2)$ in the numerator. Some recovered this error by multiplying out correctly but if mistakes were made, they could not be credited for this starting point. Further 'cancelling' of individual terms in the numerator and denominator often spoilt what had been a correct answer.

Answer: $\frac{x^2 - 3x + 8}{3(x+2)}$

Question 16

The majority of candidates demonstrated a good understanding of angles in parallel lines and were very successful with this question. Once the angle at *A* was recognised as 56, the rest of the question was usually carried out correctly. A common error was to think that $x = 56$, either by an incorrect application of angles in parallel lines, or by taking the wrong two sides of the isosceles triangle as equal. A good number of these candidates achieved two marks by following through correctly to find *y*. A small number of candidates thought angle *BCL* was equal to 90, resulting in an incorrect value for *x* of 34.

Answer: [x =] 62, [y =] 118

Question 17

Part **(a)** required the answer of 8, which was given by the vast majority, and not t^8 given by some, along with the other common incorrect answer of 5. Part **(b)(i)** proved the most challenging of the simplifications with many not dealing with the negative power, hence writing the fraction upside down. Candidates should be aware that brackets need to be removed and so $\left(\frac{x}{4}\right)^2$ was not sufficient for the mark, neither were other commonly seen fractions such as $\frac{0.0625}{x^{-2}}$ and $\frac{4^{-2}}{x^{-2}}$. Part **(b)(ii)** was much better attempted with many scoring both marks, alongside those gaining one mark for either *a* or *b* with a correct power. A division sign is not permitted as part of a simplified expression and so $b^5 \div a^3$ could only score one mark.

Answers: **(a)** 8 **(b)(i)** $\frac{x^2}{16}$ **(ii)** $a^{-3}b^5$

Question 18

The vast majority of candidates demonstrated that they could apply a correct method to solve simultaneous equations and most carried it through accurately to score all four marks available. The method of elimination continues to be the most popular method and it was using this method that candidates were most likely to go on to reach the correct values. Errors were made with the negative value, which often led to an inconsistent addition or subtraction of the equations. Those using the substitution method generally gained two marks for showing the correct substitution, but dealing with fractions when solving the equation led to far more errors. A few candidates used the matrix method of solving equations and Cramer's Rule was also seen, but these were far more time consuming and more likely to contain errors.

Answer: [x =] 6, [y =] –8

Question 19

The vast majority of candidates gained marks in this question, with many obtaining all four marks available. Most candidates knew the quadratic formula, and were successful in substituting the appropriate values into it. Those who made errors in the substitution usually faltered with the negative value of '*c*' and the uncertainty of where to use –*b* or *b*. As this question asks for all working to be shown, candidates should take care with both the fraction line, ensuring that it reaches the full length of the numerator of the fraction, and the square root sign, ensuring the line covers all terms of the discriminant. They should be aware that correct answers alone or with incorrect working will not gain full marks. Rounding correctly was an issue for a number of candidates. Many did not read the requirements of the question to give the answers to 2 decimal places and there were many incidences of truncating rather than rounding. Again, checking answers thoroughly with reference to the question would have alerted many to adjust their answers.

Answer: –3.41 and 1.08

Question 20

Candidates have obviously spent some time working with matrices as this was a well attempted question. In part **(a)**, there were often some arithmetic errors involving the multiplications of the negative values, and sometimes there were errors in which elements were being used. Some candidates had clearly not learned the procedures involved in one or both parts of the question, but these were in the minority. Candidates who could answer part **(a)** also tended to do well in part **(b)**. There were many who scored one mark for correctly showing the determinant of 10, or for showing the correct matrix with an incorrect or no multiplier.

Answer: **(a)** $\begin{pmatrix} 26 & 2 \\ 19 & 8 \end{pmatrix}$ **(b)** $\frac{1}{10}\begin{pmatrix} 3 & -2 \\ -7 & 8 \end{pmatrix}$

Question 21

Candidates demonstrated a good understanding of the graph and the questions being asked throughout all of part **(a)** which was answered correctly by the vast majority. There was a very small minority who mis-read the scale on the *y*-axis and gave an answer of 30 in part **(i)** and others gave an answer of 40, perhaps as it was the first value on the scale. Part **(b)** required a combination of interpreting what had just been written for part **(a)**, alongside knowledge of the formula for compound interest. It was a minority who earned both marks available here, but many gained the method mark for writing an expression in terms of *r* raised to the power of 14. It was common to see the correct side of the equation which was showing the compound interest alone rather than being equated to anything. Within this side of the equation, it was common to see *r* or *r*% rather than $\frac{r}{100}$ and other letters of the formula such as *A*, *n* and *t* were used rather than relating to the values within the question. Those who scored no marks were sometimes using the formula for simple interest or were using values of 54 and 280 from part **(a)(iii)**. Despite the question stating that the equation did not need solving, many went on to try and manipulate the equation to find *r* and this was occasionally done correctly; those who manipulated incorrectly were not penalised once the correct equation was reached.

Answer: **(a)(i)** 20 **(ii)** 14 **(iii)** 280 **(b)** $2[\times 20] = [20]\left(1+\frac{r}{100}\right)^{14}$

Question 22

The majority of candidates understood the need to add the probabilities in part **(a)** to gain the correct answer. Some made errors selecting the correct values from the table, either misunderstanding what was being asked or not reading the question carefully enough. The most common error here was to multiply the two probabilities and a few used probabilities of $\frac{1}{48}$ and $\frac{1}{46}$. Part **(b)** proved to be the most challenging question on the paper and so recognising and calculating probability involving dependent events is an area where candidates should strive to improve. Many candidates did understand the need to multiply the probabilities but the vast majority of these did not treat the events as dependent and so calculated $\frac{50}{200}\times\frac{56}{200}=\frac{7}{100}$. Of those who did recognise the dependent events, there were very few correct answers, as they did not consider the two permutations. Some also reduced the numerator of the second fraction, so giving $\frac{50}{200}\times\frac{55}{199}$. There were also many who added the probabilities, usually with both denominators 200, while others, as in part **(a)**, multiplied $\frac{1}{50}$ and $\frac{1}{56}$.

Answers: **(a)** $\frac{94}{200}$ **(b)** 14.1

Question 23

The majority of candidates made a correct start in part **(a)** by stating 3^{3x} and gained a mark for this correct substitution into the function. There was a minority who could then go on to manipulate the indices to find the answer of 27. The most common answer was 9, usually stemming from the 'cancelling' of the powers to 3^{2x} or from those who made the incorrect first step of $3 \times 3x$. Parts **(b)** and **(c)** were more familiar functions questions and candidates showed a good understanding of these. Most candidates could equate the two functions in part **(b)** and go on to solve it correctly. The most common error was to substitute 2^4 in to $7 + 3x$ and work out $7 + 3 \times 16$. Some candidates made errors in the algebraic manipulation of both parts **(b)** and **(c)**. Some manipulated the equation correctly in part **(c)** but then forgot to interchange *x* and *y*. The most common misconception in this final part was believing that $\mathrm{f}^{-1}(x)=\frac{1}{\mathrm{f}(x)}$.

Answers: **(a)** 27 **(b)** 3 **(c)** $\frac{x-7}{3}$

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

The paper proved accessible as nearly all candidates were able to demonstrate clearly their knowledge and ability. There was little to suggest that candidates were short of time, as almost all attempted the last few questions. The standard of presentation was generally good although there were a small number of candidates who did not keep their working within the allocated space for the question or did not clearly form distinguishable numbers particularly 4 and 9 or 1 and 7. Candidates showed evidence of good basic skills with particular success in the first six questions and in **Questions 8**, **15(a)** and **24(c)**. There were few candidates showing just the answers so consequently more method marks were awarded. There is a need to work to an appropriate accuracy; some lost marks due to rounding or truncating within the working or giving answers to less than three significant figures. Candidates found the following questions particularly challenging: set notation in **Question 7(b)**; finding the obtuse angle given sin $x = 0.43$ in **Question 12**; completing the square in **Question 16** and shading the correct locus in **Question 19(c)**.

Comments on specific questions

Question 1

The vast majority of candidates found this a very accessible first question knowing how to correctly write in standard form. The most common error was 23×10^3 and also occasionally 23. There were quite a few blank responses among the less able candidates.

Answer: 2.3×10^4

Question 2

This question was exceptionally well answered with most candidates recognising that *ON* is the same as *OM*. Although some showed working, most seem to have instinctively used symmetry. Most incorrect answers came from the use of Pythagoras' theorem to try to answer the question. Candidates are advised to consider the number of available marks which may have guided them into realising little working was required. Incorrect answers included: 5.98 from $\sqrt{9^2 - 6.73^2}$ (6.73 coming from $\sqrt{4.5^2 + 5^2}$), 5.83 from $\sqrt{5^2 + 3^2}$ and 4 from $9 - 5$.

Answer: 5

Question 3

This question was well answered with the vast majority of candidates giving the correct answer. In most cases there was no working shown as the answer could be obtained from the calculator. Some recognised 0.125 as $\frac{1}{8}$ and proceeded to show all the stages of their working, although this was not required. The ability to correctly use negative and fractional powers on a calculator is a useful mathematical skill.

Answer: 4

Question 4

This question proved accessible to the majority of candidates and produced many correct responses. Mistakes were usually due to an index error, with $6x - 2x^2$ being the most common incorrect answer. Some candidates spoilt a good start by trying to further manipulate their correct expression in some way. There were a number of candidates who preferred descending powers so the correct answer $-2x^3 + 6x$ was occasionally seen as was the incorrect answer $2x^3 - 6x$. Occasionally a more complicated expansion was attempted involving attempting to square the bracket. A small number of candidates expanded correctly but then attempted to simplify further by dividing through by 2 to reach $3x - x^3$ or, in some cases, to factorise the expression again.

Answer: $6x - 2x^3$

Question 5

This question was very well completed by nearly all candidates. Most used the efficient method of changing $\frac{2}{5}$ into $\frac{6}{15}$. Some used the less efficient 75 as a common denominator and this is generally where any mistakes occurred. It was rare to see adding the numerators and adding the denominators to give $\frac{3}{20}$ although a small number of candidates did demonstrate this misunderstanding. It was also rare to see candidates lose the marks for giving the correct answer with no working shown (a requirement of the question was to show all the working.)

Answer: $\frac{7}{15}$

Question 6

This question was well answered with most candidates correctly reaching the answer $m \geqslant 3$. Of those who did not score two marks, many scored one mark for a correct first step of $7m \geqslant 19 + 2$. Errors usually included use of an incorrect inequality, use of an equals sign or for just giving the answer 3. Only a very small number scored zero and this was generally from an incorrect first step such as $7m \geqslant 19 - 2$.

Answer: $m \geqslant 3$

Question 7

A significant number of candidates obtained the mark for part **(a)**. The most common incorrect answer chosen was $D \subset C$ and occasionally no response was seen. Part **(b)** was the most challenging question on the paper. Many candidates wrongly gave the answer as a list of integers that satisfied the condition therefore demonstrating an understanding of the union notation but not the 'n( )' notation. There were some incorrect answers of n(7) seen.

Answers: **(a)** $C \cap D = \{10\}$ **(b)** 7

Question 8

This was another well answered question with most candidates giving the correct factors. A few gained one mark for partial factorisation usually $x(y + 2) + 5(y + 2)$ but seemed unsure where to go from there. A small number attempted the partial factorisation but missed out the addition giving answers such as $y(x + 5)\,2(x + 5) = 2y(x + 5)$. There was a very small number who seemed to have no idea what to do giving answers with just one set of brackets such as $10xy(2x + 5y)$ or else confusing solving with factorising and setting up an equation.

Answer: $(x + 5)(y + 2)$

Question 9

Many candidates answered this question well and showed appropriate working with the most efficient working being $30000 \times \left(1 - \frac{2}{100}\right)^6$. Of those with correct working most remembered to also follow the instruction to round their answer to the nearest hundred. A few did not think of the context of the question leaving their answer with a decimal part number of lions. The most common answer, scoring just one mark, was to round a correct answer to a different accuracy to that required, usually to the nearest whole number. There were a small number of candidates who spent a long time calculating the change year by year; usually these candidates lost accuracy in their calculations due to premature rounding part way through. A few candidates attempting a compound percentage change calculation but increased rather than decreased by 2% per year, with some using the working $30000 - \left(30000 \times \left(1 + \frac{2}{100}\right)^6 - 30000\right)$. The most common error on this question, although very much by a minority of candidates, was to apply a 'simple interest' technique, finding the fall for the first year and multiplying by 6, resulting in the common incorrect answer of 26400.

Answer: 26600

Question 10

Quite a few candidates did not achieve two marks here although it was comparatively rare for candidates who attempted the question to score zero. Many wholly correct and efficient responses were seen but some spoiled answers were seen. A number of candidates wrote $\frac{1}{2}rt$ or $\frac{rt}{2}$ on the answer line despite $\frac{r+t}{2}$ having been seen in the working. There were also a small number of correct solutions obtained by calculating $\frac{x_2 - x_1}{2}$ and $\frac{y_2 - y_1}{2}$ then adding the result to (x_1, y_1) or subtracting from (x_2, y_2) accordingly. A significant number did not simplify $\frac{4w}{2}$. There was a variety of incorrect approaches seen. Some candidates just subtracted the *x* and *y* values and put that on the answer line, some subtracted and divided by 2. A small number reversed the *x* and *y* co-ordinates and a similarly small number of incorrect attempts were based on a gradient calculation $\frac{y_2 - y_1}{x_2 - x_1}$.

Answer: $\left(2w, \frac{r+t}{2}\right)$

Question 11

This question proved more challenging for candidates, but overall there was still a high success rate. It was quite common to see $12 + 12 + 12 = 36$ with the conclusion that the upper bound is 36.5 and the lower bound is 35.5. Others gave the bounds of the side lengths as their answers and did not go on to apply these to the perimeter. On a significant number of occasions, the correct answers were given but in the wrong order. Some candidates who found 34.5 as the correct lower bound incorrectly opted for 37.2 (from 12.4×3) as the upper bound. Some candidates were too precise with their accuracy and used 11.95 and 12.05 as the bounds for the side lengths.

Answer: 34.5, 37.5

Question 12

This question was one of the more challenging questions on the paper. The majority of candidates were able to find the inverse sine correctly. Of these, quite a few did not seem to realise the significance of being told the angle was obtuse and hence 25.5 was a common answer. Quite a few missed this mark due to incorrect rounding or truncating, with 25 or 25.4 seen quite frequently. There were also a substantial number of candidates who, having found the acute angle, were unsure what to do and 90 + 25.5, 180 + 25.5 or 360 – 25.5 were all occasionally seen. A small number used trial and improvement to get close, often leading to an integer answer such as 25 or 26. A very small number simply subtracted 0.43 from 180 or multiplied 180 by 0.43.

Answer: 154.5

Question 13

Most candidates found that 6 was the common difference and many arrived at $6n - 10$. A successful and efficient method was to find the common difference 6 and to write this in front of the n and then to work backwards by subtracting 6 from –4 to find the 'zero term' to give the –10 part of the expression. Many candidates prefer to use a formula with $a + (n - 1)d$ commonly used. However there was the occasional misprocessing of this. Also the danger in learning a formula for something where there are simpler methods is that the formula is sometimes wrongly learned, e.g. $a(n - 1)d$ was also occasionally seen or the correct formula written but no awareness of what the letters a and d represent.

Answer: $6n - 10$

Question 14

This question was quite well answered with candidates having equal success with the diagonal as well as the vertical boundaries. Many did not read the question carefully and did not label R, despite the question asking for this and this led in some situations to ambiguity about what region was intended. Others shaded the required region, rather than shading the unwanted regions. This scored full marks if R was labelled. A small number of candidates added extras, often $y = 3$ or $y = 2$.

Question 15

This question was generally very well answered. The majority of candidates had a clear understanding of how to manipulate matrices. Part **(a)** was generally correct with only an occasional candidate missing a negative sign or including an incorrect negative sign. The numbers were nearly always correct. Part **(b)** proved to be more challenging although most candidates were able to score at least one mark. Some did not calculate the determinant correctly or forgot to include it. A few did not take the reciprocal of it. It was rare to see the reciprocal of all the numbers in the matrix **M** but there were still some candidates demonstrating this misunderstanding.

Answers: **(a)** $\begin{pmatrix} 15 & -9 \\ -3 & 6 \end{pmatrix}$ **(b)** $\frac{1}{7}\begin{pmatrix} 2 & 3 \\ 1 & 5 \end{pmatrix}$

Question 16

This question was one of the most challenging on the paper for many candidates. A few efficient methods were seen with more able candidates realising all they were being asked to do was to complete the square and many went straight to the answer without a need to show any working. Because the words 'complete the square' were not used candidates were less able to answer this question than when this instruction is given. Many tackled it by algebraic manipulation with no apparent comprehension of the need to compare coefficients having done this. Many started by multiplying out the brackets to find $(x + b)^2$, usually successfully, although $2bx$ was sometimes left out and $2b$ was sometimes seen instead of b^2. Long, complicated algebraic answers were often seen on the answer line. A few candidates gained two marks by correctly finding $a = 36$ but not correctly finding b. A very small number gained one mark for finding $b = -6$ but not correctly finding a usually because of an incorrect method of rearranging.

Answer: $a = 36$, $b = -6$

Question 17

Candidates found this question challenging and scored the full range of marks with two or three marks being most common. Candidates were very good at showing full working so arithmetic slips that caused a loss of the final mark often resulted in all or some of the method marks being awarded. The first mark was obtained by many candidates with only a very small number attempting the gradient of *CD* incorrectly. The wrong method was usually finding $\frac{9--1}{7-2}$ instead of $\frac{7-2}{9--1}$ or a mix of *x* and *y* co-ordinates on the numerator (and denominator). A sizeable number of candidates who did find the gradient of *CD* correctly were unable to find the perpendicular gradient. Common errors included arithmetic slips, only doing one out of 'negative' and 'reciprocal', or most commonly simply using their found gradient unchanged (i.e. finding a parallel line.) The given point (1, 3) was usually shown correctly substituted in an equation even if they were attempting a line with an incorrect or unchanged gradient. Some candidates did not gain this mark as they substituted one of the original points rather than (1, 3).

Answer: $-2x + 5$

Question 18

This pie chart question was very well answered with the vast majority of candidates gaining all four marks. Three marks were available for a correct chart without labels but this was seen on only a few occasions; sometimes angles were written in place of labels. Two marks were available for the correct angles or percentages for the three sections found but then incorrectly drawn. This was commonly awarded for candidates who showed their working out. Insufficiently accurate percentages, i.e. giving 48%, 38% and 15% spoilt this in a few cases. When calculating angles, the incorrect calculation of dividing by 180 was occasionally seen. One mark was also often awarded for one correct section as the incorrect section generally came from showing university as 189° from the incorrect use of a protractor. The other common incorrect response scoring no marks was just to use the frequencies as degrees measurements which led to the pie chart not being filled.

Question 19

Although the majority of candidates answered the first two parts of this question correctly, there were a large number leaving this blank, which could either be due to a lack of mathematical equipment or a lack of understanding. In part **(a)**, most drew appropriate arcs showing how they found the angle bisector and there were only a few occasions where it was found without correct supporting arcs. One error occasionally seen was to draw the perpendicular bisector of the line *BD* rather than the angle *BCD*. A few found the bisector of angle C*BA* instead. Candidates are advised that the initial arcs need to be on *CD* and *CB* (or an extension of these lines). These arcs also need to be equidistant from *C*, so having these arcs at points *B* and *D* is going to give the wrong result. Having arcs too close to *C* also led to inaccuracies.

In part **(b)**, most recognised that the arc of a circle was required here and, of those drawn, most were done with sufficient accuracy. There were some arcs that were incomplete and did not score the mark as they did not extend all the way to the sides of the pentagon. On some occasions, a single straight line of 3 cm was drawn from *E*. A small minority found the region 3 cm from the side *ED* rather than the point *E*.

For those with valid attempts in part **(a)** and part **(b)**, the shading in part **(c)** was often correct. A significant number misinterpreted or missed the word 'and' so they shaded two regions on the diagram rather than the overlapping region.

Question 20

This question was one of the more challenging questions on the paper although there were still many candidates scoring the full four marks. Whilst most re-arranged in the expected way, other equivalent methods were sometimes seen. The most efficient and usually correct method was $2x - mx = 3m$, then $2x = 3m + mx$, then $2x = m(3 + x)$ followed by the correct answer. Generally, most candidates knew how to start and multiplied to give $x(2 - m) = 3m$. Quite a few went wrong at that point by, for example, subtracting m from within the brackets to give $2x = 3m + m$. A fairly common error was to expand the bracket incorrectly to give $2x - 2m = 3m$ which prevented any more than one further mark being scored as after the correct collection of terms in m giving $2x = 3m + 2m$, factorisation was not required. Another fairly common error was a sign error when gathering like terms, leading to $2x = 3m - xm$, but following through from here still allowed the candidate to score three marks. Candidates often moved both the $3m$ and $2x$ leading to $-3m - mx = -2x$ which scored the mark, but led to a harder factorisation and there were usually errors following this step. Many candidates who reached $2x = 3m + mx$ tried to simplify by dividing by x rather than factorising, giving $\frac{2x}{x} = 3m + m$, preventing any further marks. Quite a few candidates gave an answer which still had m appearing twice, e.g. following $2x - mx = 3m$ by $m = \frac{2x - mx}{3}$.

Answer: $\frac{2x}{3 + x}$

Question 21

The most successful candidates here used their knowledge of equilateral triangles to efficiently find angle *CAB* as 60°. However quite a number of candidates over complicated the method and went to some length to calculate the angle *CAB* using, for example, the cosine rule and in some cases a mixture of Pythagoras' theorem and trigonometry. This sometimes led to accuracy issues. Occasionally angle *CAB* was taken to be either 45 or 90. The most efficient method for the area of the triangle was to use $\frac{1}{2} \times 10 \times 10 \times \sin 60$ but it was reasonably common to see much longer, less efficient methods. Some candidates calculated the height of the triangle using Pythagoras' theorem and hence the area from $\frac{1}{2} \times 10 \times \sqrt{10^2 - 5^2}$. A very common error was to calculate the area of the triangle as $\frac{1}{2} \times 10 \times 10$ (= 50). In calculating the sector area, some used $\frac{60}{360} \times 2\pi r$ instead of $\frac{60}{360} \times \pi r^2$.

Answer: 30.2

Question 22

Whilst many candidates achieved full marks on this question, it proved challenging for a similar number. Most correctly used Pythagoras' theorem to find the length of the diagonal across the base of the cuboid, $\sqrt{16.2^2 + 5.5^2}$ or 17.1, thus securing the first two method marks. A number did not then use the efficient $\tan^{-1}\left(\frac{8}{17.1}\right)$ but went on to find the length of the diagonal *AB* and to use inverse sine, inverse cosine or sometimes used the sine rule or the cosine rule. At each extra stage of calculation there was scope for premature rounding to affect the accuracy of the final answer and hence a mark of three was often seen. A small number spotted the correct angle to find and almost all were aware of the right angle between the diagonal across the base and the edge up vertical to *B*. In a small number of cases $\tan x = \frac{8}{16.2}$ and $\tan x = \frac{5.5}{16.2}$ were used to find two angles that were sometimes added to give an incorrect answer. This gained no marks.

Answer: 25.1

Question 23

This question was well answered by a large number of candidates. In part **(a)**, scoring no marks was rare but many scored just the one mark for identifying 2 and 7 or 2, 2, 2, 7 as the only prime factors but not writing them as a product. Step diagrams were more popular than factor trees and usually more accurate. Part **(b)** was better answered generally with more of the candidates obtaining full marks. A fewer higher multiples such as 336, 1176 and 2352 were seen, scoring one mark. Very few candidates obtained the answer by the less efficient method of listing multiples of 56 and 42; more used prime factors or common factors to help them find the answer.

Answers: **(a)** $2^3 \times 7$ **(b)** 168

Question 24

Most candidates did well on all parts of this question, showing the ability to read correctly from the cumulative frequency graph. In part **(b)** and part **(c)** some showed the intermediate values and the working leading to the answer and others did not. The large majority of candidates got part **(a)** correct. The most common incorrect answer was 40. Part **(b)** was less well answered. A few made errors in reading values from the graph but usually had one of the two quartiles correct and so could earn one mark. A small number of candidates found the quartiles correctly but then added them or only found one of the quartiles. The most common incorrect method was to find $60 - 20$ and either to give the answer as 40, or to read from 40 on the graph and to give the answer as 25. Part **(c)** was the most successful part of the question with most candidates who were successful in earlier parts going on to score here also. However, many who did not score all the previous marks often managed to score here. Those who did not earn both marks often identified 75 for one mark.

Answers: **(a)** 25 **(b)** 12 **(c)** 5

Question 25

Many candidates answered part **(a)(i)** correctly. Common incorrect answers were $(5x + 2)^3$, $5x^3 + 2 = 0$ (i.e. writing an equation), $5(x^3 + 2)$ and $x^3(5x + 2)$. Candidates who were most successful in part **(a)(ii)** changed y for x to start with, then rearranged $x = 5y + 2$. Those that did not do this sometimes gave answers such as $\frac{y-2}{5}$. Sign errors were reasonably common in rearranging and occasionally candidates demonstrated the common misunderstanding of the notation, giving the reciprocal of $5x + 2$ as their answer. Part **(b)** was the least well answered part of the question but there were still a significant number of candidates able to obtain at least one mark. Some were unable to understand the terminology of, e.g. h(–2). The most common errors were sign errors. Many found the coefficient of a by calculating -2^2 rather than $(-2)^2$. Even with $21 = a(-2)^2 + 1$ correctly written, correct solutions did not always emerge with other sign or rearranging errors seen.

Answers: **(a)(i)** $5x^3 + 2$ **(ii)** $\frac{x-2}{5}$ **(b)** 5

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, show all necessary working clearly and use a suitable level of accuracy.

General comments

There were a number of instances of rounding answers to an inappropriate degree of accuracy and the use of 2 significant figures for answers and working was an issue. In working, it is recommended that figures are kept as accurate as possible. Many candidates know how to reach the answer from their calculators but in most questions they will be expected to show some working. Where working was shown, in many cases it was difficult to follow so candidates should try to set it out logically.

Comments on specific questions

Question 1

Almost all candidates answered this question correctly.

Answer: 126

Question 2

Most candidates answered this correctly; the most common incorrect answer was $-y(2y)$.

Answer: $y(1-2y)$

Question 3

Most candidates answered this correctly; the most common incorrect answer was 0.02.

Answer: 2

Question 4

In this question there were quite a few candidates who rounded to just 2 significant figures and gave the answer as 6.6.

Answer: 6.59

Question 5

Many gave the correct answer, usually from use of a calculator.

Answer: $\frac{9}{25}$

Question 6

In part **(a)** the answer was usually correct; the most common incorrect answer was 500 207. In part **(b)** the most common incorrect answers included 8.13×10^3 and 813×10^{-3}.

Answer: **(a)** 5 000 207 **(b)** 8.13×10^{-3}

Question 7

Most responses were correct; the most common incorrect answers included the wrong addition of the p and the q terms giving an answer of $-7pq$ or not adding the two similar terms together and leaving the answer as $p(2-5)+q(-1-3)$.

Answer: $-3p-4q$

Question 8

Most candidates gave the correct answers in both parts. The most common incorrect answers were in part **(a)** 0.1, 0.077, 0.07600 and 0.08, and in part **(b)** 10 100 and 10.

Answers: **(a)** 0.076 **(b)** 10 000

Question 9

Most candidates gave the correct answer but many did not show the working $\frac{1}{4} \times \frac{3}{2} = \frac{3}{8}$. Attempts included $\frac{1}{4} \div \frac{2}{3} = \frac{3}{8}$ or $\frac{\frac{1}{4}}{\frac{2}{3}} = \frac{3}{8}$ with no multiplication seen of 1 with 3 and 2 with 4.

Answer: $\frac{3}{8}$

Question 10

Many correct answers were seen; the only error seen came from an incorrect first step of $3w = 32 - 7$.

Answer: 13

Question 11

This question was answered well, but a common incorrect start was $\pi r^2 - A = \pi rL$ or an incorrect attempt to divide by πr, leading to $\frac{A}{\pi r} = \pi r^2 + L$. A small number of candidates incorrectly tried to simplify a correct answer such as $\frac{A - \pi r^2}{\pi r} = A - r$.

Answer: $\frac{A - \pi r^2}{\pi r}$

Question 12

Many candidates found this question challenging and the three most common incorrect responses were $\sqrt{42.45}$ which led to 6.52, $\sqrt{42.5}$ which also led to 6.52 and writing 42.25 but then dividing by 4 instead of square rooting.

Answer: 6.5

Question 13

The most common correct methods were to use 18.88… – 1.88… or 18.88… – 0.188… A few candidates did not show the recurring figures and some thought that the number was 0.1818… so they produced the incorrect answer. There were a few candidates with the correct answer but no supporting working.

Answer: $\frac{17}{90}$

Question 14

There was little working shown in this question and the most common error was to assume it was a rotation, usually 90°.

Answer: Reflection $y = x$

Question 15

The working in this question was not always logically set out. It was common to see 108 divided by 20 rather than multiplied by it. Many used 360 rather than 3600 for the seconds in an hour and some used 100 metres in a kilometre. It was also common to see $20 \times 30 = 60$ clearly written down.

Answer: 600

Question 16

Part **(a)** was usually answered correctly with an occasional *w* as an incorrect answer. Part **(b)** was not answered as accurately as part **(a)** with the most common incorrect answers being $3w^9$ *or* $9w^9$. A few left their answer in brackets.

Answers: **(a)** $\frac{1}{w}$ **(b)** $27w^9$

Question 17

The most common errors were using inverse proportionality and writing x^2 instead of $\sqrt{x}$. Some forgot to square root 25 when calculating the required value.

Answer: 10

Question 18

Most candidates knew the correct method and the most common error was to write $x^2 + 1$ for the denominator after writing $x(x + 1)$.

Answer: $\frac{1}{x(x+1)}$

Question 19

Many candidates calculated the perimeter correctly. Some candidates evaluated the correct total perimeter as 19.54 and gave answers for the two values such as $19.54 - p$ and $19.54 - q\pi$. Some candidates gave *p* as 6 rather than 12.

Answer: [p =] 12 [q =] $\frac{12}{5}$

Question 20

Some candidates tried incorrectly to factorise the expression. A few used the completing the square technique and usually they were successful. Most used the quadratic formula to find the solutions. The most common errors were to not include $-(-2)$ in the numerator of the fraction and inside the root to write -2^2. Some did not round their answers to 2 decimal places.

Answer: –0.55, 1.22

Question 21

In part **(a)** many candidates gave the correct answer. In part **(b)** the common error was to attempt 480 ÷ 12 whilst many who reached 35 did not add on 10 to get the correct answer.

Answers: **(a)** 1.2 **(b)** 45

Question 22

Many candidates were able to factorise either the numerator or the denominator correctly, but not always both. Some attempted to cancel expressions which were not common factors. The most common incorrect approach was to attempt to cancel from the original fraction, for example, $\frac{2x^2-x-1}{2x^2+x}=\frac{-x-1}{x}$.

Answer: $\frac{x-1}{x}$

Question 23

The major challenge for many candidates was identifying the correct angle to be found. A good proportion of the candidates were awarded credit for producing either $\sqrt{12^2+6^2}$ or $\sqrt{12^2+6^2+4^2}$, but then went on to use these in attempts to calculate the wrong angle, often attempting to find angle *PAB* rather than the required angle *PAC*. The most common correct approaches were working with sine or tangent, but some candidates correctly worked with cosine or the cosine rule. The use of the cosine rule led to the highest proportion of errors.

Answer: 16.6

Question 24

Most candidates answered part **(a)** correctly. In part **(b)** the minus sign did cause some to get the first column wrong. In part **(c)** common errors included an incorrect determinant, −6 and $4-2=2$ being seen. Some candidates were confused about which operations to perform on the matrix and it was common to see the minor diagonal swopped rather than the major diagonal.

Answers: **(a)** $\begin{pmatrix} 9 & 3 \\ 6 & 9 \end{pmatrix}$ **(b)** $\begin{pmatrix} 2 & 10 \\ -1 & 16 \end{pmatrix}$ **(c)** $\frac{1}{6}\begin{pmatrix} 4 & -2 \\ 1 & 1 \end{pmatrix}$

Question 25

In part **(a)** some candidates left the partial factorisation as the final answer such as $x(p-1)+y(p-1)$. In part **(b)** many achieved the first step to $2(t^2-49m^2)$. However they did not see the expression in the bracket as a difference of two squares and often left the answer as a partial factorisation.

Answers: **(a)** $(x+y)(p-1)$ **(b)** $2(t+7m)(t-7m)$

Question 26

Those who understood the topic of vectors usually answered all three parts correctly. The main incorrect answers in part **(a)** were $\mathbf{a} + \mathbf{c}$ or $\mathbf{c} - \frac{2}{3}\mathbf{a}$ .In part **(b)** some candidates used $\mathbf{c} - \mathbf{a}$ for vector *CA* instead of $\mathbf{a} - \mathbf{c}$. In part **(c)** some candidates found vector *XP* but then could not work out the ratio whilst others gave the correct answer without any working being shown.

Answers: **(a)** $\mathbf{c} + \frac{2}{3}\mathbf{a}$ **(b)(i)** $\frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{c}$ **(ii)** $3 : 2$

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings.

General comments

The majority of candidates were able to access all questions and the presentation of their work was generally good. This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. The vast majority of candidates were able to complete the paper in the allotted time. Very few candidates omitted part or whole questions. However candidates should be encouraged to not write over previous wrong answers when correcting their work, instead cross out wrong work and replace, as often answers are very difficult to read.

A common error which led to loss of marks this year was rounding exact answers. Candidates should only round inexact answers.

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 be encouraged to think whether their answer is appropriate to the data given in the question.

Comments on specific questions

Question 1

(a) (i) Completing the tally chart was well done by nearly all candidates. On rare occasions candidates wrote fractions in the frequency column, usually out of 24, or put the correct numbers in the tally column, or used cumulative or density figures.

(ii) The vast majority of candidates gained full marks for correctly completing the bar chart with an appropriate linear scale. The main errors were in writing a linear scale on the vertical axis, particularly between 0 and their first label or at the top. Some candidates omitted the scale altogether, despite being reminded in the question to do so. A few candidates chose an awkward scale, 2 squares to 3 drinks for example, which then often led to incorrect bar heights. A few line graphs were seen.

(b) (i) The best solutions seen included the time the café was open each day, given in an appropriate format of hours and minutes, followed by a multiplication or addition sum to give the final answer of 64 hours. A very common incorrect answer was 28, when the hours worked were added correctly but for three days only. Some calculated the daily hours correctly but wrote the answer as a time, e.g. 64 00. Some candidates used 100 minutes in an hour, so for example 8 h 30 mins is given as 8.3 hrs. Also candidates need to recognise the difference between a specific time, e.g. 8:30 am or 08 30 (hours) and a time interval e.g. 8 hrs 30 min.

(ii) Candidates were usually able to find the percentage of opening hours worked by Ron. Many candidates used a method which did not explicitly show their working out and therefore many candidates did follow through correctly but did not gain the method mark as their answer was rounded to 2 significant figures and the method could not be seen. For example, if **(b)(i)** was given as 46, then the working shown below achieved no marks for two reasons. Firstly the method seen does not show explicitly what they are doing and secondly, while a correct follow-through answer would still achieve the method mark an answer to 2 significant figures does not infer a correct method.

$46 \rightarrow 100$

$6 \rightarrow x = 13$, answer 13

To score the mark, this would have to be either $\frac{6}{46}\left[\times 100\right]$ and/or an answer 13.0 (i.e. 3 significant figures or more).

(c) This part was well answered. Good solutions showed clearly the calculation of the cost of the tea subtracted from the total cost and the result was then halved to find the cost of one cookie. Common errors came from not reading the question fully. Many candidates saw '2 cookies for $6.95' and divided $6.95 by 2. Others subtracted the cost of only one cup of tea from 6.95 before halving while others found the cost of two cookies but did not divide by 2 to find the cost of one cookie.

(d) Many candidates found $0.91 (35%) and gave that as their answer. Less able candidates often took 0.35 from 2.60 so 2.25 was seen often.

Answers: **(a)(i)** 7, 3, 6, 8 **(b)(i)** 64 **(ii)** 37.5 **(c)** 0.85 **(d)** 1.69

Question 2

(a) The vast majority of candidates showed understanding of factors, with very few giving multiples instead. Most candidates were able to gain one mark for correctly identifying four or five of the factors but a significant number missed the factors of 1 or 18 or both. A common error was to give the product of its prime factors (2×3^2) instead of all the factors of 18.

(b) This part was well answered. Some less able candidates gave a prime number outside of the range and many candidates attempted to give all prime numbers between 40 and 50, often leading to an error of including 45 or 49. Candidates should reread the question carefully as they were only required to give one prime number rather than all of them.

(c) Candidates generally demonstrated good calculator skills in finding the correct value but many did not gain full marks as the question required the candidates to give their answer to 1 decimal place. Correct answers were often truncated to 5.3 instead of rounded to 5.4, or given to more than 1 decimal place; 5.36 and 5.35 were common final answers.

(d) (i) Finding the square root of 2.89 was one of the best answered questions of the whole paper with nearly all candidates correctly finding the answer.

(ii) Finding the cube of 14 was equally as successful for nearly all candidates.

(iii) The majority of candidates correctly used their calculator to find the answer of 0.0625 or gave the answer as the fraction $\frac{1}{16}$. However candidates need to be reminded not to round exact answers as a significant number of candidates lost the mark because they rounded the answer to 0.06 or 0.063.

(e) (i) Most candidates correctly identified k as 7. However, the most common incorrect answer was 108 which came from $126 - 18$.

(ii) Writing 90 as the product of its prime factors proved to be the most challenging part of this question. Successful candidates usually used a factor tree or ladder to find the prime factors and then went on to write them as a correct product. Some candidates drew a correct factor tree but then listed the factors instead of writing them as a product which only gained one mark. Many less able candidates gave a product of two numbers which equalled 90. However the most common incorrect answer was 2 or a list of factors (not prime factors).

(iii) The most used and successful method to find the LCM of 90 and 126 was to make a list of multiples until a common multiple was found. Candidates who used this method generally found the correct answer of 630. Many candidates attempted to use the product of prime factors of 90 and 126 but then gave the Lowest Common Factor as their answer (2) or the Highest Common Factor (18) from $2 \times 3 \times 3$.

Answers: **(a)** 1, 2, 3, 6, 9, 18 **(b)** 41 or 43 or 47 **(c)** 5.4 **(d)(i)** 1.7 **(ii)** 2744 **(iii)** 0.0625
(e)(i) 7 **(ii)** $2 \times 3^2 \times 5$ **(iii)** 630

Question 3

(a) (i) The table was completed correctly by nearly all candidates.

(ii) This was almost always answered correctly. An answer of 100 was the most frequent error by using the differences from all three rows instead of the total only, but that was very rare.

(iii) Most candidates were able to identify the correct figures from the two way table although simplifying sometimes led to errors. Candidates who used the wrong figures from the table commonly gave $\frac{225}{275}$ or $\frac{96}{129}$ as their answers. Some who chose the correct figures did not simplify the fraction.

(iv) Most candidates were able to start with the ratio 240 : 260. If followed by attempts to simplify, it was started more often by dividing by 2 rather than 10. Some candidates continued to simplify beyond 12 : 13. Maybe because the previous part had asked about the fraction who were adults, some candidates found the ratio of adult males to females, 96 : 129, rather than what was being asked.

(v) Many of the candidates were able to correctly identify the probability and of these the vast majority gave their answer as a fraction. Candidates who didn't score on this part tended to be giving either: if a child is picked, what is the probability that it is male $\left(\frac{144}{275}\right)$, or simply the probability of a male $\left(\frac{240}{500}\right)$. Many candidates converted a fraction to a simpler fraction, a percentage or a decimal even though this was not required to gain the mark.

(b) (i) The correct answer was seen often by more able candidates. Incorrect answers included 44 (frequency of one person), 30 (either the middle frequency or an incorrect attempt at the mean). Some candidates found the median instead of the mode.

(ii) Finding the mean from a frequency table continues to challenge all but the most able candidates. It is important that candidates understand what a frequency table is telling them. This part is about the number of people in cars and therefore answers giving an average of 24, 30 or 72 people per car should make the candidate rethink their response. Successful answers showed the full method of multiplying, adding and dividing by 150. The most common answer seen however was 30 from dividing the number of cars by 5 $\left(\frac{150}{5}\right)$. Other common errors were 72 from dividing the number of people by 5 $\left(\frac{360}{5}\right)$ and 24 from dividing the number of people by 15 $\left(\frac{360}{15}\right)$.

(c) Finding the number of people using the gym was very well answered. A common error was $1500 - 50 + 18 = 1468$. This question again highlights the importance of showing working out explicitly, which should be $\frac{18}{50} \times 1500$ or equivalent.

Answers: **(a)(i)** 96, 131 **(ii)** 50 **(iii)** $\frac{9}{20}$ **(iv)** 12 : 13 **(v)** $\frac{144}{500}$ **(b)(i)** 1 **(ii)** 2.4 **(c)** 540

Question 4

(a) (i) Most candidates gained at least one mark for correctly finding the y values for $x = 0$ and 6. The most common error was for $x = -1$ with a y value of 4 instead of 6. This is because candidates found $(-1)^2 = -1$ instead of 1.

(ii) There was good plotting of points and the follow through from part **(a)(i)** was seen often. Very few straight lines joining points was seen and even fewer thick or feathered curves drawn. Some candidates did not gain full marks as they drew a straight line between the points at $x = 2$ and $x = 3$. It was important that candidates draw a curved line between these points which goes below their co-ordinates.

(iii) Candidates found this part of the question challenging. Most were able to make an attempt but the most common incorrect answer was to give the co-ordinates from the table of (2,–6) or (3,–6). Only the most able candidates read the lowest point from the curve and to gain the mark their curve had to be curved between $x = 2$ and $x = 3$.

(iv) Candidates found this part equally challenging with only the most able candidates correctly identifying both values of x. Many left it blank and those that did attempt it often did not use their graph to find where their curve crossed the line $y = 3$, with very few lines drawn to assist the candidate. Many candidates attempted the quadratic formula but very few were successful. The most common incorrect answers given were 0 and 5 which are the x values where the curve crosses the x-axis.

(b) (i) Finding the equation of the line was a very challenging question for most candidates. Few correct gradients were seen with a variety of incorrect answers given. These included calculations involving run/rise, giving the common incorrect answer of 2 or –2. Many candidates attempted to use co-ordinates on the line but few were successful in finding the change in y co-ordinates/change in x co-ordinates and often the gradient was given as $\frac{1}{2}$ instead of $-\frac{1}{2}$. Only the most able candidates gave the correct equation with many candidates giving answers without the x variable.

(ii) To gain both marks the line had to be parallel, through (0, –1) and the full width of the grid as the question stated 'for $-5 \leqslant x \leqslant 5$'. Accuracy was key to correct answers with many candidates only gaining one mark because their line was not parallel and outside of tolerance at $x = -5$ and $x = 5$ or did not reach the edges of the grid. Some candidates drew a parallel line but through (0, –0.5) because that was one square below the x-axis. The most successful answers saw candidates plotting points six squares below the line L at various places and then joining them up. A significant number of less able candidates showed misunderstanding of the statement 'for $-5 \leqslant x \leqslant 5$' and drew a line joining (–5, 0) and (0, 5) or (0, –5) and (5, 0).

Answers: **(a)(i)** 6, 0, 6 **(iii)** (2.5, –6.4 to –6.1) **(iv)** –0.7 to –0.4, 5.4 to 5.7 **(b)(i)** $y = -\frac{1}{2}x + 2$

Question 5

(a) (i) Candidates demonstrated good understanding of scale and measuring with the vast majority of candidates scoring full marks; 37.5 was the most common given value from a measurement of 7.5 cm. Few scored one mark by showing their measurement but not multiplying by 5 correctly; this was often a difficulty in multiplying a decimal and not using their calculator.

(ii) Candidates should be encouraged to estimate roughly where their answer should lie and then check that the resulting answer is in line with this. There were many correct responses but equally many candidates gave answers less than 90 or more than 180; the bearing is south-east so 090 to 180. Common errors included giving the reverse bearing *L* from *S* or problems using the protractor properly. Many answers of around 47 (and sometimes then 227) indicated candidates are reading the wrong scale on the protractor, so they should be encouraged to read around from zero. Many wrote down a measurement around 7.4 rather than an angle.

(iii) There were many well drawn bearings of the correct angle and length from *L*. Candidates were generally more successful at getting the distance of *T* from *L* (4.4 cm) for one mark rather than the correct bearing. A few measured from *S* instead of *L*. A large number of candidates did not mark *T* with a dot or cross which did lead to loss of marks due to ambiguity of where their point *T* was. If candidates do not draw a line they should be reminded that a clear dot or cross is needed to exactly indicate where *T* is.

(b) (i) To draw a correct bisector with arcs, candidates should be encouraged to set the compasses about $\frac{3}{4}$ of the distance between the two points and then draw clearly visible arcs using the same compass setting. Many arcs were only just crossing at the mid-point of *P* and *Q* and therefore two intersection points were not visible. Many arcs were extremely faint; candidates should be reminded not to rub out their construction arcs. In order to be fit for purpose in part **(b)(ii)**, the bisector had to reach beyond a 7 cm radius of both *P* and *Q*.

(ii) The best seen answers showed a neat arc of sufficient length and radius and clear shading of the appropriate region. A number of candidates drew an arc with the correct radius but it was usually not long enough to be fit for answering the question, or just used the arcs from part **(b)(i)**. Those with a complete, correct arc often shaded the wrong region, often a region formed with another arc with centre *P*. Only the most able candidates gained marks on this question with many candidates showing they could not interpret the phrase 'closer to *P* than to *Q*' as the area to the left of their bisector.

Answers: **(a)(i)** 37 **(ii)** 133

Question 6

(a) (i) Most candidates gave the correct co-ordinate. However, some less able candidates reversed the *x* and *y* co-ordinate with (5, –2) the most common incorrect answer given.

(ii) Candidates found writing a column vector challenging. Common incorrect answers were $\begin{pmatrix}4\\3\end{pmatrix}$, $\begin{pmatrix}-4\\3\end{pmatrix}$ and $\begin{pmatrix}3\\4\end{pmatrix}$ demonstrating a misunderstanding of which part of the vector describes a horizontal movement and which a vertical movement. $\begin{pmatrix}5\\2\end{pmatrix}$ was also seen often, showing confusion between co-ordinates and a movement.

(iii) Candidates also found plotting point *R* a challenge and there was a wide variety of incorrect answers given including (3, 2), confusing the vector with a co-ordinate and (4, 5), 2 right and 3 up.

(iv) Completing the parallelogram *PQRS* proved challenging for all but the most able candidates. The most common shape drawn was a trapezium.

(b) (i) The majority of candidates correctly identified the transformation as a translation, although translocation was a common error. Writing the correct column vector however proved much more challenging with few correct vectors given. The majority of incorrect answers were (–4, 2) given as co-ordinates rather than a column vector or a column vector with incorrect values. Few candidates attempted to describe the translation in words and very few answers were given as more than one transformation.

(ii) Many candidates drew the correct reflection but many used an incorrect horizontal line, usually $y = 0$. Some reflected in $x = -1$. Candidates who drew the mirror line were more successful.

(iii) Candidates were more successful at rotating the shape. The most common error was to rotate the shape 180° but around the wrong centre so their shape was the correct orientation but in the wrong position.

Answers: **(a)(i)** (–2, 5) **(ii)** $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ **(iii)** (5,4) plotted **(iv)** (1, 7) **(b)(i)** translation and $\begin{pmatrix} -4 \\ 2 \end{pmatrix}$

Question 7

(a) Nearly all candidates were able to calculate $\frac{7}{10}$ of the cherries, although many thought this was the final answer and did not subtract to find the mass of the cherries left. Other common errors were $250 \div 0.7$ or $250 - 0.7$.

(b) (i) Finding the volume of a two tiered cake proved challenging for all but the most able of candidates. Successful answers calculated the volume of each tier separately and then added, with the best solutions starting with the correct formula for the volume of a cylinder and then substituting the radii and height for each tier. There were a variety of incorrect formulae used including the circumference of a circle, the surface area of a cylinder or a cubic. Candidates were confused with surface area, or using the formula for the volume of a cuboid, or just multiplied all of the given numbers together. Some good starts were spoiled by multiplying the sum of the cross sections by 20 instead of 10. Common incorrect answers involved a 2, a half or no radius squared and some did not use π at all.

(ii) This part was found challenging with a large proportion of candidates not attempting it. Candidates found it difficult to associate this question with circumference. Many added 4 to a combination of numbers taken from the question. The most common of these was 34 from 15 + 15 + 4. There were also a few candidates who lost marks due to rounding prematurely, giving 98 as the answer.

(c) Most candidates recognised this as a bounds question but many used ± 1, ± 0.5 or ± 10 instead of the correct ± 5.

Answers: **(a)** 75 **(b)(i)** 9080 **(ii)** 98.2 or 98.3 **(c)** 1245, 1255

Question 8

(a) This algebra question was well attempted by most candidates. Common errors involved the $-c$ term which often led candidates to $-8d$ or $4d$ instead of $8d$.

(b) Substituting into the formula was again well answered by the majority of candidates. Candidates who showed the substitution before giving the final answer gained a mark even if they gave the common incorrect answer of 8 from 20 – 12.

(c) Solving the equation was equally well answered by most candidates. Most candidates who did not gain full marks still were able to score one mark for correctly expanding the bracket. The most common error was subtracting 21 after expanding the bracket instead of adding 21.

(d) Fewer candidates were able to make r the subject of the formula. Candidates were more successful when they worked in stages, writing $r - 7 = 6t$. The most common error was $7 - r$ instead of $r - 7$ before dividing by 6. Candidates who started by dividing by 6 often went wrong as they did not divide both the r and the 7 by 6.

(e) Most candidates appeared to understand the problem but many found the algebraic skills required to form a correct equation challenging and could only express a partial solution. Many candidates therefore gave an expression $3x + x + x + 15$ but many did not form an equation equal to 180. Common errors at this stage was to make their equation equal to 360 or 0. Many chose to omit the equation and use a trial and improvement approach. This often led to the correct answer of 33 which didn't score full marks as the question specifically said to write down an equation and solve. Candidates with the correct equation generally went on to find $x = 33$ and gain full marks. However a common error at this stage was to change $x + 15$ to $15x$ which meant candidates could not find the correct value of x.

Answers: **(a)** $3c + 8d$ **(b)** 32 **(c)** 11 **(d)** $\frac{r-7}{6}$ **(e)** 33

Question 9

(a) The correct answer was derived usually from the area of a trapezium rather than from the sum (or difference) of the areas of rectangle and triangle. Those who used the triangle plus rectangle method often went wrong with the rectangle, using 150×90 instead of 120×90 while still adding the triangle, not subtracting it. Others did not divide by 2 when using the area of a triangle. Some used the correct formula for the area of a trapezium but substituted in the incorrect lengths. Problems included multiplying the two parallel sides together when using the formula; forgetting to divide by two; or using $\frac{1}{2}bh$. Many less able candidates just added all the numbers together and then divided by 2.

(b)(i) Candidates should be encouraged to leave out the unit of measurement from calculations and to give the correct units with their final answer. Frequently seen was, for example, $90\,\text{m}^2$ instead of $(90\,\text{m})^2$ or just 90^2. The correct units can then be added to the final answer if not provided on the answer line. Generally this part was quite well attempted with the main loss of mark being the need to show the evaluated value of the square root of 9000 which then rounds to 95, not just showing 95. Some trigonometric methods were seen which needed to be completely correct to gain any marks which was rare. Many candidates did not attempt this question. Several candidates used the value 95 in a calculation for the perimeter and then subtracted all the other measurements from the perimeter until they got back to 95 m. Candidates should be reminded that in a 'show that' question they should not use the value they are being asked to show.

(ii) Candidates who found the previous two parts challenging were more successful in calculating the cost of fencing the field. This part was well answered with the correct answer seen frequently. One mark was awarded often for obtaining the perimeter 455. However a large number of candidates took their answer for the area in part **(a)** and divided it by 5 then multiplied by 48, rather than finding the perimeter, or missed out 95 when adding the sides together. Other candidates correctly worked out the perimeter but then only multiplied by 48 and did not divide by 5 also.

Answers: **(a)** 12 150 **(b)(ii)** 4368

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, apply mathematical knowledge in a variety of situations, 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 continued to improve and was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be paid to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings. Candidates should be aware of the difference between a time and a time interval and be able to write both in a correct form. 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 delete the incorrect work, 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) A significant number of candidates did not appreciate that this part required a units conversion, a division and a rounding with few fully correct answers seen. Common errors included $\frac{89}{22}$ with no conversion of units, the incorrect operation of 89×22, and no attempt at rounding to the nearest 10 as required.

(ii) This part was generally well answered with the majority of candidates able to interpret the given practical situation and apply the correct numerical operations. A common error was not rounding the quotient value down to 132 and leaving the answer as 132.8, 132.9 or rounding to 33.

(b) This part was generally answered well.

(c) This part on using a given ratio was well answered with the majority of candidates able to give the correct answers. Common errors included dividing by 3 to get 130, and the answers from $\frac{390}{7}$, $\frac{390}{3}$ and $\frac{390}{2}$. As the answers were all exact values they should not have been rounded.

(d) This part on finding a percentage decrease was well answered. Although a number of valid methods were seen the most common method used was $\frac{(3500-3080)}{3500}\times 100$. Common errors included $\frac{420}{3080}$, $\frac{420}{100}$ and the incorrect first step of 3500 + 3080.

(e) This part on drawing the net of the given open cuboid was generally answered well although a small number of candidates drew a three dimensional representation of the cuboid. A small number did not appreciate the mathematical definition of a net and added extra lines or squares to an otherwise correct diagram.

Answers: **(a)(i)** 4050 **(ii)** 132 **(b)** 676 **(c)** 227.50 97.50 65.00 **(d)** 12

Question 2

(a) (i) This part was generally well answered with the majority able to correctly complete the given bar chart.

(ii) This part was generally well answered although common incorrect answers of 8, 2 and 13 were seen.

(b) This part was generally found to be more demanding for a number of candidates although many fully correct answers with clear and sufficient working were seen. The first mark was for the initial calculation of 9 hours 45 minutes. Common errors at this stage included 10 hours 45 minutes, 9 hours 85 minutes, 8.85 hours and 36 hours 45 minutes. The second mark was for recognising the need to multiply this answer by 7 and more candidates were successful at this stage. The final accuracy mark was for the correct evaluation of 9 h 45 min × 7. Common errors at this stage included 66 h 15 min, 68 h 25 min, and 63 h 315 min.

(c) This part was generally well answered with the majority able to score full marks, although a small number of arithmetic errors were seen.

(d) This part was generally well answered with the majority able to correctly find the required percentage.

(e) (i) This part was generally well answered with the majority able to correctly find the required time. However a significant number lost the mark by the use of incorrect notation. Candidates need to appreciate that the time needed to be written as 21 05, whereas 21 h 5 min implies a time interval. Other common errors included 20 25 and 21 20.

(ii) This part was reasonably well answered with a significant number able to correctly find the required time. Again incorrect notation proved to be a problem. Common errors included 20 h 20 min, 20 30, 21 20 and 20 40.

(f) This part was generally well answered with the majority able to correctly find the required change.

(g) (i) This part was generally well answered with the majority able to correctly find the required temperature difference.

(ii) This part was generally well answered with the majority able to correctly find the required temperature.

Answers: **(a)(ii)** 3 **(b)** 68 h 15 min **(c)** 424 **(d)** 30 **(e)(i)** 21 05 **(ii)** 20 20 **(f)** 1.45 **(g)(i)** 21 **(ii)** –14

Question 3

(a) (i) This part on simplifying a given algebraic expression was generally well answered. Common errors included $12c - 9d$, $20c - 9d$, and $11cd$.

(ii) This part on simplifying a given algebraic expression with indices was again generally well answered. Common errors included $8x^{21}$, $6x^{10}$, 8192 and 8^{10}.

(b) This part on solving a given equation was reasonably well answered with a number of candidates clearly showing in their working the three required steps. However sign errors were very frequent throughout when applying the inverse operations. While many were able to score the method mark and successfully reach $-2x = 3$, the accuracy mark was often then lost by incorrect answers of 1.5, $-\frac{2}{3}$ and $\frac{2}{3}$. A significant number made sign errors at the initial first step with $-2 + 1 = 5x - 3x$ and $3x - 5x = 1 - 2$ being common.

(c) The majority of candidates understood the method involved in this part and either gained full marks, or one mark for a partial factorisation with $x(3xy - 5y)$ being the most common.

(d) This part on changing the subject of a formula proved to be a good discriminator and very demanding for a significant number of candidates. Although a good number were able to score the method mark for a correct first step, usually $T = 3r + 15$, few were able to continue correctly and score full marks. Sign errors were often seen when attempting to rearrange terms with $3r = 15 - T$ being common. Common errors at the initial step included $T = 3r + 5$, $T - 5 = 3r$, and $r = 3(T + 5)$.

Answers: **(a)(i)** $12c - d$ **(ii)** $8x^{10}$ **(b)** –1.5 **(c)** $xy(3x - 5)$ **(d)** $\frac{T}{3} - 5$

Question 4

(a) The majority of candidates were able to identify the given transformation as an enlargement but not all were able to correctly state the three required components. The identification of the centre of enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (6, 5) and (5, 6) being common errors. A small number gave a double transformation, usually enlargement and translation which results in no marks. It should be noted that explanations that include statements such as 'and movement by' and 'then followed by' together with a column vector imply a second transformation of a translation.

(b) The majority of candidates were able to identify the given transformation as a rotation but not all were able to correctly state the three required components that were needed for a full description. The identification of the centre of rotation proved the more challenging with a significant number omitting this part. Similar to above, a small number gave a double transformation, usually rotation and translation.

(c) Although many candidates were able to correctly draw the required translation, this part proved to be challenging for some. Common errors included drawing a translation with one of the vertices at the point (2, 5), or a triangle with only one of the vector components correct.

(d) The majority of candidates were able to correctly draw the required reflection. Common errors included drawing a reflection with a different line of reflection such as $x = 0$ or $y = 0$.

Answers: **(a)** Enlargement, scale factor 2, centre (6, –5) **(b)** Rotation, 180°, centre (0, 0)

Question 5

(a) This was very well answered with a large majority scoring full marks. The common error was to include the two diagonal lines.

(b) This part was generally found challenging. A significant number of candidates did not know how many sides a hexagon has, with 5, 7 and 8 sides all frequently used. Common errors included using the formula $\frac{[(n-2)\times 180°]}{n}$ with an incorrect value for n, using the formula incorrectly with $n-1$ or 360, and a variety of other incorrect methods. Some candidates managed to score the first method mark for $\frac{360°}{6}$ or for $(6-2)\times 180°$ or these expressions correctly evaluated.

(c) This part on finding the area of a composite shape proved to be demanding for the majority of candidates with full marks rarely awarded. Those who did gain full marks usually split the rectangle vertically forming the areas $288 + 288 + 160$. However, a very common error was to add $288 + 288 + 400$ (from 10×40) so the answer 976 appeared often. Many candidates earned one method mark, usually for finding one area, 24×12 or 24×40, or for finding one of the missing lengths, 14 or 16. Other common errors included adding all the given dimensions together, or multiplying three or more of them together.

(d) A significant number of candidates were able to correctly find the required angle in the given isosceles triangle. A further number were able to score one mark for finding 48° by using angles on a straight line. Common errors included leaving 48 as the answer, 24, 132, 156 and 264.

(e) This part proved to be a good discriminator and was generally found to be challenging. There was a lot of confusion about area and circumference formulae and π was often omitted in the formula used.

(i) In this part there were few fully correct answers although a significant number were able to gain a method mark for one of the circles' area. Many candidates subtracted the radii first and worked out $\pi \times 1.5^2$ rather than subtracting the areas of the outer circle and inner circle. Other common errors were to calculate $\pi \times 7.5 \times 6$, $\pi \times (7.5 + 6)$ and to use $2\pi r^2$ for the area of a circle.

(ii) A minority of candidates gained the mark in this part by multiplying their cross-sectional area by 18 to find the volume but most started a new incorrect calculation. Candidates did not see the connection between this question part and the previous one. Common errors included finding the volume of a cylinder $\pi \times 6^2 \times 18$ or $\pi \times 7.5^2 \times 18$ rather than the volume of metal, and use of $\pi \times 15 \times 18$ was seen regularly.

(iii) Again in this part there were few fully correct answers although a small yet significant number were able to gain a method mark for the correct initial step of using $2 \times \pi \times 7.5$ to find the circumference of the circular end. Common errors included the inclusion of the area of the circular ends, the use of incorrect formulas such as $\pi \times 7.5^2 \times 18$, 7.5×18, and the incorrect use of 6 or 1.5 for the radius.

Answers: **(b)** 120 **(c)** 736 **(d)** 84 **(e)(i)** 63.6 **(ii)** 1140 or 1150 **(iii)** 848

Question 6

(a) (i) Many correct answers were seen but the most common error was to give the answer of 19, with these candidates not realising that 19 was not a sensible answer for the modal number of attempts at a driving test. Other common errors included 5, as it appeared twice in the table, and answers which were attempts at median or mean.

(ii) There were some excellent responses here, with candidates showing clear method and accurate answers. However, it was reasonably common for candidates to lose the final mark because they gave an answer of 2.85 or 2.9 and did not show a more accurate value to at least 3 significant figures first. Other common errors included calculating $\frac{200}{6}$ or $\frac{200}{21}$ or $\frac{70}{6}$ or $\frac{70}{21}$. Some candidates showed a correct calculation such as $\frac{19+34+24+48+45+30}{70}$ but didn't divide the whole of the numerator by the denominator because of incorrect use of the calculator.

(iii) Many different answers were seen here, most of which did not score the mark. The best answers usually showed that the 35th and 36th values were both 2 or that $\frac{2+2}{2}=2$. Common errors included ordering the frequencies as 5, 8, 9, 12, 17, 19 and then calculating $\frac{9+12}{2}=10.5$; recognising that the answer needed to be something to do with the 35th and 36th pieces of data but unable to go any further; stating 35 from $\frac{70}{2}$; or stating 'Jules is wrong because there is no 3.5 in the data'. Some candidates however were successful in selecting 2 after writing out the entire list of 70 numbers.

(b) (i) Most candidates correctly recognised that the correlation was negative. A few thought it was positive and a smaller number thought there was no correlation/none. Other incorrect answers seen included 'driving test', 'driving lessons', 'number of attempts' 'weak correlation', 'line' and 'graph'.

(ii) Although the majority of answers included the denominator 17, relatively few correct answers were seen. A common error was $\frac{7}{17}$ found from more than 5 attempts (that is not including the three people who took 5 attempts). Some candidates just gave the number of people and did not give it as a probability.

(iii) Most responses to this question were ruled lines, within tolerance and covering the length of the data. Errors seen included lines which were just out of tolerance such as lines with a very unbalanced number of crosses on each side of their line or lines that were too short or lines drawn from (0, 10) to (30, 0). A few unruled lines and a few zig-zag responses joining all the points together were seen.

(iv) An integer value was required for this mark and many candidates scored this mark even if they did not have a correct line. The most common error was to give a decimal answer reading straight from their line, normally between 5 and 6.

Answers: **(a)(i)** 1 **(ii)** 2.86 **(b)(i)** negative **(ii)** $\frac{10}{17}$ **(iv)** 5 or 6

Question 7

(a) This question was generally well answered but place value was a challenge for many with extra noughts frequently added such as 800 000 023 000 or errors such as 8 230 000 seen. There was only one number to write in figures and the few candidates writing the two separate numbers 8 000 000 and 23 000 did not score.

(b) The recommended way to answer this question is to convert all of the numbers into the same form, either decimals or percentages. Few candidates showed any working or had erased their decimal or percentage equivalents, so unless their answer was correct, they could not score. Of those showing working, sufficient figures needed to be seen and a common error was to see, for example, both 42% = 0.42 and $\frac{3}{7} = 0.42$. A number of candidates gave answers from largest to smallest.

(c) In this question, there was only one correct answer for each part. A number of candidates did not score because they gave more than one response on the answer lines in this part.

(i) Many correct answers were seen although some either did not know what a prime number was or struggled to find the prime number from the list. Common incorrect answers included 111 and 39 or more than one answer.

(ii) This part was answered well with almost all selecting 39. Again, sometimes, more than one answer was seen.

(iii) Candidates were less successful on this part and although some correct answers were seen, it was clear that some candidates did not understand the word irrational. A common incorrect answer was to give both $\sqrt{64}$ and $\sqrt{97}$.

(d) It was rare to see a correct answer to this part with most candidates not realising that, in this case, rounding to 2 significant figures meant the number had been rounded to the nearest 100 hence the need for ± 50. There were a wide range of incorrect answers seen including 5200 and 5400, 5299.5 and 5300.5, 52.5 and 53.5. A few candidates had the correct two values reversed.

(e) This question was generally well answered. Candidates who were successful clearly showed their working, as evidence of working was required for the marks to be awarded. Almost all candidates scored one mark for the correct conversion of at least one of the given mixed fractions to an improper fraction. Some then recognised that $\frac{7}{4} \times \frac{9}{7}$ could be simply cancelled directly to $\frac{9}{4}$ whilst others arrived at $\frac{63}{28}$ or even $\frac{1764}{784}$ from $\frac{49}{28} \times \frac{36}{28}$, all scoring the second available mark. The final answer was required as a mixed fraction in its simplest form. Some candidates were clearly expecting that at some stage they would be required to invert the second fraction. Other common errors seen included $\frac{49}{28} \times \frac{36}{28} = \frac{1764}{28}$, final answers of 2.25 or adding, subtracting or dividing the fractions.

Answers: **(a)** 8 023 000 **(b)** $\frac{7}{17}$ 42% $\frac{3}{7}$ 0.45 **(c)(i)** 47 **(ii)** 39 **(iii)** $\sqrt{97}$ **(d)** 5250 5350 **(e)** $2\frac{1}{4}$

Question 8

(a) The table was generally completed well with the vast majority of candidates giving four correct values.

(b) This quadratic graph was generally plotted very well. The majority of candidates were able to draw a correct smooth curve although a small yet significant number plotted a number of points inaccurately mainly due to the misreading of the vertical scale.

(c) Only a small number of candidates were able to give the correct line of symmetry for the graph. However a good number appreciated that the value of 4 was involved but gave incorrect answers such as 4, (4, 16) and $y = 4$. Other common errors included $y = mx + c$, $y = 8x - x^3$ and 1 (possibly as one line of symmetry).

(d) This part on the interpretation and use of the graph was answered reasonably well although remains a challenging question for a number of candidates. Those candidates who appreciated the method of reading from the graph at $y = 10$ to find the required values were generally successful. A significant number attempted to solve the equation algebraically but were rarely successful.

Answers: **(a)** 7 16 7 0 **(c)** $x = 4$ **(d)** 1.45 to 1.65 and 6.35 to 6.55

Question 9

(a) The vast majority of candidates were able to correctly find the required missing angle. Common errors included angles of 143 (overlooking the angle of 90), 37 and 233 (incorrectly using 360). A small number attempted invalid trigonometrical methods involving 90 and 37 in a variety of ratios.

(b) (i) There were many completely correct responses to find the area of the triangle; the most common error was to multiply the two sides and omit to halve this. Many did not read the question carefully and found the hypotenuse of the triangle. The question asked for units and candidates should be aware that the answer space is usually set out like this in order to write the value and the units. Many omitted the units, again demonstrating the need to check answers and read through questions carefully. Giving the correct units proved challenging; the most common incorrect units being cm and cm^3 with many simply writing 'units'.

(ii) The final question which asked for the perimeter of the triangle proved challenging. Those who understood the need to use Pythagoras' theorem to find the length of the hypotenuse usually did so correctly. Sometimes candidates found the length of the hypotenuse and then forgot that the question asked for perimeter and so did not gain the final answer mark, once again, a case for checking back over answers. Candidates should also be careful to check that they are rounding accurately as many lost the accuracy mark by rounding incorrectly to 11.2 or prematurely to 11. Those who did not gain any marks were generally using one of five incorrect methods; assuming that the triangle was isosceles and so taking the missing side as 6.8 or (more usually) 9; missing the hypotenuse completely and giving an answer of 15.8; adding the given two lengths and doubling; calculating the area of the triangle; or adding the area of the triangle to the two sides given.

Answers: **(a)** 53 **(b)(i)** 30.6 cm^2 **(ii)** 27.1

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key Messages

This paper required candidates to have a good knowledge across all of the key areas, number, algebra, shape and space and probability and statistics.
Candidates should show working to support their solutions.

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 question paper within the given time and even when there were questions they found more challenging, candidates moved on to other questions they were able to answer. The standard of presentation was generally very good, but some candidates need to be careful that they write digits clearly and there is no ambiguity as to what they intend. Particular areas of strength included responses to **Question 1** and **5**. Questions found generally hardest were **Questions 2** and **9**. There were a number of questions where candidates often gave answers which were not to the required three significant figures, namely **5(d)**, **8(b)(i)**, **8(b)(ii)**, **9(d)(i)** and **9(d)(ii)**. Candidates need to ensure they learn the correct mathematical words in explaining and naming questions such as **2(a)**, **2(b)**, **3(b)(ii)**, **4(b)(ii)**, **4(c)(ii)**, **6(a)**, **9(a)** and **9(c)**.

Comments on Specific Questions

Question 1

(a) (i) Nearly all candidates had the first two answers correct. Many scored the remaining two marks but often the third mark was lost by those who chose Mexico or Brazil rather than Bali. The last mark was frequently lost by those listing Caribbean and Brazil in reverse order or choosing the wrong combination of countries.

(ii) Many candidates answered this correctly but others were not sure how to approach the question. Those who recognised that Bali was one fifth of the pie chart were more successful than those who chose to find the number of people in every sector as these candidates occasionally forgot to add the 180. Some candidates scored full marks with no working shown.

(b) (i) The majority of candidates scored full marks on this question. The most common error was to find 70% of 450 correctly but then subtract this from 450 to get 135 as the cost of a child's ticket. Most of the candidates who did this managed to score one mark for the cost of the two adults' tickets.

(ii) A good proportion of candidates scored full marks on this question. Most others scored 1 mark for adding 2 hours 11 mins to 09 29 correctly but then added the 1 hour time difference instead of subtracting it, thereby losing the second mark. Some scored 0 marks for giving the answer 12 40 with no working shown.

(iii) This part was answered correctly by a large majority of candidates. A few lost all the marks by not reading the question properly and adding $3.50 to $2.15 then multiplying by 38.

(iv) Nearly all candidates scored full marks. Only a few multiplied 1335 by 17.8 rather than dividing.

Answers: **(a)(i)** 26, USA, Bali, Caribbean/Brazil **(ii)** 900 **(b)(i)** 1845 **(ii)** 10 40 **(iii)** 85.2[0] **(iv)** 75

Question 2

(a) Only a minority of candidates were able to give the correct mathematical name for the shape. Parallelogram, rhombus and quadrilateral were some of the incorrect answers given.

(b) (i) A large majority of candidates knew the transformation was an enlargement and many gave the correct scale factor. Finding the centre of enlargement proved more challenging with many omitting it altogether or giving a vector. It was common for candidates to imply more than one transformation and to say the shape was translated/moved and enlarged. Candidates often described the shape as 'made bigger' rather than state 'enlargement', which did not score.

(ii) This part was not answered very well with many giving the transformation as a reflection. A significant number gave at least two transformations, usually including reflection or translation along with rotation. Vectors were often included as part of the answer and non-mathematical descriptions such as 'turn' or 'move' were very common.

(c) (i) Many candidates scored full marks for drawing the correct translation. Some scored one mark, usually for translating the shape correctly by the horizontal distance. A common incorrect answer was to translate the shape by $\begin{pmatrix} -4 \\ 8 \end{pmatrix}$.

(ii) Many candidates scored full marks for drawing the correct reflection. Some scored one mark for a reflection in the wrong vertical line or in the line $y = 2$.

(d) A small majority of the candidates found the correct area of the shape either by counting squares or by splitting the shape into a triangle and square. The correct answer was often seen with no working shown.

Answers: **(a)** Trapezium **(b)(i)** Enlargement, scale factor 3, centre (–5, 0) **(ii)** Rotation, 180°, centre (0, 0) **(d)** 13.5

Question 3

(a) Nearly all candidates scored full marks for the correct scaled distance. Most of the rest scored one mark for measuring 6 cm.

(b) (i) This part was not well answered. Many incorrect angles were given including 75, 105 and 285 (from 360 – 75).

(ii) Very few candidates could describe the correct method to find the bearing and gave statements about using a protractor and measuring it. A common error was to subtract their previous answer from 360 (angles around a point) and not carry on to subtract this from 180 using interior angles. Others added 180 or subtracted their previous answer from 180. Many candidates did not give any response.

(c) (i) Although many candidates scored full marks, this part of the question was not very well answered. Many were able to score one mark usually for plotting *D* at a correct distance but with an incorrect bearing. Some neat and accurate diagrams to show the bearing and distance of *D* were seen but others had placed point *D* very inaccurately, sometimes measuring 100° from the line *AC* or a horizontal line at *C*. Others had read the wrong scale on their protractor and had the bearing at 80° rather than 100°. Candidates should be encouraged to represent the required point by a single dot rather than a large blob or just the letter *D*.

(ii) This part was reasonably well answered with many scoring full marks. A common error was to change the units of time from $1\frac{1}{2}$ hours to 90 mins for the division which was not necessary. Others divided by 1.3 instead of 1.5.

(iii) The majority of candidates scored full marks in this part. Some made an error in the method with the division by 8 and multiplication by 5 the wrong way around.

Answers: **(a)** 60 **(b)(i)** 255 **(ii)** Subtract 180 from their **(b)(i)** **(c)(ii)** 64 **(iii)** 60

Question 4

(a) Most candidates were able to draw pattern 4 correctly on the grid. The most common errors seen included either drawing an extra square in the top row or drawing 2 squares in the bottom row.

(b) (i) Almost all candidates were able to write down the next two terms correctly. The most common errors seen was 17, 23.

(ii) Candidates clearly recognised that the sequence rule was to subtract 6 although candidates did not always express this as required. Whilst minus 6, −6, less 6, were accepted, the *n*th term, $47 - 6n$, was not accepted or incorrect rules such as $n - 6$ or $-6n$ or inaccurate answers such as subtract −6.

(c)(i) Many candidates were able to give the correct expression for the *n*th term. A common acceptable equivalent seen, also awarded full marks, was $11+4(n-1)$. Some candidates were awarded a method mark for $4n+k$. A common incorrect answer was $7n+4$.

(ii) Candidates were able to approach this question in a number of different ways. For full marks candidates needed to give some numerical evidence and support it with some written conclusion. Candidates who solved $4n+7=129$ to reach $n=30.5$ needed to explain that because 30.5 is not a whole number, 129 cannot be a term in the sequence. Candidates who showed the 30th term is 127 and the 31st term is 131 needed to explain that there is no term between 127 and 131 so 129 cannot be in the sequence. Candidates who equated their equation from part **(c)(i)** to129 were awarded one mark. Some candidates were successful after writing out the first 31 terms in the sequence and giving a supporting explanation, but this was not the recommended approach. Some candidates misread the question and attempted to find the value of the 129th term. Many other approaches were seen and these were awarded marks according to numerical accuracy and the explanation given.

Answers: **(b)(i)** 17, 11 **(ii)** subtract 6 **(c)(i)** $4n + 7$ **(ii)** no, with correct reason

Question 5

(a) (i) This question was answered accurately by many candidates. Errors included working out 0.66 but then giving a final answer of 0.7 .Candidates who did not score usually did not recognise that they needed to find 3.5×1.24 as a first step.

(ii) Whilst many candidates answered this correctly, there were a significant number of candidates who did not know that 1 kg = 1000 g. Common incorrect answers included 350, 35 and 0.35.

(b) Candidates demonstrated good problem solving skills and careful reading of the question with many correctly giving the maximum number of oranges. Common errors scoring only the method mark included giving an answer of 11.76 or rounding 11.76 to 12. Those candidates giving only an answer of 12 with no supporting working were unable to score as there was no evidence to support where the 12 had come from.

(c) Candidates answered this question well. The most common errors included converting 87% to 0.087 or 8.7 or finding 13% of 700 g.

(d) Candidates answered this question well with an answer correct to at least three significant figures. Some candidates showed no working and an inaccurate answer of 21 with no evidence of where it had come from did not score. Other candidates correctly found 150 but did not go any further. Other common errors included finding the range or median.

(e) A number of candidates were able to write down a pair of correct simultaneous equations and show clear working to solve them, usually by the elimination method. Some candidates were able to write down a pair of equations but could not solve them usually because, after equating coefficients, they added rather than subtracted their equations. Others attempted the elimination method but made errors with signs. A number of candidates were unable to score any marks on this question because they did not know how to form two equations, some using the same letter for both the apples and the plums. One mark was awarded for correct answers with wrong or no working and in addition, method marks were available for those candidates who set up the equations incorrectly but who could demonstrate a correct understanding of the process of solving simultaneous equations.

Answers: **(a)(i)** 0.66 **(ii)** 3500 **(b)** 11 **(c)** 609 **(d)** 21.4 **(e)** 0.3, 0.38

Question 6

(a) Candidates were required to write all parts of 602 047 in words with no numbers included. Whilst the majority of candidates were successful, a variety of errors were seen. Some candidates made errors with place value, usually starting with six million, others included the word thousand twice, for example 'six hundred thousand and two thousand and forty seven'.

(b) (i) The majority of candidates gave a correct multiple of 14 with 28 being the most common correct response. Other correct responses included 14, 42 and 140. The most common incorrect answer was to give a factor of 14, usually 7.

(ii) This was well answered with almost all candidates giving the correct answer.

(iii) The majority of candidates cube rooted the given number correctly. Most candidates who did not score had incorrectly square rooted the given number.

(iv) Again the majority of candidates knew that $12^0 = 1$. The most common incorrect answer was zero.

(c) Many candidates answered this correctly and had approached the question by using factor tables or factor trees. Even if the correct LCM was not found, or if the HCF was found in error, candidates were often awarded one method mark for their tables or trees. There were a number of arithmetic errors seen as well as tables/lists with either too few or too many factors. Candidates who gave a larger multiple of 156 such as 312 were awarded one mark.

(d) Again many candidates answered this correctly or were able to score one mark for giving 2 or 3 as their final answer. Candidates who found the HCF in the previous part usually went on to find the LCM in this part.

(e) Candidates who used a factor tree were most successful in reaching the correct answer and the best answers were those that were written in index form, even though $2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3$ was also awarded full marks. Some candidates incorrectly assumed this part related to previous parts and others did not know how to approach the question.

Answers: **(a)(i)** Six hundred and two thousand and forty-seven **(b)(i)** any multiple of 14 **(ii)** 3136 **(iii)** 47 **(iv)** 1 **(c)** 156 **(d)** 6 **(e)** $2^4 \times 3^3$

Question 7

(a) The majority of candidates completed the table correctly. A common slip was to omit the negative sign from the −1.5 when $x = -4$.

(b) Graphs were generally plotted accurately and smoothly drawn. When points were inaccurately plotted it was usually the (−5, −1.2), (−4, −1.5), (4, 1.5) and (5, 1.2) points because the scale had been consistently misread. Relatively few other errors were seen but included candidates drawing both sides of the graph above or below the *x*-axis, joining the points with a ruler or joining (−1, −6) to (1, 6).

(c) Candidates did well on this question with many correct answers seen including the accurate answer $1\frac{1}{3}$ which had most likely been obtained from solving the equation, even though this was not the intended method. A few candidates were able to obtain the mark from a follow through on their graph. Incorrect answers often came from misreading the scale or from wrongly solving the equation as $6 \times 4.5 = 27$.

(d) (i) Many candidates did not give a response to this question. However, a minority drew a correct ruled line covering the width of the grid. The most common incorrect line seen was $y = -x$.

(ii) A minority of candidates did not give a response to this question. Candidates who had drawn $y = x$ were most successful in this part. Errors came predominantly from misreading the scale or inaccuracies with minus signs.

Answers: **(a)** −1.2, −1.5, 1.5 **(c)** 1.2 to 1.4 **(d)(ii)** (−2.6 to −2.3, −2.6 to −2.3) and (2.3 to 2.6, 2.3 to 2.6)

Question 8

(a) Throughout part **(a)**, answers were accepted in fraction, decimal and percentage form. In a question like this it is usually best to give the answer as a fraction and it is not necessary to convert it into another form. Some candidates were unnecessarily giving all three forms on their answer lines.

(i) Most candidates answered this part correctly. The most common incorrect answers were $\frac{1}{4}$ or 4.

(ii) Most candidates answered this part correctly. The preferred answer was zero but candidates were rewarded for $\frac{0}{20}$.

(iii) Most candidates answered this part correctly. The most common error was to give the probability of pink, $\frac{3}{20}$.

(b) (i) Candidates were generally able to recognise that this question required Pythagoras' theorem and many were successful in scoring full marks. A number of candidates showed no working and gave the answer of 9.74 which, with no method seen, could not score. The most common incorrect answer was 13.9 from $12^2 + 7^2$.

(ii) Many candidates answered this question correctly and recognised that twice their answer to part **(b)(i)** needed to be added to 14. Follow through marks were awarded a number of times allowing those who did not score in the previous part an opportunity to gain a mark.

(c) This question was not answered well. Whilst some candidates scored full marks with clear and accurate constructions and shading, many were not able to correctly interpret the information given. Whilst many candidates drew arcs from *P*, these were not always drawn with the correct radius, did not always reach *PQ* and *PS* and some were not drawn with compasses. Very few candidates recognised the need to draw the perpendicular bisector from *P* and those that did draw the correct line did not always show any construction arcs. A common incorrect line was to join *P* directly to *R*.

Answers: **(a)(i)** $\frac{4}{20}$ **(ii)** 0 **(iii)** $\frac{17}{20}$ **(iv)** 9.75 **(b)(i)** 33.5

Question 9

(a) A large minority of candidates gave the correct mathematical name for line *DE*. The most common incorrect answer was chord. Many candidates did not offer a response.

(b) Many candidates drew a clear radius on the diagram. Some candidates chose to use *OA* or *OB* as their radius and, provided they indicated the end of their radius clearly, they were awarded the mark. Common errors included drawing an ambiguous radius where the intention was not clear or drawing a diameter or chord.

(c) (i) This part was not answered well. Whilst a number of candidates scored a mark for 90°, few candidates explained that the angle between the radius (or diameter) and tangent is 90° or that the radius (or diameter) and tangent are perpendicular.

(ii) Again, whilst a number of candidates knew that angle *ACB* = 90°, few were able to explain clearly that the angle in a semi-circle is 90°. A common incorrect response was to use the word triangle, rather than angle.

(d) (i) This question was answered well with answers frequently given to at least the correct three significant figure accuracy required. Common errors included not giving the correct units or omitting the units or calculating the circumference rather than the area of the circle.

(ii) A number of candidates recognised that trigonometry needed to be used to find the length of *BC*. Some candidates were able to gain the method mark by showing $\sin 35 = \frac{BC}{9}$ even if this was subsequently rearranged incorrectly. Other errors included using $\cos 35 = \frac{BC}{9}$.

Answers: **(a)** tangent **(c)(i)** 90°, radius and tangent **(ii)** 90°, angle in a semi-circle **(d)(i)** 63.6 cm^2 **(ii)** 5.16

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.

Candidates should take sufficient care to ensure that their digits from 0 to 9 can be distinguished.

General comments

Although a few question parts proved to be a challenge to many candidates, most were able to attempt almost all of the questions reasonably well. Solutions were usually well-structured with clear methods shown in the space provided on the question paper.

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 overlooked the rubric instruction to give answers in degrees to one decimal place.

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.

Answers to angles were occasionally in Grads and centres are encouraged to ensure candidates have calculators set in degrees.

Some handwriting was of a poor standard and on occasions it was difficult to recognise figures.

The topics that proved to be accessible were ratio, expressing as a percentage, currency conversion, reverse percentage, plotting points and drawing curves, drawing a tangent, finding the mean of grouped data, drawing and using a cumulative frequency diagram, trigonometry in right-angled triangles, recall of and recognition of when it is appropriate to use the cosine rule and the sine rule, recall and use of formulae for arc length and sector area and the use of the quadratic formula to solve a quadratic equation.
More challenging topics included area of similar shapes, inequalities from graphs and adapting a given graph to solve an equation, precision required to show a given result, total surface area of a triangular prism, probability from a Venn diagram, interpretation of set notation, calculating the length and mid-point of a line segment, interpreting written information to form and manipulate an equation involving algebraic fractions, recognising the difference of two squares and manipulating fractions and factorising to change the subject of a formula.

Comments on specific questions

Question 1

(a) (i) This ratio question was almost always correctly answered. A few candidates did not divide by the sum of the two parts and a few gave the printing cost instead of the profit.

(ii) Expressing a quantity as a percentage of another was also very successfully answered either by using their answer from part **(i)** or directly from the ratio.

(iii) This currency conversion question was generally well answered. Some candidates multiplied by the conversion rate instead of dividing and a few gave a truncated answer of 5.49 instead of the correctly rounded answer of 5.50.

(b) This question involving similar areas was much more challenging. It had the added complication of the need to calculate the area of one rectangle before being able to take the square root of the ratio of the areas. Many candidates gave an answer of 29.4, thinking that the ratio of the lengths was the same as the ratio of the areas. The square root of the area factor was best as the exact value of 1.4 and this led to the exact answer of 21. Candidates who found the square roots of the areas separately often gave final answers which were not exactly 21.

(c) This reverse percentage question was well answered with most candidates recognising that the given amount was 92% and not 100%. Some candidates did treat the given amount as 100% and found either 108% or 92%.

Answers: **(a)(i)** 2.25 **(ii)** 37.5 **(iii)** 5.5[0] **(b)** 21 **(c)** 525

Question 2

It is important throughout this question that candidates use standard terms for transformations rather than general properties such as shift, translocate and reduction. Candidates are advised to learn the spellings of the standard transformations, in particular translation.

(a) (i) The majority of candidates correctly answered this part. The vector notation was usually correct with only a small proportion of candidates either stating the vector as a co-ordinate or introducing a fraction line. A very small proportion of candidates described more than one transformation.

(ii) Virtually all candidates knew that the transformation was an enlargement. The candidates who drew lines from corresponding points on the diagram invariably correctly obtained the centre of enlargement. A number of candidates gave the centre of enlargement as –7 instead of using co-ordinates. There was some confusion in finding the enlargement scale factor with some candidates stating the answer as –2. A small minority of candidates attempted to describe the transformation using non-standard terms such as reduction.

(iii) The vast majority of candidates recognised the transformation as a rotation. Some candidates knew that the transformation was a rotation but also included a description of a movement using terms like shift. Some candidates appeared to use a second transformation (usually a translation) as a means of compensating for the fact that they could not find the centre of rotation.

(b) This part was omitted by a significant proportion of candidates. A small number of candidates changed the size of the triangle. It was clear that the majority of candidates who attempted this question knew where $y = –1$ was although a minority of candidates reflected the triangle in $x = –1$. A very small number of candidates miscounted the number of squares from the line of reflection to their image.

Answers: **(a)(i)** Translation $\begin{pmatrix} 5 \\ 8 \end{pmatrix}$ **(ii)** enlargement, scale factor 0.5, centre (0, –7) **(iii)** rotation, 90° anticlockwise, origin

Question 3

(a) The majority of candidates correctly completed the table of values. A significant proportion incorrectly rounded their calculated value at $x = 2.75$ frequently giving this value as 0.85.

(b) The majority of candidates correctly plotted the points and drew a correct curve with a maximum within the correct region. The point at $x = 2.75$ was sometimes plotted at $x = 3$. The point plotted at $x = 2.75$ was frequently plotted as a negative value. Some errors observed included incorrect curvature at the maximum; the point at $x = 0.5$ plotted instead at $x = 0.25$ or with a positive y value; and linking points with straight line segments.

(c) Candidates who drew the line $y = –1$ on their diagram invariably transferred their values correctly. A significant number of candidates misread the scale or read off the values where the curve intersected with the y-axis.

(d) (i) This question proved to be a challenge for many candidates. Very few candidates showed any working. Most knew that the answer would contain an x term and a number. A small number of candidates rearranged the given equation but did not then know that this was telling them that $y = 1 – x$ was the relevant line. A common incorrect answer was $y = 2x – 1$.

(ii) Candidates with the correct response in part **(i)** usually correctly completed the drawing of the line and read off the value at the intersection. A small number of candidates had the correct line but did not draw their line to a sufficient degree of accuracy.

(e) When drawn, the tangents were usually correct. A small number of candidates found the drawing of the tangent a little harder because they did not have a particularly smooth curve between $x = –0.5$ and the origin. Many candidates misread the scale when calculating the gradient. Errors seen included drawing the tangent at $x = –0.5$ or at $x = 0.25$. Candidates using big blobs for points on their curve often did not draw an accurate tangent that would touch the curve with no daylight.

Answers: **(a)** 0 –2 0.9 **(c)** −0.45 to –0.35 1 2.35 to 2.45 **(d)(i)** $y = 1 – x$ **(ii)** 2.25 to 2.4 **(e)** 1.7 to 3.7

Question 4

(a) This question was well answered with most candidates showing clear and accurate working leading to the correct answer. Only a small minority of candidates used the interval widths or the upper or lower ends of each interval. The most common error was to overlook the instruction to give the answer correct to 1 decimal place. A few candidates added the frequencies and divided by 6.

(b) In this question candidates needed to calculate the frequency densities and then divide by 2 to find the required heights. Many correct calculations for the frequency densities were completed but it was common to give these as the final answers instead of going on to find the heights. A few candidates inverted the correct calculation for frequency density and divided the group width by the frequency. Others used all the group widths as 10.

(c) The majority of candidates correctly completed the cumulative frequency table.

(d) Many complete correct cumulative frequency diagrams were seen. Some candidates made errors when using the scale for the vertical axis. Only a small minority of candidates plotted the points using the lower end or mid-point of each group. The quality of the curves drawn was good and candidates who instead chose to use a polygon also produced accurate, good quality diagrams.

(e) (i) Many correct values for the interquartile range were seen. Other candidates gave either the upper or lower quartile as their answer. A relatively common error was to subtract the position of the lower quartile, 45, from the position of the upper quartile, 135 and then read off the height at cumulative frequency 90. Some errors with using the scales were also seen, for example, reading the graph at cumulative frequency 50 instead of 45 for the lower quartile.

(ii) Many candidates correctly calculated 70% of 180 and read their graph accurately at cumulative frequency 126. Candidates should be encouraged to show their calculation for the position of the 70th percentile so that some credit can be given even when they go on to misread their graph. A few candidates read their graph at cumulative frequency 70.

(iii) Many candidates accurately read the cumulative frequency from their graph at height 106 cm and subtracted from 180 as required. Some candidates omitted the subtraction. Other candidates read their graph at 105 cm instead of at 106 cm or made errors using the vertical scale. Candidates using ruled lines up from 106 cm and across to the cumulative frequency axis usually gave accurate answers.

Answers: **(a)** 100.2 **(b)** 0.8 2.8 0.65 **(c)** 8 34 69 136 164 **(e)(i)** 15 to 17 **(ii)** 107 to 109 **(iii)** 66 to 72

Question 5

(a) (i) A 'show that' question is always demanding as every stage of the working must be clear. It is essential that candidates do not use the value to be shown as part of their working. It is also not appropriate to use the answer to a later question part in this first part. Many candidates demonstrated each step very clearly and many others earned two of the three marks by making a clear and correct statement such as $253.8 = \frac{1}{2} \times 6 \times h \times 18$ as their first step. The usual loss of a mark was by not showing a division and another error was to overlook the fact that the shape was a triangular prism, not a cuboid. A small number of candidates worked with the numbers until they reached 4.7. An example of this was $253.8 \div (18 \times 6) = 2.35$, $2.35 \times 2 = 4.7$. This, without other working, is not sufficiently rigorous. A few candidates used 4.7 to calculate the given volume and this did not gain any marks.

(ii) This right-angled trigonometry question was very well answered, with most candidates using the tangent ratio correctly. A few candidates gave an answer of 38 without a more accurate answer seen. A number of candidates calculated the hypotenuse and went on to use sine or cosine, which was fine as long as accuracy was maintained.

(b) This six mark question to find the total surface area of the prism was found to be demanding and it did allow the more able candidates to excel. Almost all candidates collected marks for separate areas and three marks were found to be easily accessed. These were the areas of the triangles together, the area of the rectangular base and the area of the vertical rectangle. The challenging marks were for calculating the hypotenuse in the triangle and for calculating the area of the sloping rectangle. The final mark was for a correct total area from adding up the areas of the two triangles and the three rectangles. The most common error was to think that two of the three rectangles had equal areas. An inaccuracy seen was the calculation of the hypotenuse to be 7.6216... and then to use 7.6 in the calculation of the area of the sloping rectangle.

Answers: **(a)(ii)** 38.1 **(b)** 358

Question 6

(a)(i) This question was very well answered. On the rare occasion when an incorrect answer was seen the candidate gave the number of students who only studied Music.

(ii) This question part was very well answered. Incorrect answers were rare. A few candidates gave an answer of 3, the students who studied Music and Drama and others included the students who studied all three subjects to give 18.

(iii) This question part proved to be challenging for the majority of candidates with only a minority using the correct product $\frac{5}{22} \times \frac{4}{21}$. Of the candidates who recognised that a product of two fractions was required, a common error was to overlook the non-replacement aspect of the problem and instead used the product $\frac{5}{22} \times \frac{5}{22}$. It was also common to see $\frac{3}{22} \times \frac{3}{22}$ or $\frac{3}{22} \times \frac{2}{21}$ where candidates omitted the students who studied all three subjects. A large number of candidates stopped after finding the probability of choosing one student who studied Music, $\frac{5}{22}$. Some candidates selected from all 43 students or from the 14 who studied Music instead of the 22 that studied Drama.

(iv) Candidates found interpreting this set notation a challenge. Many correct answers were seen but there were also a variety of common errors. These included shading the region for students who studied Music only; shading the region containing 4 only; shading $M \cap D, (M \cap D)'$ or D'.

(b)(i) A significant number of candidates did not attempt this question. Many correct answers were seen but again there were many varied errors. Some candidates repeated elements in two or more regions whilst others omitted at least one element, often the 3 and the 5, or the 10.

(ii) Only a minority of candidates were successful in this question part. A very common error was to omit the element in the intersection of sets A and B.

Answers: **(a)(i)** 14 **(ii)** 16 **(iii)** $\frac{20}{462}$ **(b)(ii)** 3 4 5

Question 7

(a) This use of the formula $\frac{1}{2}$ *ab*sin*C* for the area of a triangle was generally well answered. The allocation of only two marks should have made candidates realise that not much working or strategy would be involved here. The candidates who used the cosine rule and calculated the length of the base and then again used trigonometry to calculate the height and finally used $\frac{1}{2}$ base $\times$ height, did a lot of work for two marks or even only one mark if accuracy was lost. A few candidates simply used the cosine rule to calculate the base, clearly reacting to the given information as opposed to what the question was asking.

(b)(i) Most candidates recognised the need to use the sine rule in triangle *BCD* and answered this part successfully. A few candidates started with a correct sine rule statement but worked with values to 3 significant figures or less, leading to answers out of range. Another error seen was to lose the 'sin' from sin123.5 and treat the 123.5 as a length. A quite frequent error was to treat the triangle as isosceles and candidates are expected to realise that they should only use what is given in the question and not to make other assumptions.

(ii) This was one of the discriminating questions on this paper, requiring some strategy towards calculating a length. The more able candidates approached the question very well and demonstrated this with clear working, probably realising that five marks would require this.
Many candidates realised that the cosine formula would be the likely method and so an angle would be needed. Many correctly used their answer to part **(i)** to find the third angle of triangle *BCD* and then subtract this from the given right angle at *B*. The error of incorrectly collecting terms with the cosine rule was occasionally seen,
i.e. $11.6^2 + 18^2 - 2 \times 11.6 \times 18\cos 60.509 = 458.56 - 417.6\cos 60.509... = 40.96\cos 60.509...$ Some candidates treated *CDA* as a straight line and used the sine rule. A small number of candidates treated triangle *ABD* as right-angled. A few candidates calculated *AC* using Pythagoras' theorem and then used triangle *ADC*, which proved to be very difficult.

Answers: **(a)** 42.2 **(b)(i)** 27[.0] **(ii)** 15.9

Question 8

(a) This part was almost always answered correctly. The error (6, 5) was seen on a few occasions.

(b) Many fully correct answers were seen. Some candidates did not choose two appropriate integer points to use to find the gradient and so obtained only an approximate value. Some candidates gave the positive gradient $\frac{4}{5}$. The majority of candidates incorporated the intercept with the *y*-axis correctly into their equation. A significant minority of candidates omitted the *x* from their 'equation'.

(c) The majority of candidates understood that parallel lines have the same gradient and that the required line would have a *y*-intercept at –2. Some candidates omitted the *y* = and so did not have a complete equation as required. Once again there were a number of candidates who omitted the *x* from their 'equation'.

(d) (i) This question part proved to be a challenge for many candidates. Although many candidates did use the negative reciprocal of the gradient of line *l*, others just used the reciprocal or chose a point on line *l* together with (8, 14) to try to calculate the gradient. Many candidates attempted to substitute 8 and 14 into their equation with some success. Another error seen was again to omit the *y* = so that an equation was not given.

(ii) Many complete correct answers were seen but there were also a significant number of errors and candidates who omitted this question part completely. Common errors included loss of accuracy by writing $\sqrt{73}$ as 8.5; the subtractions of $14-6$ and $8-5$ seen but then no use of Pythagoras' theorem; or an attempt at Pythagoras' theorem but with an error such as $\sqrt{8^2-3^2}$ or adding 14 and 6, and 8 and 5 before squaring and adding.

(iii) This question part was omitted by a significant number of less able candidates and when attempted, produced a variety of incorrect answers. Candidates who did understand how to find the mid-point often gave the answer (4, 8) following an error in adding –2 and 14 or misreading the co-ordinates of *B* as (0, 2).

Answers: **(a)** (5, 6) **(b)** $[y=]-\frac{4}{5}x+3$ **(c)** $y=-\frac{4}{5}x-2$ **(d)(i)** $y=\frac{5}{4}x+4$ **(ii)** 8.54 **(iii)** (4, 6)

Question 9

(a) (i) Most candidates were able to give the correct expression but some spoiled this by $m=\frac{72}{m}$.

(ii) Again the correct expression was often stated with a few spoiling it as in part **(i).**

(b) Many candidates omitted this question part. Only the most able candidates could write down the correct equation and continue with no errors to reach the stated one. A significant number of candidates reversed the subtraction when writing the initial equation and then changed signs in their working in an attempt to reach the required equation.

(c) (i) Almost everyone used the formula to solve the quadratic equation with great success. Errors occasionally seen were to use 162 instead of –162 and 9 instead of –9.

(ii) Candidates who had correct answers in parts **(a)(i)** and **(c)(i)** usually gave a correct answer here too.

Answers: **(a)(i)** $\frac{72}{m}$ **(ii)** $\frac{72}{m+0.9}$ **(c)(i)** 3.6 and –4.5 **(ii)** 20

Question 10

(a) Nearly all candidates used the right angle at *B* so earned some credit. Many candidates used the efficient method of calculating angles *XOB* and *BOY* from the two right-angled triangles using tangent and the given sides. There were some who calculated the angles *XAB* and *BCY* and did not realise that at least one further step was needed to reach the correct solution. Answers in degrees should usually be given to one decimal place and so a greater degree of accuracy is required throughout the working. Premature approximation was seen from many candidates but particularly from those who chose to use Pythagoras' theorem twice to find the lengths of *AO* and *OC* followed by the cosine rule in triangle *AOC*.

(b) This question part was answered well by the majority of candidates. The common error seen was to use the formula for the area of a sector instead of the length of an arc.

(c) Most candidates found the area of triangle *AOC*, occasionally by adding the two smaller triangles, and deducted from this the area of the sector *XOY* which was usually found correctly. A few less able candidates subtracted the length of the sector found in the previous part.

Answers: **(a)** 132.26 **(b)** 18.4 or 18.5 **(c)** 75.7 to 75.9

Question 11

(a) The majority of candidates attempted this question and knew how to at least partially factorise. There was some confusion about the numerical factor with some candidates starting with 5 as a factor and then introducing 5 squared. Candidates who recognised the difference of two squares very occasionally spoiled a correct answer. It was very common for $5\left(m^2 - 4p^4\right)$ to be given as the final answer.

(b) The majority of candidates either left this question blank or gave an incorrect first line in their working. The first step done by candidates was invariably to multiply by 100, frequently incorrectly to give $100A = P + PRT$. Only a small minority of candidates then factorised. Many candidates did not observe that the terms containing *P* were already collected on one side of the equation and went on to subtract one of these terms from $100A$. Another common error following an incorrect first step was to divide by *RT* incorrectly to get $\frac{100A}{RT} = P + P$. Other errors seen included $101P$ after $100P + PRT$ and candidates ignoring the fact that there were two terms containing *P* and so leaving an answer for *P* which still had a term containing *P* on the right hand side of the equation.

Answers: **(a)** $5\left(m - 2p^2\right)\left(m + 2p^2\right)$ **(b)** $P = \frac{100A}{100 + TR}$

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 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 need to be aware that in drawing graphs, linear functions should be ruled and curves should be drawn freehand with a sharp pencil.

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

General comments

Solutions were usually well-structured with clear methods shown in the space provided on the question paper. A small number of candidates wrote down numbers that were not legible.

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. There were a small number of candidates losing 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. Some candidates are also omitting important steps in their method, for example when using the sine rule, they often show the initial substitution but then not the rearrangement to the explicit form. In cases like this where the answer is given correctly then full marks are scored but when the answer is inaccurate e.g. given to two significant figures, then the correct full method cannot be implied and only partial method marks are awarded.

The topics that proved to be most accessible were: currency and percentages, solving equations, working with indices, transformations, cubic graph drawing, finding the mean from a grouped frequency table, drawing histograms, volume of cone, angles in circles.

The most challenging topics were: solving equations using graphs, problem solving with speed-time graphs, comparing distributions, problem solving with mensuration and measures, vectors, harder probability.

Comments on specific questions

Question 1

(a) (i) This part was very well answered by most of the candidates, with only a few incorrectly multiplying the amount by 1.635 instead of dividing.

(ii) This part was also very well answered. A small number of candidates reached \$294.30, but then did not subtract. A small number of candidates correctly calculated 85%, but of their answer to part **(a)(i)** instead of \$1962.

(iii) This part was answered less well. Many did not recognise that the problem involved using a difference in the ratio, 5 – 1 and worked instead with 5 or 5 + 1. A few started correctly and divided 220 by 4 to give 55 but then did not read the demand carefully and gave the height as 55 m.

(b) (i) This part was well answered. Some candidates reached 265 but did not then subtract 100. A small number correctly reached 165 but then subtracted 100, giving a final answer of 65%. The most common error among those who scored few marks was to find 9752 – 3680 and then to divide this by 9752, finding the rate as a percentage of the increased amount rather than of the original amount.

(ii) This part was well answered by many who recognised this as requiring a reverse method. The common error was to find 45% or even 55% of 74 240.

Answers: **(a)(i)** 1200 **(ii)** 1667.70 **(iii)** 275 **(b)(i)** 165 **(ii)** 51 200

Question 2

(a) This part was very well answered. The most common error was almost always due to a problem with changing signs across the equality sign in the second step or losing the negative value in the final answer.

(b) Almost all the candidates scored at least one mark in this part. Many candidates only partially factorised the expression and did not choose $6ab^2$ as the factor to remove. Most however were able to give a correct partial factorisation at least.

(c) (i) This part was answered well by the majority of the candidates.

(ii) This part was answered less well, with the fractional index causing some difficulty. The numerical value was often given as 12

(d) There was some discrimination among candidates in this part. Those who knew that their starting point needed to be $y = \frac{k}{(x+2)^2}$ invariably went on to find that $k = 50$ and usually but not always obtained the correct answer. There were however a large number who could not set up the correct algebraic form from the proportion given, with square root and direct proportion being the common errors.

(e) Candidates also varied considerably in their success with this part. Most found the common denominator that was required but a large number either omitted essential brackets in the numerator or correctly wrote $5 \times 2 - (x - 5)(x - 2)$ but then the expansion of the brackets frequently led to sign errors. Almost all scored marks however in this question

Answers: **(a)** –1.5 **(b)** $6ab^2(2b + 3a^2)$ **(c)(i)** $10a^5c^9$ **(ii)** $\frac{8a^6}{c^9}$ **(d)** 0.5 **(e)** $\frac{7x - x^2}{2(x-2)}$

Question 3

(a) This part was answered well by the majority of candidates and full marks were often earned. There were a few common errors seen including 90° with no direction or anti-clockwise; incorrect centres of rotation; or simply omitting the word 'rotation' itself. A very small number spoiled their answer by mentioning a second transformation, usually a translation, not realising that the rotation would change the position of the triangle as well as its orientation.

(b) (i) This part was nearly always correct except for the few who reflected the triangle in the *y*-axis.

(ii) Again, this part was nearly always correct, except for the few who translated the triangle correctly, but in one direction only.

(iii) This was the least successful part of the question, but there were still a good number of fully correct transformations seen. If not fully correct, some earned part marks for drawing an enlargement with scale factor $\frac{1}{2}$ but from a different centre. While many candidates recognised the transformation represented by the given matrix and showed no working, there were some who wrote down a matrix multiplication and this was sometimes incorrect in the application.

Answer: **(a)** Rotation, 90° clockwise, (0, 0)

Question 4

(a) Many candidates answered this part very well and showed clear working at each stage. The majority of candidates wrote down a correct equation for the area of the triangle although a small number did not equate this to 30. Some errors were seen in the next step, such as using $4x-1$ for the height or dividing the contents of both brackets by 2 but almost all candidates expanded the brackets correctly. The most common error was the omission of brackets, for example, $\frac{1}{2}\times 8x^2+12x-20$ was seen on a number of occasions although it was usual to see the next step written down correctly. A few candidates omitted the '=0' at the end of the required equation.

(b) The instruction to use factorisation to solve the equation was often overlooked with many using the quadratic formula and although candidates were given credit for obtaining the correct solutions, method marks were not earned in this case. The majority of candidates who attempted factorisation to solve the equation obtained the correct factors and the two correct solutions to gain full marks.

(c) There were many correct answers with most substituting their positive value from part **(b)** into $4(x – 1)$ and $2x + 5$. Some candidates used $4x – 1$ and many made errors when squaring the terms, such as giving $4(2.5-1)^2$. There were some candidates who attempted to use Pythagoras' theorem to obtain an algebraic expression for *BC* but they often made an error in the expansions of $(2x+5)^2$ or $(4x-4)^2$.

Answers: **(b)** 2.5 and –4 **(c)** 11.7

Question 5

(a) The two values required to complete the table were almost always calculated correctly.

(b) Most candidates drew an accurate smooth curve and scored full marks. Points were generally plotted accurately although, in a number of cases, the point (–1.5, 0.1) was plotted at (–1.5, –0.1).

(c) (i) The majority of candidates drew an accurate tangent from (0, –17) to the curve ensuring that their line touched the curve. Some drew a horizontal line from (0, –17) with a small number of these attempting to draw a tangent from (–3, –17).

(ii) Those candidates who earned the mark in part **(c)(i)** usually also earned the mark in this part.

(iii) The candidates who had drawn the correct tangent and then selected the points (0, –17) and (2, 1) generally calculated the gradient correctly and used the *y* co-ordinate of the point (0, –17) to write down the correct equation. Those candidates whose answer to part **(c)(ii)** was not (2, 1) or who chose to use two other points on their tangent often found calculating the gradient more difficult with a sign error being the most common error. A number of candidates did not recognise that the value of c in $y = mx + c$ could be written down as –17, without any further calculation and so substituted their value of m, together with the co-ordinates of a point on the tangent, to find the value of c. This often led to a slightly inaccurate value.

(d) Many candidates found this part challenging but some were able to score full marks. Those who were able to rearrange $x^3 - 6x - 3 = 0$ into the form $x^3 - 3x - 1 = 3x + 2$ were usually able to draw the line $y = 3x + 2$ and obtain the solutions. Some did not plot the points accurately enough to give a correct line and others made an error when reading off the *x* co-ordinates of the interceptions with the curve. There were candidates not following the instructions to draw a straight line who drew the graph of $y = x^3 - 6x - 3$ and were given credit if they gave the correct answers.

Answers: **(a)** –3, 17 **(c)(ii)** (1.7 to 2.2, –1 to 2.5) **(iii)** [y =] $9x - 17$
(d) $y = 3x + 2$ drawn and –2.2 to –2.1, –0.6 to –0.4, 2.6 to 2.8

Question 6

(a) This part was well answered. A common error was to make the assumption that the initial speed was 0 m/s and so the incorrect answer of 1 m/s^2 was sometimes given.

(b) The majority of candidates understood that it was necessary to find the area under the graph in order to find the distance travelled. There were many however who thought that, in order to find the distance travelled by the runner, the area of the 'upper' trapezium was required rather than the total area under the graph and it was common therefore to see an incorrect answer of 27.9 m. Some who did appear to attempt to find the total area under the graph incorrectly gave the area of a trapezium with parallel sides 19 and 12 and a height of 3. Those with an incorrect complete method often scored one mark for giving the area of at least one of the relevant areas under the graph.

(c) This was a challenging part and correct answers were only occasionally seen. Many candidates understood the area of the rectangle is required to find the distance covered by the walker so it was quite common to see $19 \times 1.2 = 22.8$. Many then subtracted this from their answer to part **(b)** but many did not then use the 10 m to give the final answer.

Answers: **(a)** 0.6 **(b)** 50.7 **(c)** 17.9

Question 7

(a) This part was well answered. Most realised *EA* was perpendicular to *AO* and gave the correct answer. A few assumed that triangle *BAC* was isosceles leading to angle *ABC* = 70°, angle *AOC* = 140, angle *OAC* = 20 and angle *BAO* = 55 – 20 = 35. A few halved the angle *BAC*.

(b) This part was well answered with the majority of candidates finding angle *OAC* and using the properties of an isosceles triangle. Answers that correctly followed through from part **(a)** were given full credit as was the case in the rest of the question.

(c) Most were able to correctly apply the 'angle at the centre = 2 × angle at the circumference' property. A few doubled angle *AOC* rather than halving it.

(d) Many answers were correct using the properties of cyclic quadrilaterals. The few errors were in doubling angle *ABC* or in thinking that *OCDA* was a cyclic quadrilateral and giving angle *CDA* = 180 – angle *AOC*.

Answers: **(a)** 29 **(b)** 128 **(c)** 64 **(d)** 116

Question 8

(a) The majority of candidates realised they needed to use distance ÷ time. However, many who did not use the calculator function for time had difficulty in converting 2 hours 20 minutes into hours. Those who used a fraction were often successful but decimals of 2.3, 2.33 or 2.2 led to answers outside the accepted range. Others gave an answer of 6.17 (km/min) from use of 140 minutes.

(b) This part proved straightforward for most candidates. The majority used the cosine rule correctly although a few did use the implicit form initially. Common errors included omitting the 2 or using + 2 in the cosine formula while others used the order of operations incorrectly by evaluating $(864^2 + 928^2 - 2 \times 864 \times 928) \cos 67$. Occasionally premature rounding within the calculation led to inaccurate final answers.

(c) (i) Many found this challenging as they were unsure which angle was the bearing. Attempts were made to find angles at *B* but few realised that the question could be answered using the angle properties of parallel lines. Incorrect methods of 360 – 133 and 180 – 133 were very common.

(ii) There were some excellent solutions to this part with efficient working seen. Many were able to gain three marks using the sine rule correctly to obtain the angle *HGB* or angle *HBG* with a few using the cosine rule. The main difficulty was in using this result to find the bearing. Although the final answer was usually an angle at *G* it was not always the required bearing. Some rounded values to the nearest degree within their working, leading to solutions which were incorrect to 3 significant figures. Less able candidates often did not realise that they needed to use trigonometry and often only used angles given in the question.

Answers: **(a)** 370 **(b)** 991 **(c)(i)** 313 **(ii)** 79.5 to 79.6

Question 9

(a) (i) This part was well answered. Most candidates were able to find the estimated mean and showed clear calculations to support their answers. A few used the class width of each interval rather than the mid-interval values or added the mid-interval values and divided by 6. The most common errors were due to an arithmetic slip with one of the mid-points rather than a lack of understanding of the method.

(ii) The vast majority of candidates scored full marks. Histograms were ruled and mainly accurately drawn. There were some who used the class width as 20 throughout leading to frequency densities of 0.9, 1.1, 2, 1.05 while others calculated frequency ÷ mid-interval value to calculate the frequency density.

(b) There were only a few correct acceptable comments. Correct comments usually indicated that more time was spent on Saturday or less on Wednesday; very few made a comment about the range. Many candidates commented on individual intervals rather than the whole distribution or referred to the number of people rather than to the time interval e.g. many/more/most people.

Answers: **(a)(i)** 42.8

Question 10

(a) (i) This part was answered well with most candidates giving $75\,000 \times 60 \times 20$ or $75\,000 \times 1200$. A small number used the given answer and showed $90\,000\,000 \div 75\,000 \div 60 = 20$ and in these cases, marks will not be awarded as candidates should arrive at the given answer and not use it in their reasoning.

(ii) Many candidates found this part challenging and it was not attempted by some. The majority of candidates did not identify a correct method and it was quite common to see 90 000 000 – 550 000 or to see a square root or cube root taken; others incorrectly wrote down the area divided by the volume. The majority of those who gave a correct first step made at least one error in attempting to convert the units but earned one mark for an answer with the correct figures but with the decimal point in the wrong place.

(iii) This part was generally answered well. A small number of candidates found the area of the sector and a few omitted to add on the lengths of the radii to the arc to find the total perimeter.

(b) (i) Virtually all candidates answered this correctly.

(ii) The vast majority of candidates scored one mark for dividing their volume of the cone by 2 as a correct first step, but were unable to make any further progress. Very few appreciated that the ratio of the radii (1 : 2) needed to be converted to a ratio of the volumes. The most common incorrect response was to divide the volume of the smaller cone by 3 and equate this to $\frac{4}{3}\pi r^3$ leading to an answer of 5.31 cm. A smaller number used $\frac{4}{3}\pi r^3 + \frac{4}{3}\pi 2r^3$ but did not put brackets around the 2*r*.

Answers: **(a)(ii)** 16.4 **(iii)** 28.3 **(b)(i)** 3770 **(ii)** 3.68

Question 11

(a) (i) This part was well answered with many candidates earning full marks. Errors made were mainly to do with signs, while a few candidates added the vectors instead of subtracting.

(ii) Many candidates assumed they must find the determinant of a matrix in this part and often stated 'impossible' but it was the magnitude of the vector that was required here. Some others wrote $-3^2 + 2^2$ or squared the numbers correctly but subtracted instead of adding. A final answer in surd form was acceptable but decimals had to be given correct to at least 3 significant figures.

(iii) There were many good solutions to this part and many candidates earned full marks. Most candidates were able to write down two equations in *m* and *n* from the given vector equation initially. Most were able to solve these correctly and credit was given to correct methods even if the equations themselves were wrong. Candidates usually used elimination or substitution methods but some used matrices. The question required the method to be shown and candidates who just wrote down values for *m* and *n* could not score full marks.

(b) (i) In these four parts, it was important for the candidate to read the question carefully. Many candidates took the vector **c** to represent $\overrightarrow{OB}$ instead of $\overrightarrow{OC}$. More able candidates answered all parts well.

(i)(a) This was answered well if the vector **c** was correctly used.

(i)(b) Many candidates earned this mark for multiplying their previous answer by $\frac{3}{8}$.

(i)(c) There were many correct answers but $\frac{3}{2}\mathbf{c}$ was seen as a result of confusion with ratios.

(i)(d) Often omitted, some candidates were able to gain some credit for describing a correct route from *C* to *D*.

(ii) Most candidates found this part challenging. The answer was often incorrectly given as $\frac{1}{4}$. Many candidates wrote down a division of their answers to parts **(i)(c)** and **(i)(d)**, and vector answers rather than a numeric value was often seen.

Answers: **(a)(i)** $\begin{pmatrix} -19 \\ -2 \end{pmatrix}$ **(ii)** 3.61 **(iii)** –0.5 and 2.5 **(b)(i)(a)** $-\mathbf{a} + 2\mathbf{c}$ **(i)(b)** $\frac{3}{8}(-\mathbf{a} + 2\mathbf{c})$ **(i)(c)** $\frac{1}{2}(5\mathbf{a} - 2\mathbf{c})$ **(i)(d)** $\frac{1}{8}(5\mathbf{a} - 2\mathbf{c})$ **(b)(ii)** 4

Question 12

(a) (i) Almost all of the candidates were able to score full marks in this part by clearly showing the product $\frac{10}{20} \times \frac{9}{19}$.

(ii) There were some good attempts at this question but relatively few completely correct answers. Correct solutions usually involved finding the sum of the 6 combinations BS + SB + BC etc. rather than the quicker but less obvious sum of 3 combinations of B not B etc. The method of subtracting those not required from one was not often used and it proved less successful. There were many partially correct attempts identifying the pairs, e.g. BS, BC and SC, but not considering that each pair produced two combinations. A few candidates with incorrect answers did not show clear products in their working and in those cases it was difficult to award method marks.

(b) There were fewer fully correct answers here but many candidates were able to gain part marks for correct products calculated. The method used was usually the sum of 7 products. The combination C C and not C was nearly always C C B + C C S and then repeated 3 times rather than just multiplying by 3. A common error was not realising there were 3 combinations of two packets of chicken chips and often just 1 or 2 combinations were used. The other main error was not including three packets of chicken chips. As in part **(a)(ii)** it was important for candidates to show clear products to enable method marks to be awarded.

Answers: **(a)(ii)** $\frac{62}{95}$ **(b)** $\frac{5}{57}$

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 the vast majority of 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.

Some candidates lost marks by approximating values prior to the final answer. This was apparent for example in **Question 6** with angles being rounded to the nearest degree. The requirement for accuracy to the nearest thousand in **Question 2(b)** was often ignored.

The topics that proved to be accessible were reflection, rotation, translation, mid-point of a line, ratio, percentage increase, reverse percentage, exponential increase, curved surface area and volume of a cone, density and mass, plotting points and drawing curves, finding the mean of grouped data, drawing histograms, interpreting a cumulative frequency curve, using the sine rule, probability, simple trigonometry, using functions including composite functions and linear sequences.

More challenging topics included length of a vector, finding annual percentage change for an exponential increase, manipulation of the formulae for volume and surface area of cylinders and spheres, finding the exact answer for the point of intersection of two curves, volumes and surface areas of similar solids and inverse functions.

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.

Comments on specific questions

Question 1

(a) (i) Many correct answers were seen. Reflection in either the *x*-axis or the line $x = -1$ were the two most common incorrect answers. A small number of candidates gave two transformations, reflection in the *x*-axis followed by a translation of two units down.

(ii) 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 $\begin{pmatrix} -5 \\ -2 \end{pmatrix}$.

(iii) Many correct rotations were seen. Partial credit was earned for a correct 90° rotation either about a wrong centre or in a clockwise direction.

(iv) Although a majority of correct enlargements were seen, candidates were generally less successful in this part. Enlargements with scale factor $\frac{1}{2}$ were often seen and, to a lesser extent, enlargements with scale factor $-\frac{1}{2}$ with an incorrect centre. A small number drew enlargements with scale factor 2 and a significant number made no attempt at all.

(b) (i) Many correct column vectors were seen with only a few examples of the components separated by a fraction line. The most common incorrect answers included two by two matrices that used the co-ordinates as their elements.

(ii) The process of finding the magnitude of a vector was not understood by many of the candidates and only a minority gave a correct value. There was no pattern to the wide variety of incorrect answers. Some of the more common ones included giving the equation of the line *AB*, adding or multiplying the components of the vector and some just repeated the vector. A significant number of blank responses were seen.

(iii) Many correct answers were seen. Common errors included doubling the co-ordinates of *B* and finding the mid-point of *AB*.

(iv) A majority of candidates clearly understood the method required, showed the various stages of their working and obtained the correct equation. Having found the correct gradient, a significant number went on to find the gradient of the normal and attempt to find its equation. Many of the incorrect equations resulted from slips when calculating the gradient. With or without the correct gradient, not all candidates appreciated that the co-ordinates of a point on the line could be substituted to find the constant term. Only a small number of candidates used *A* with either *B* or the mid-point to count back to find the intercept.

(v) A majority of candidates earned credit for the correct answer or for an answer that followed through from their incorrect equation. Not all candidates with the correct equation gave the correct co-ordinates of *D* as several gave the answer as (–4, 0). Others gave the co-ordinates of the point where the line crossed the *x*-axis.

Answers: **(a)(i)** Reflection $y = -1$ **(b)(i)** $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ **(ii)** 4.47 **(iii)** (7, 10) **(iv)** $y = 2x - 4$ **(v)** (0, –4)

Question 2

(a) (i) Many correct calculations were seen in this part. A common error involved starting with 115 and showing the number of students to be 240. Some candidates did not show both steps in the calculation, usually omitting 240 ÷ 48.

(ii) Many correct answers were seen with a significant number earning partial credit for a ratio not in its simplest form, usually 22 : 20. A small number of candidates gave the answer as 10 : 11.

(iii) Almost all candidates gave the correct answer.

(iv) Many candidates understood the method for calculating a reverse percentage. Those that recognised that 240 was 160% of the original number of students almost always went on to obtain the correct answer. A significant number of candidates simply reduced 240 by 60% leading to the common incorrect answer of 96.

(b) A good majority of candidates understood exponential increase and calculated the correct population after 30 years. Some candidates mistakenly calculated the overall increase as 60% and a population of 409 600 was a common incorrect answer. Some forgot that the question asked for an answer correct to the nearest thousand, often giving the exact answer instead.

(c) Only a minority of candidates were able to begin correctly with $\left(1+\frac{r}{100}\right)^{32} = 4.09$ or its equivalent.

Many of those with a partial understanding did not realise that the population after 32 days was 409% of the original and so 3.09 was usually seen in place of the 4.09. Those that did use 4.09 often went on to find the correct rate of interest. Two errors were very common. Firstly, many divided 309 by 32 and gave an answer of 9.6% and secondly, many calculated $\sqrt[32]{309}$ which led to an answer of 19.6%.

Answers: **(a)(ii)** 11 : 10 **(iii)** 276 **(iv)** 150 **(b)** 464 000 **(c)** 4.50

Question 3

(a) (i) Most candidates calculated the correct curved surface area. Common errors usually involved using the perpendicular height or calculation of the total surface area.

(ii) Again, most candidates were able to calculate the correct volume of the cone. Common errors usually involved the incorrect use of Pythagoras' theorem, often $17^2 + 8^2$, and the occasional use of 17 for the height of the cone.

(iii) Almost all candidates demonstrated a good understanding and calculated a correct mass for their volume in the previous part. The most common error was dividing the volume by 0.8.

(iv) The vast majority of candidates calculated the correct mass of the box. Adding the mass of the cone to 1.2 kg and confusion over the number of grams in a kilogram were the most common errors.

(b) (i) Although many candidates were able to make a start, only a minority were able to obtain the correct fraction. The manipulation and simplification of the algebraic formulae proved to be challenging. For the cylinder, squaring $3r$ incorrectly to give $3r^2$ was a very common error. Cancelling the fraction but still having π or r in the fraction or inverting the fraction were also common errors. The absence of numerical values to substitute into the two formulae caused problems. Some overcame this by allocating a value to r. Rounding intermediate values during the process meant that candidates rarely reached the correct final fraction.

(ii) A majority of candidates understood the need to find the radius from the given information. Equating $4\pi r^2$ and 81 was a common error at this stage. With $r = 4.5$ many were able to find the correct curved surface area. Other common errors included the use of r as the radius instead of $3r$ and squaring $3r$ incorrectly. Some forgot that the question asked for the answer to be given in terms of π and answers in the range 3052 to 3055 were seen. Some attempted to convert their numerical answer to a multiple of π but this rarely gave the exact multiple.

Answers: **(a)(i)** 427 **(ii)** 1010 **(iii)** 808 **(iv)** 392 **(b)(i)** $\frac{1}{54}$ **(ii)** 972π

Question 4

(a) Almost all candidates completed the table correctly.

(b) Many candidates plotted the points correctly and drew an acceptable curve. Plotting (3, 0.9) at (3, –0.9) was a common error. Although many good curves were seen, candidates need to understand that a curve should be drawn with a sharp pencil. Some used a pen which led to problems when corrections had to be made and others used blunt pencils that produced curves that were far too thick. However, very few candidates joined up the points with ruled lines.

(c) A majority of candidates were able to draw an accurate tangent and calculate its gradient correctly. Some candidates calculated change in x divided by change in y. Others misread the scales when finding the changes in x and y and some made numerical slips, largely because of the negative values used. Having done all the correct work some ignored the negative and gave the absolute value of the gradient. Some less able candidates made no attempt at this part.

(d) Almost all candidates completed the table correctly.

(e) Many candidates plotted the points correctly and drew acceptable curves with very few instances where candidates had joined the two separate sections. As in part **(b)** some used a pen and some drew curves that were far too thick. Again, very few joined up the points with ruled lines.

(f) (i) A majority of candidates gave a correct value for *x* at the point where the curves intersected.

(ii) This proved challenging for many candidates and only a minority were able to use their previous answer to give a correct inequality. Some did use their answer but then used less than instead of greater than. Many incorrect responses did not use their previous answer.

(g) Again this proved challenging. Only a minority were able to set up a correct equation, rearrange it and find the correct value of *k*. Most did not use algebra, preferring to cube the value from part **(f)(i)**.

Answers: **(a)** –1, 3 **(c)** –2 to –1.5 **(d)** –3, 3 **(f)(i)** 3.6 to 3.85 **(ii)** $x >$ *their* **f(i)** **(g)** 52

Question 5

(a) i) Calculating the mean of grouped data was well answered with most candidates showing clear and accurate working leading to the correct answer. Only a small minority of incorrect answers resulted from the use of the interval widths.

(ii) Many accurately drawn histograms were seen, the majority of which were neatly ruled. Calculations for the frequency densities were rarely seen and if blocks were incorrect it was often impossible to spot where the candidates had gone wrong. Drawing the first block to cover the width from 0 to 200 tonnes was a common error.

(b) (i) Many correct answers were seen. Answers of 8 and 10 were two common errors but there was no pattern to many of the other incorrect answers.

(ii) The median was usually stated correctly.

(iii) The value of the upper quartile was usually correct.

(iv) Although many candidates obtained the correct value for the interquartile range, fewer correct answers were seen than in the previous parts. Some gave incorrect answers such as 38 – 62, others gave the value of the lower quartile.

(v) Many candidates were able to estimate the number of days when the mass was greater than 20 tonnes. Occasionally candidates stated the number of days when the mass was less than 20 tonnes. Some candidates misread the scale and incorrect answers of 89 and 11 were seen.

Answers: **(a)(i)** 265 **(b)(i)** 100 **(ii)** 56 **(iii)** 62 **(iv)** 24 **(v)** 88

Question 6

(a) A majority of candidates showed their working clearly and obtained the correct value for the angle. Some started with $11^2 = 13^2 + 4^2 - 2 \times 13 \times 4 \times \cos C$ and then rearranged it incorrectly trying to obtain an expression for cos*C*. Others had a correct statement of the cosine rule for an angle other than *C* and some stated the cosine rule incorrectly. Many of the less able candidates found this question challenging and did not recognise that the cosine rule was needed and the use of the sine rule and simple trigonometry were seen.

(b) Most candidates calculated angle *DAC* correctly. Some rounded their answer to 37 which led to their answer for angle *ACD* being out of range. A significant number of candidates recognised that the sine rule could be used directly for angle *ACD* if the length of *AD* could be found. Some candidates set up the cosine rule for angle *D* correctly which led to a quadratic equation in *AD* which was sometimes solved correctly. Many of the other attempts to find *AD* were incorrect, such as Pythagoras' theorem and simple trigonometry.

(c) Full correct answers were in the minority although many candidates earned partial credit for a correct method for the area using their incorrect angles from the previous two parts. Several candidates successfully calculated a correct perpendicular height for each triangle and used them correctly. Some used the wrong angle, not realising that the angle in the area formula needed to be the included angle. Some treated one or both triangles as right-angled triangles for a simpler calculation.

Answers: **(a)** 52.0 **(b)** 62.7 **(c)** 66.7

Question 7

(a) (i) Many correct responses were seen. Having found the correct probabilities, a minority of candidates made no comparison which required using an inequality sign, finding equivalent fractions with the same denominator or converting to a decimal or percentage.

(ii) A majority of candidates had a good understanding of probability and were able to use a correct method for calculating the probability. Several attempted a tree diagram with some success but not all trees showed all of the correct outcomes A common error occurred in the fraction work with a significant number of candidates thinking that $\frac{2}{5}\times\frac{1}{4}=\frac{3}{20}$. Some applied the wrong operations and $\left(\frac{3}{5}+\frac{3}{4}\right)\times\left(\frac{2}{5}+\frac{1}{4}\right)$ was often seen. Others attempted to calculate the probability of two different colours from each bag.

(b) (i) Many correct answers were seen in this part. Some calculated the probability with replacement and some appeared to refer back to the previous part and calculated the probability that both balls were black.

(ii) Although many correct answers were seen, candidates were slightly less successful in this part. Some thought that the probability could be found by using 1 – probability of all black. Others gave a probability with replacement and some ignored the fact that there were not three white balls in the bag and gave the answer as $\frac{2}{5}\times\frac{1}{4}$.

(c) Although this proved to be a challenging question, a small majority of candidates were able to calculate the correct probability. The fact that the ball chosen from bag *A* was placed in bag *B* did not fully register with all candidates as many still gave their probabilities out of 4. An error similar to the one in part **(a)(ii)**, $\frac{2}{5}\times\frac{1}{5}=\frac{3}{25}$, was often seen. A small number calculated the probability of the two balls having the same colour but not all subtracted their answer from 1.

Answers: **(a)(ii)** $\frac{11}{20}$ **(b)(i)** $\frac{6}{60}$ **(ii)** 0 **(c)** $\frac{11}{25}$

Question 8

(a) (i) Many correct answers were seen in this part. Some could not identify the corresponding sides correctly and 3 was the most common error.

(ii) Most candidates had a good understanding of trigonometry and had no difficulty in finding angle *XAB*. Some calculated angle *XBA* as their first step and some used the cosine rule. Some candidates lost accuracy by giving their answer as 37 without first showing a more accurate value.

(b) This part proved to be quite demanding for many of the candidates. With the complexity of the diagram, candidates needed to look carefully in order to identify the circle theorems that could be applied to the work. Identifying the value of *v* was the key part of the question and most of the more able candidates found *v* correctly and followed this with the remaining three angles. Many of the rest did not identify *v* as the angle at the centre and the 75 as the matching angle at the circumference. More candidates recognised that triangle *OPT* was isosceles and so were able to find *w* correctly from their *v*. Not all candidates recognised *w* and *x* as a pair of angles at the circumference. Many earned partial credit for y by identifying the third angle in the triangle with y and v (or its opposite) as 20°.

(c) To achieve success in this question, candidates needed a good understanding of scale factors for length, area and volume and how to use them. Only the more able candidates achieved much success and fully correct responses were in the minority. Some recognised that $\frac{94}{226}$ was an area scale factor and were able to square root it to find the linear scale factor. Many others simply used the area factor as the volume factor and obtained an answer of 282, a very common incorrect answer.

Answers: **(a)(i)** 4 **(ii)** 36.9 **(b)** 150 15 15 10 **(c)** 182

Question 9

(a) The vast majority of candidates calculated the value of the function correctly.

(b) Many correct responses were seen in this part. Most candidates evaluated h(–1) as their first step and then substituted its value into the function f(x). Some opted to find the composite function fh(x) as their first step but this usually produced more errors, such as $3(3^x) + 4 = 9^x + 12$. Some found the product of the two functions.

(c) 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.

(d) The composition of two functions, ff(x), was more challenging but many candidates answered this part well. Many of the less able candidates took the composition to be a product of the two functions, resulting in a quadratic expression that replicated the next part if carried out correctly. Errors with the expansion of brackets and the resulting simplification were seen quite often

(e) Squaring the function f(x) was completed correctly by many candidates. Errors with the expansion of brackets and the resulting simplification were quite common. Less able candidates often squared the individual terms and the answer $9x^2 + 16$ was quite common.

(f) Success in this question was largely dependent on the algebraic step of moving from $h^{-1}(x) = g(2)$ to the composite function $x = hg(2)$. 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. The common error was to equate 3^x to g(2). Several candidates treated the inverse function as the reciprocal function.

Answers: **(a)** 0 **(b)** 5 **(c)** $\frac{x+1}{2}$ **(d)** $9x + 16$ **(e)** $9x^2 + 24x + 16$ **(f)** 27

Question 10

(a) Most candidates obtained the next term in the sequence. Those that treated the numerators and denominators as separate sequences usually had no difficulty in finding an expression for the nth term. When errors occurred, they were more likely to be seen in the denominator. Those that worked with the fractions as a whole, made no progress as they could find no common difference. A significant number of candidates made no attempt at the nth term.

(b)(i) Many correct responses were seen with most in their simplest form. Common incorrect answers included $n - 2$, the next term and the common difference.

(ii) Many candidates produced a difference table showing the third difference to be 6. Some of these led to a cubic expression but some led to linear expressions involving $6n$ or quadratic expressions involving $6n^2$ or $3n^2$. Some candidates with the correct expression did so without showing working. There was a significant number of blank responses.

Answers: **(a)** $\frac{8}{15}$, $\frac{n+2}{2n+3}$ **(b)(i)** $1 - 2n$ **(ii)** $n^3 + 1$