MATHEMATICS

Paper 0980/12
Paper 12 (Core)

Key messages

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

General comments

Most candidates presented their work clearly.

Accuracy of answers suffered from rounding in the middle of a calculation requiring two or more stages, as well as the rubric not being followed to give answers to 3 significant figures.

Comments on specific questions

Question 1

A few candidates drew more than one line (horizontal or diagonal) and many did not rule the line. While freehand and dashed lines were not penalised, reasonable accuracy was expected. While most gained credit, a considerable number who knew where the line was didn't draw it within a generous tolerance.

Question 2

The list of factors was well answered but often one factor (usually 1 or 42) was missing. Some candidates lost credit for a missing pair (often 3 and 14 or 1 and 42). Only a few gave incorrect factors but quite a number gave less than six factors which resulted in no credit.

Question 3

Whilst a few candidates drew a parallel, instead of perpendicular, line, most errors were from a line far from 90° to the given line. Some candidates constructed the bisector of the line which did not pass through the point, *P*. A tolerance was allowed but many did not use their protractor carefully enough or simply drew any line through the point, *P*. However, there were many who knew what perpendicular meant and drew a correct line.

Question 4

Finding the mean of a set of numbers was answered well but quite a few candidates either could not add 5 numbers, or divide by 5, correctly. Incorrect use of a calculator often resulted in just the last number being divided by 5. Otherwise some confused mean with the median value of 270 or gave the middle value of the unordered list, 185.

Question 5

The main challenge was to understand that 65 had to be substituted for *C* in the formula and not to replace the 9, which led to an answer of 45. Some replaced *F* with 65. Incorrect order of operations also led to errors, but many correctly substituted and resolved the formula.

Question 6

This question specifically tested order of operations and while it was quite well answered, many did assume the operations needed doing in the order they occurred instead of following the BODMAS convention. This commonly produced the answer of 47 from 9 + 5 calculated first. Since the method mark was for seeing the results of 5×7 and $4 \div 2$ or these bracketed, the answer of 42 could not have credit if preceded by incorrect working. **Part (b)** was answered more successfully although there was a significant number of blank responses to this part.

Question 7

While this question was well answered with nearly all candidates demonstrating understanding of subtraction of vectors, most errors came from handling directed numbers. This was most noticeable with the first component being 3 instead of 7 from 5 – (−2). A fraction line was seen occasionally.

Question 8

Once again, handling directed numbers caused errors to be made in both parts of this question. While most responses were correct, quite a number put the whole calculation, rather than a single value, in the answer space. The wording of **part (b)** was more demanding and that was reflected in the responses, the common answer being 5.

Question 9

While the question was quite well answered, many wrote a whole number answer rather than 3 significant figures as in the rubric. Although the question required 3 bar totals to be added, it was common to see 2 or 4 bar totals added. Changing to a percentage was a significant challenge for some with division by 100 and multiplication by 55 often seen. Some rejected the given total of 55 and added all the bars incorrectly.

Question 10

This question was answered well although some candidates changed the fraction to a decimal and then gave an answer of 0.7 instead of subtracting that from 1.

Question 11

Many candidates were able to find the fourth root of a number but those unfamiliar with the notation usually calculated $4 \times \sqrt{0.0256}$ resulting in an answer of 0.64. Another error seen was calculating the square root, leading to 0.16.

Question 12

While there were a considerable number of candidates who could interpret the stem-and-leaf diagram correctly and knew how to find the required statistical measures, many did not gain full credit. Leaving off the stem part in the responses was quite common. Finding the median was the most challenging with a mean often calculated or 11.5 for those who thought the middle came between 11 and 12. Mode and range were usually correct for those who could interpret the diagram, although occasionally 20 – 3 was given for the range.

Question 13

(a) While many candidates did understand the meaning of reciprocal, the answer was often left as $\frac{1}{0.2}$ instead of working out the division. Responses to the prime number were more successful although occasionally even numbers were given. The incorrect answer of 91 was often seen and some candidates gave numbers (not always prime) outside the required range of 90 to 100. Some thought that there was more than one prime number in the range.

(b) Most candidates were able to select the irrational number but $\sqrt{9}$ was often seen. Again, some assumed there was more than one irrational number. Many did not understand irrational resulting in a variety of incorrect choices.

Question 14

Common incorrect answers were 5 from 9 − 4 and 36 from 4 × 9 but many did find the correct value for *x*. However, some gave 7^{13} as the answer.

Question 15

(a) The vast majority of candidates chose the option 'negative correlation'. Ringing the crosses or adding crosses to the diagram were seen, indicating a lack of understanding of the question.

(b) This part was answered correctly by the majority of candidates but a small number of candidates had little understanding of what a line of best fit was by choosing diagrams B or D.

Question 16

Many candidates made a good start to this question with division of the volume by 12. However, many then did not realise they needed to find the square root and divided by 2, 4 or 6. Some who calculated the square root rounded the division by 12 to 3 significant figures producing inaccuracy in their answers. Since the question involved a volume, a significant number found the cube root. While some tried to start with an equation, this was rarely worked successfully and often dividing the volume by 12^2 was seen.

Question 17

Candidates who understood that the given line was a diagonal and that the sides had to be 6.5 cm and constructed using compasses gained full credit. Some gained partial credit from a correct rhombus but no construction arcs. Just one triangle constructed on the diagonal as base was occasionally seen. There was a significant number not attempting this question.

Question 18

Most candidates started correctly by changing the mixed number to an improper fraction. While that led to full credit for many, some did not show the working for either the invert and multiply or division with common denominator method. Other errors seen were inverting the wrong fraction and writing the answer as a decimal. Of those gaining 2 marks for a correct method, more errors were made resolving the division method than invert and multiply.

Question 19

(a) Few candidates gained full credit but the clear majority did gain partial credit for a correct first branch. The wording 'puts it back in the bag' should have stopped the many second branch probabilities being out of 7, instead of 8. Working in decimals was acceptable but very often produced errors. Some of those who realised the two fractions that were needed put them on the wrong branches. Others, lacking understanding, just wrote colours or whole numbers on the branches.

(b) Many candidates added, rather than multiplied the two probabilities. Many could not attempt this part as they did not have two probabilities from **part (a)** while some gave probabilities greater than 1.

Question 20

This question asked candidates to show the calculations involved to show that the cylinders were similar. Many candidates did what was required, but in a wide variety of ways. Finding or using the scale factor or proportion factor in two expressions was the key to success but often more lengthy explanations were seen. Missing out steps in the solution was an issue for some since while they clearly understood the relationship, the detail was absent from their explanations. Those who went into volumes or areas did not make any progress towards what was required. Many candidates did not attempt this question.

Question 21

(a) The change to standard form question was well answered but an index of 3, instead of −3 was often seen. Some did not understand standard form, giving answers such as 654×10^{-5} or answers having no resemblance to $a \times b^n$. It was common to see rounding of 6.54 to 6.5.

(b) This part was found challenging and it was a very different type of question on standard form. A few candidates started to write it as an ordinary number but soon gave up. Some did realise that it was simply 102 – 3 but most gave answers of 102, 3 or a variety of numbers.

Question 22

This question was quite challenging since this type of question in the past has asked for an equation to be formed and then solved. Here the approach was not directed but many did start with an attempt to add the angles, although some multiplied them. It was common to see $6x = 75 + 87$ with no reference to angles in a quadrilateral. Errors were made specifically dealing with the x terms, finding $8x$ rather than $6x$. Those who did go the step further to an equation often gave an incorrect total for angles in a quadrilateral or the total without the right angle. There were a few who worked out the correct answer by trial and improvement.

Question 23

While there was a sensible, correct approach, factor trees or ladders, to this question, many didn't find the LCM, giving the answer as the HCF. The few who formed lists of multiples, using their calculators, nearly always found the correct answer.

Question 24

Again, may candidates found working with directed numbers challenging in this expand and simplify question. An easy first bracket expansion did enable most candidates to gain partial credit but few reached the correct final answer. Expanding $-3(x - 5)$ and then combining with the first bracket terms led to many errors. Even some reaching the correct answer then combined the two parts into a single term.

Question 25

(a) Arc length and area of a sector were found challenging. However, a significant error was working with area in this part and circumference in **part (b)**. While many did work out the circumference, few knew to multiply by $\frac{72}{360}$ and instead tried fractions such as a quarter or a third. Some candidates used 3.14 or $\frac{22}{7}$ for π.

(b) Candidates who worked **part (a)** correctly usually had success with the area of the sector. However, some worked with $2\pi r^2$ as the area formula. Both parts were not attempted by a significant number of candidates.

MATHEMATICS

Paper 0980/22
Paper 22 (Extended)

Key messages

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

General comments

There were many excellent scripts with a significant number of candidates demonstrating an extensive understanding of all topics. Few candidates were unable to cope with the demand of this paper. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Non-response was most common in **Questions 4**, **17**, **21b** and **23**. Candidates showed particular success in the fundamental skills assessed in **Questions 1**, **2**, **5b**, **7b**, **8** and **9**. The more challenging questions were **Questions 4**, **5a**, **12ai**, **12b**, **19a** and **21b**. Candidates were very good this year at showing their working. It was rare to see stages in the working omitted and so in the majority of cases it was possible to award method marks when answers were not correct or inaccurate. Some candidates lost marks due to rounding or truncating prematurely within their working, or giving answers to less than the required three significant figures: this was particularly evident in **Questions 10a**, **14** and **19**. Candidates are advised to learn how to store and retrieve answers to previous calculations on their calculator, to help with the issue of premature rounding.

Comments on specific questions

Question 1

Candidates got off to a good start with this probability question and there were very few who could not answer **part (a)**. There were a few more errors seen in **part (b)** where a fraction of $\frac{35}{50}$ was sometimes given along with an answer of 15 from those who did not read the question carefully.

Question 2

This question was almost always answered correctly with both 0.4 and $\frac{2}{5}$ frequently seen. The most common incorrect response was 0.64 which came from candidates misunderstanding the notation and calculating $4 \times \sqrt{0.0256}$ instead of $\sqrt[4]{0.0256}$. Some took the square root instead of the fourth root and 0.16 was another common incorrect answer.

Question 3

A large number of candidates calculated all three values correctly, interpreting the stem and leaf diagram appropriately and including the tens digit as well as the units in their answers. Of those who did not score well, a common error was to give the units digit only, so, for example, giving the mode as 6 rather than 16. Some candidates miscalculated the median and/or the range. A common error seen for the median was to give the 7.5^{th} value of 9.5, with incorrect values of 11.5 or 12 also seen. For the range, a common error was to give the answer as 3 – 20 without performing a subtraction. Some candidates calculated the mean, 10.7, and gave that as one of the values.

Question 4

Few candidates were able to offer a correct response to this question. Approximately a quarter of candidates offered no response. Some gave a numerical answer, or wrote 'maximum value – minimum value', illustrating a lack of understanding of the demand for an 'expression'. A minority were more able to engage with the question, writing an expression in *k*, but a common wrong answer seen was *k* + 1. The most successful candidates first tried with numerical examples e.g. 1, 2, 3, 4, 5 followed by range of 4 then 1, 2, 3, 4, 5, 6, 7 followed by range of 6, to see that the range was always one less than the number of consecutive values. Misunderstanding was sometimes evident in offering an answer using inequalities.

Question 5

Part (a) was a challenging question for many, with very few candidates selecting "It is not possible to tell if there is correlation as there are not enough points". The vast majority of candidates selected "It shows negative correlation". Only an occasional candidate circled the other two options.

Part (b) was very well answered with the majority of candidates selecting the correct answer C. The next most popular answer was A, with some candidates believing that a line of best fit needs to go through the origin, and a few candidates chose D. It was very rare for a candidate to select option B.

Question 6

Most candidates were able to construct the rhombus correctly and show correct arcs. Some constructed a perpendicular bisector of the given line, showing arcs and then measured to find the position of the vertices so incorrect method of construction. A few just drew one triangle. Some used the dashed line as one of the sides of the rhombus and then often went on to accurately construct equilateral triangles either side of the dashed line. A few rectangles were seen with the dashed line as one of the sides, indicating a lack of understanding of what a rhombus is. Seeing a correctly drawn rhombus without arcs was rare. Very few candidates left this blank.

Question 7

Most candidates were able to score at least one mark for **part (a)**, usually for the prime number. The most common incorrect answer for the prime number was 91. Many candidates did not understand the meaning of the word reciprocal. Common incorrect answers included –5, $\frac{1}{5}$, $\frac{2}{10}$ and the unfinished answer $\frac{1}{0.2}$.

Most candidates answered **part (b)** correctly with the most common incorrect answers being $\sqrt{9}$ and $\frac{7}{5}$ and very rarely, but occasionally, 0.6 or 8 were chosen.

Question 8

Nearly all candidates gained both marks for this question. Of those making errors, many still gained one mark for the correct initial substitution. Mistakes following this included incorrect rearranging, usually dividing by 10 instead of multiplying, squaring 56.25 rather than square rooting or leaving the answer as 56.25. Those who did not score any marks often omitted the 2 or the 5 from the denominator or squared 5 instead of multiplying it by 2.

Question 9

Another question that was generally well answered with many gaining full marks. The most common and most successful method was to multiply $\frac{2}{3}\times\frac{7}{10}$. The common denominator method of $\frac{14}{21}\div\frac{30}{21}$ was often less successful with many not realising that the next step was to just divide the numerators. Consequently, this was sometimes followed by the incorrect working $\frac{14\div 30}{21}$ rather than $\frac{14}{30}$ or $\frac{14}{21}\times\frac{21}{30}$. Of those who did not score full marks, most did not show all of the working, although this was rare. Very few scored no marks as even those with missing method tended to show the improper fraction $\frac{10}{7}$ at the start. There was also a small minority who did not simplify the final answer and scored just two marks. Use of decimals was rarely seen.

Question 10

Part (a) of this question was correctly answered by the majority of candidates. A small number of candidates gave the answer as 6.54×10^3 and a very small number only gave two significant figures in their answer.

Many correct answers were also seen in **part (b)**. The most common error was to see the answer given as 102.

Question 11

This question was often answered well, with the standard algebraic method for changing a recurring decimal into a fraction was well known by many, whilst others seemed either to simply remember standard results for 99ths, or used their calculator to write the correct answer only. The most common incorrect answer offered was $\frac{1}{25}$, suggesting the dots indicating recurring digits were not seen or not understood. A few answered for only the 4 recurring, reaching 4/90.

Question 12

This question proved to be a challenging question for many candidates, with many scoring zero in all three parts. Few candidates gained the mark in **part (a)(i)**, mostly because they only wrote part of the answer, namely 'square' or 'even' or 'not odd'. The most common incorrect answer was 'odd square numbers.' Fewer responses involved the descriptor 'prime numbers' as set A was not part of the question, although it was not uncommon to see the answer 'square prime numbers' with candidates not realising there are no square prime numbers. A few candidates gave examples or values as their answer rather than the description asked for in the question.

Part (a)(ii) was the best answered part of the question indicating an understanding of subsets. A commonly seen incorrect answer was ABC.

Part (b) was not well answered, with very few candidates correctly shading all but the central section.

There was a very wide variety of incorrect answers and there was not much of a pattern in the incorrect answers. Candidates often had more sections of set D left unshaded, often with both intersections of E and F left unshaded. Many did not shade outside the circles. The most successful responses were seen where the candidates labelled the ***sections 1 – 9*** and broke the question down into steps.

Question 13

Many candidates gained full marks here with solid understanding of the question and complete working shown. It was rare to see the alternate segment theorem used but some candidates did show *DAC* and *DCA* as 68, but then did not know where to go from there. Few clearly labelled the angles in their working, so it was not always clear what angle they were attempting to find. Common errors were: *AOC* as 136 correct but then finding the reflex angle at *O* and halving that for *x*, doubling *ADC* to get 88 and then halving to give 44, $x = 136$ from 180 – 44 or $x = 22$ from 44 ÷ 2.

Question 14

Many candidates were able to score four marks for this question. For candidates scoring three marks, the main error was using prematurely rounded values in their calculations, usually to two or three significant figures for the base of the triangle, leading to an inaccurate final answer. The majority of candidates used the tangent ratio to calculate the base of the triangle and then used area of triangle = $\frac{1}{2} \times$ base $\times$ perpendicular height, often leading to the correct final answer. A less efficient approach was to calculate the hypotenuse length for the triangle before using Pythagoras to calculate the base of the triangle. This was often done correctly, but usually lacked the required accuracy to gain full marks. A small number of candidates calculated the hypotenuse length of the triangle and used area of triangle = $\frac{1}{2}ab\sin C$ usually leading to a final correct answer provided interim values were not prematurely rounded. Many candidates did not work out triangle areas but instead worked out the area of the trapezium using area $=\frac{1}{2}(a+b)\times h$. A common error here, leading to two marks, was to only use one of the 15.4 cm lengths or only one of the bases of the triangle in their calculation. $\frac{1}{2}((9.68+15.4)+15.4)\times 18.2=368$ was the most common incorrect working and answer.

Question 15

The majority of candidates gained at least one mark in this question. Candidates were able to decide whether the triangles were congruent or not but many struggled with the criterion. For the first two congruent triangles, many copied the criteria from the example of ASA. In the first triangle, many had written the wrong order of SAS, either ASS or SSA so it must be emphasised that the order is essential for the criteria. For those saying that the bottom triangle was congruent, something to do with the right angle was often quoted, for example RHS or RA triangle. A few candidates tried to describe the congruency criterion in words but this was often too ambiguous, for example in the first triangle '2 sides and an angle' which is not sufficient.

Question 16

There were many correct answers to **part (a)**. Common errors included finding the gradient or finding the mid-point. Others made errors in the use of Pythagoras including adding the coordinates, $\sqrt{(9+5)^2+(-1+7)^2}$, subtracting the squares $\sqrt{(9-5)^2-(-1-7)^2}$ or not squaring the differences, $\sqrt{(9-5)+(-1-7)}$. Some candidates who had the correct surd form $\sqrt{80}$ or $4\sqrt{5}$, then lost a mark by writing their final answer to only two significant figures.

Part (b) was generally answered better than **part (a)** with many candidates gaining full marks. Common errors included finding the gradient as $-\frac{1}{2}$ instead of –2 or arithmetic errors in substitution, often leading to *c* = –3 instead of 17. Few candidates made both of these errors, so most were able to score at least one mark. A very small number of candidates gave the final answer without 'y ='. There was a large proportion of candidates who offered no response to this question.

Question 17

There was a mixed response to this question. There was a large proportion of candidates who offered no response to this question. While many candidates recognised the need to find the negative reciprocal of the gradient, not all were able to determine the gradient of the given line. Some candidates assumed that the gradient was the coefficient of x and consequently gave the answer as $-\frac{1}{4}$, while others recognised the need to divide throughout by 3 to make *y* the subject, but were then unsure how to proceed often giving $\frac{4}{3}$ or $-\frac{4}{3}$ as the answer. A few candidates assumed that the equation of a perpendicular line was needed or gave the answer as $-\frac{3}{4}x$. Some candidates used values from **Question 16** in this question.

Question 18

Many candidates understood the nature of the compound function notation, and applied it in the correct order, scoring at least one mark, often two, for a correct first step on each side of the equation. The gf(x) was most commonly correct with a common error in fg(x + 1) being to forget the +1. A good number then had confident algebra skills to work through to the correct answer. Algebraic errors hindered others, many were unable to correctly square a bracket as $(x + 5)^2$ was often followed by $x^2 + 25$. Others did not simplify (x + 1 + 4) before attempting to square and often each term was squared again, resulting in $x^2 + 1^2 + 4^2$. More basic slips were in evidence in collecting terms after correctly negotiating the squaring of brackets. It was also common to see $(x + 5)^2 – 25$ becoming $x^2 + 10x + 25$, i.e. forgetting the –25 part. For those not scoring on the question the issue was either applying the functions in the incorrect order, or a lack of familiarity with the function notation, instead attempting products. It was rare to award the special case because for those who used the incorrect order many also had slips in the algebra too.

Question 19

Part (a) was a demanding question but quite a few candidates gained full marks. If they could not do this question, they often managed to gain M1 for the angle, although a number of candidates seemed to be unable to recall the properties of an equilateral triangle. Occasionally the cosine rule was used on the triangle ABC to reach the 60 degrees. Writing $\frac{k}{360} \times \pi \times 12.4 \times 2$ to score M1 was less common as many did not substitute in any numerical r because they did not know the numerical value for *k*. Some tried to work from the full circumference of the circle and often added or subtracted the length of *BC*. Some correctly found 60 or 300 but used them with an area formula instead of a perimeter formula. Many found the correct arc length of 64.9 but added an incorrect value (multiples of 12.4 rather than just 12.4, often 3) or no value. Several just found the perimeter of the triangle, with 37.2 being a very common incorrect answer.

Candidates were slightly more successful in **part (b)** than **part (a)**, perhaps because the angle was given this time, however they did not often score all three marks. Many calculated using 41 degrees rather than 360 – 41 = 319. Using 41 led to √208 and an answer of 14.4, which were both common ways of scoring M1. Others gained M1 for writing the correct equation $74.5 = \frac{319}{360} \times \pi r^2$ and this was the most successful starting point. Those who started with $74.5 = \pi r^2 - \frac{41}{360} \times \pi r^2$ often struggled with the fact that r^2 appeared twice and it was not uncommon to see r^4 appearing. Of those scoring two marks, the lost mark was usually due to premature rounding part way through the calculation and obtaining an answer outside of the acceptable range of 5.172 to 5.173…Rounding also played a part when the calculation was completely correct, a mark being dropped for a 2sf answer of 5.2 without a more accurate answer being seen. Common errors included: thinking 74.5 was the area of the whole circle or the minor sector; using a formula for arc length instead of sector area; thinking the area of a circle is $2\pi r^2$ rather than πr^2 or re-arranging the formula incorrectly.

Question 20

There were a lot of candidates who gained full marks here for correctly expanding three brackets and simplifying correctly. Many candidates were also able to achieve at least one mark for one correct expansion with at least three terms correct. The most common error was where candidates expanded the first pair of brackets and then expanded the second pair of brackets and then added these terms leading to a quadratic expression. Slips in signs prevented many from scoring more than one mark. The most common of these was to expand the first two brackets correctly but then to simplify $-4x + 5x$ as $-x$ leading to two incorrect terms when multiplying by the 3rd bracket. The most common reason to score two marks was for one small slip in one of the terms often an incorrect power of x in one of the terms, or simply omitting the *x* in a term. Another common error was those who were attempted to multiply all three brackets in one go. For example, $(x - 2)(2x + 5 + x + 3)$ was seen a few times. Some candidates gave final answers with a term in x^4 indicating that they were unaware of the form of correct answer they should be expecting i.e. a cubic in *x.*

Question 21

Part (a) was well answered with many candidates scoring two marks. The main error was to not combine the two expressions, after finding $k = 108$ correctly candidates gave the answer $F = \frac{k}{d^2}$. Common errors included these starting points $F = \frac{k}{d}$, $F = \frac{k}{\sqrt{d}}$, $F = kd^2$.

Part (b) was a challenging question for many and many offered no response to this question. The most common incorrect answer was $\frac{1}{2}$. The candidates who achieved the correct answer often achieved it from using their formula in **(a)** with numerical values.

Question 22

There were many fully correct simplifications scoring all four marks and the majority of candidates scored at least one mark, usually for the correct factorisation of the denominator. The coefficient of 2 in the numerator caused problems for many, although various good strategies were seen to deal with this. Many resorted to using the quadratic formula or their calculators to solve the quadratic on the numerator equal to 0, resulting in solutions 4 and –1.5 which were then turned into the incorrect factorisation $(x-4)(x+1.5)$. There were various results close to $(x-4)(2x+3)$, such as $(x+4)(2x-3)$. Candidates should be encouraged to check their answers to factorisations by multiplying them back out to ensure that they get the correct terms; this would have highlighted errors for those who were close to the correct factorisation but had the positive and negative or had the 3 and 4 the wrong way round. Some were unable to factorise fully the denominator even if they were able to factorise the numerator. Weaker candidates were seen attempting to cancelling terms on the numerator with terms on the denominator by crossing them out and not factorising anything. A small minority equated the numerator and denominator and attempted to solve their resulting equation.

Question 23

Few candidates scored no marks in this question with most able to find the principal angle of 48.59 or 48.6. Obtaining the second angle caused a few more problems. Incorrect answers seen included 48.6 + 90 = 138.6, 360 – 48.6 = 311.4, 270 – 48.6 = 221.4 or 48.6 + 180 = 228.6. Those who used a sketch graph or a 'CAST' diagram to help them usually did better. In some cases, candidates found the principal value and then 131.4, but then went on to only write 131.4 in the answer space, thus only getting one of the two marks. Others went on to write more than two answers in the answer space.

Question 24

A variety of approaches were seen to this question: the most popular was that of establishing a common denominator for the left of the equation in the first instance, and then adding the two fractions to make a single fraction. Many candidates were able to do this successfully, although mistakes were seen in the expansion of 9(x + 1), which frequently became 9*x* + 1. The next stage in the working was found to be more problematic and here errors were seen in attempts made to simplify the fraction on the left (e.g. cancelling 10*x* seen in the numerator and denominator). Those who successfully managed to cross multiply were often able to follow through to establish that $x^2-9=0$ and then find the correct values of x. Many solved this equation by factorising x^2-9 initially, rather than solving $x^2=9$ directly by taking the square root of both sides. It was also not uncommon to see candidates using the quadratic formula to solve $x^2-9=0$. Having said this, some candidates demonstrated excellent skills in algebraic manipulation and confidently obtained the required solutions in a very efficient manner.

MATHEMATICS

Paper 0980/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper, making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer and the loss of the accuracy mark. In 'show that' questions, such as **Questions 1(a)**, **1(b)** and **8(b)(v)**, candidates must show all their working to justify their calculations to arrive at the given answer, and should not use the given answer in a circular or reverse method. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) This proved to be a challenging question for many candidates. Few appreciated that the given information could be written as the ratio $1:1\frac{1}{2}:1\frac{1}{4}$, and then by multiplying by 4 gave the required ratio of $4:6:5$. As a 'show that' question all working needed to be shown and justified. A very common error was to perform a reverse method using the given ratio, or $\frac{4}{15}:\frac{6}{15}:\frac{5}{15}$, or the value of 142 500 from later in the question, or starting with an unjustified ratio such as $8:12:10$.

(b) This also proved to be a challenging question for many candidates. Again, in this 'show that' question many candidates used an unacceptable circular argument starting with the given value of 142 500. For example, $\frac{142500}{15}$ = 9500 then 9500 × (4 + 6 + 5) = 142 500 is an incorrect circular method and gains no credit. It should also be noted that sole working of 9500 × 15 and 47 500 + 38 000 + 57 000 are both insufficient as the values used have not been justified.

(c) (i) This part was more accessible and was generally answered well although common errors included $\frac{5}{4}\times 47500$, $\frac{47500}{0.25}$, 95 000, $\frac{15}{4}\times 142500$, $\frac{(142500-47500)}{2}$ = 47 500, or $\frac{142500}{3}$ = 47 500; the last two were also seen in the next part.

(ii) This part was generally answered well although it was noted that many candidates completed a second calculation rather than appreciating that their previous answer could be used on a follow through basis and a simple subtraction was all that was required. Common errors as in **part (i)** were seen.

(d) The compound interest formula was well remembered and used successfully by a good number of candidates. A small yet significant number spoilt an otherwise correct method by either adding or subtracting the principal amount. Some candidates did not give their answer correct to the nearest dollar as instructed in the question. A small minority made the error of using simple interest to calculate their answer.

(e) This part was generally answered well with the most successful method being to split the work into the two stages of 142 500 × 0.27, followed by 142 500 + 38 475.The more direct method of 142 500 × 1.27 was rarely seen. Common errors included the use of + 1.27, + 27, 73% or 0.73, and answers of 38 475 or 104 025 (from subtracting rather than adding).

Question 2

(a) Many candidates could give the correct name of the pentagon. Incorrect answers given included hexagon, heptagon, quadrilateral, equilateral, rhombus, rotation and prism.

(b) This part was not generally well answered and few accurate and correct answers were seen. The majority of candidates did not appreciate that the easiest way of finding the area of the given polygon was to use the method of counting squares. Many tried to split the shape into squares, rectangles, triangles and/or trapezia but this was rarely successful either due to incorrect measurement or more usually incorrect formulas used. Other common errors included attempting to find the perimeter, or using the angles of a pentagon as evidenced by the use of 180, 360 or 540.

(c) Throughout this part the majority of candidates were able to identify the given transformation but not all were able to correctly state the required components for the full description. Candidates should understand that the correct mathematical terminology is required, and that terms such as turn, mirror and move are insufficient.

(i) A smaller number of candidates were able to identify the given transformation as a translation, with transition, translocation and transformation being common answers. The identification of the translation vector proved more challenging with the common errors being reversed or inverted vectors, incorrect signs, and the use of coordinates.

(ii) This part was generally answered well with the majority of candidates able to identify the given transformation as a rotation and more were able to correctly state the three required components. The identification of the centre of rotation proved the more challenging with a significant number omitting this part, and (2, –2) and (3, –4) being common errors. The angle of rotation was sometimes omitted with 90 being the common error.

(iii) The majority of candidates were able to identify the given transformation as an enlargement, although disenlarge, minimise and shrinkage were common answers. However 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), (–2, –4) and (2, 4) being common errors. The scale factor also proved challenging with –2 and 2 being the common errors. A few candidates gave a double transformation, usually enlargement and translation, which results in no credit.

(d) This part was generally answered reasonably well with a good number of candidates able to correctly draw the required reflection. However, this part proved very challenging for less able candidates and a significant number were unable to attempt the drawing. A very common error was to draw a reflection in the line $x = 0$, with a small number of vertical translations also seen.

Question 3

(a) (i) This part was generally answered very well although common errors included 1330 am, 1330 pm and 13 hr 30 mins.

(ii) This part was generally answered very well although common errors included 4h 35 min, 7h 35 min.

(b) This part proved challenging for many candidates and proved to be a good discriminator with the full range of marks seen. Generally, a large proportion of candidates picked up partial credit for some correct working and methods were usually well set out. Some started by adding on 6 hours first and stated 2235, although sometimes this addition resulted in an answer of 0035. Errors after this often came from attempting to add on 13 hours 45 minutes, or candidates incorrectly subtracting 13:45 from 22:35. Others started by attempting to add 13 hours 45 minutes to 1635 – a common error was to arrive at a time of 0520 and give a final answer of Friday, 1120. Quite a few stated 1 for the day instead of Friday or gave the day as Saturday.

(c) The majority of candidates were able to apply the correct formula to find the average speed, with most knowing to divide 10736 by a time but many found it challenging to use the correct time. Errors included dividing by 13.45, 825 or 13 h 45 earning partial credit but there were also a wide variety of other times such as their arrival time from **(b)** or their answer to adding 13 hours 45 minutes to 1635.

(d) This part was generally answered very well. A few candidates rounded to the nearest euro. Common errors came from dividing by the exchange rate rather than multiplying, resulting in an answer of 607.9. Other errors came from incorrect answers after seeing the correct multiplication written in the workspace, e.g. $400 \times 0.658 = 26.32$.

(e) This part was generally answered very well, although a small number of candidates rounded to the nearest dollar. Common errors included adding £850 rather than subtracting, or subtracting the cost of one night and then dividing by 5.

Question 4

(a) Almost all candidates identified the equivalent fraction correctly.

(b) Many candidates gained full credit in this part. Others scored partial credit for having 4 of the 5 values in the correct order, and some for showing the correct decimal values, A common error included treating 58% as 58 rather than 0.58 and subsequently having this as the largest number. Other candidates did not include enough accuracy when converting all of the numbers to either decimals or percentages with, for example, $\frac{5}{12} = 0.58$, $\frac{8}{13} = 0.6$ or $\frac{2}{3} = 0.6$, making them impossible to order.

(c) The majority of candidates were able to write 0.724 as a fraction in its simplest form. Some left the fraction as $\frac{724}{1000}$ without simplifying. Other errors were to start from $\frac{724}{1000}$ leading to $\frac{181}{250}$, but then approximating as either $\frac{72}{100}$ or $\frac{7}{10}$, or simply rewriting the given number in standard form.

(d) Most candidates found this question challenging. Candidates recognised the need to work out the upper and lower bound, however, most could not do this correctly. Common errors were $410 \leqslant m < 420$, $414.5 \leqslant m < 415.5$, $414.95 \leqslant m < 415.05$, and $5 \leqslant m < 415$. A few candidates wrote the correct bounds in reverse.

(e) A good proportion of candidates were able to work out that 6 bags of flour were needed. The best approach was to work out $7\times\frac{3}{4}$ but other less efficient approaches, such as drawing out bags of flour or evaluating $\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}$ were seen. The majority of candidates scored partial credit either because they did not consider the context that whole bags needed to be bought and gave 5.25 bags as their answer or because they rounded down to 5 bags. This showed that they could not relate it to the functional problem they were asked. Less able candidates couldn't progress with this question because they could not set up $7\times\frac{3}{4}$ correctly.

(f) (i) Almost all candidates were able to show a good understanding of writing equations in this part and the next. Common errors were 15.50tp, 5tp, 15tp and 15.

(ii) Similarly, this part was also answered well. Common errors included omitting the 28.50 and giving only $5t + 4p$, $5t + 4p = 28.5tp$, $5t + 4p = 28$, or trying to collect the terms as $5t + 4p = 9tp$.

(iii) Candidates found this part quite challenging and it proved to be a good discriminator. A good number of candidates were able to show clear and correct working and gain full credit. The majority attempted to use the elimination method to solve their equations with equal attempts to equate the coefficients of t and p. However a number of numeric and algebraic errors were seen in the setting up of the equations. Candidates should be encouraged to substitute their answers back into both equations to check for this. The most common error in the method was to add rather than subtract the equations. Candidates who did not score the method mark were able to earn the SC mark for finding 2 values that satisfied one of their equations, provided the evaluation of the second value was given to enough accuracy.

Question 5

(a) The table was generally completed well with the vast majority of candidates giving six correct values. Common errors included missing negative signs and giving 2.3 instead of 2.25 in both the positive and negative versions.

(b) The reciprocal graph was generally plotted well and the majority were able to draw a correct smooth curve. Common errors were plotting (8, 2.25) and (–8, –2.25) outside of the tolerance, and sometimes (–4, –4.5) and (4, 4.5). Curves were generally smooth although sometimes rather thick. A small number of candidates incorrectly joined the points with ruled line segments and/or joined the two sections of the graph from (-2, –9) to (2, 9). Most had a good version of the correct shape so remaining parts of the question were accessible.

(c) This part was generally answered very well, particularly by those candidates who had drawn the graph correctly and knew the meaning of rotational symmetry. Common errors included a variety of incorrect answers often 1 or 4, and answers referring to transformations, angles or directions of turn.

(d) (i) Generally, a well answered question with many candidates gaining full credit. Less able candidates often scored partial credit for correctly plotting the point (6, 4). Common errors included (–3, –8) plotted instead of (–8, –3), (4, 6) plotted instead of (6, 4), not joining the points with a straight line, despite the instruction to do so.

(ii) This part showed mixed responses, with candidates who had accurately drawn the line in **part (i)** often able to read off the measurements, but a significant number not appreciating the readings to be taken. Common errors included missing off the negative sign for the negative intersection value, errors associated with reading the scale, and giving the coordinate where the line met the y-axis and the x-axis. A significant number were unable to attempt this part.

(iii) This was the most challenging part of this question. However, a good number of candidates understood how to calculate the gradient of the line, either from the coordinates given or from their line drawn, but there were a variety of numerical or algebraic errors made. A gradient of 2 was frequent. The calculation of the intercept proved more challenging. Whilst some tried to use the equation $y = mx + c$ by substituting values in to find a value of c, the more successful method was to use their line drawn. A significant number were unable to attempt this part.

Question 6

(a) (i) The majority of candidates were able to measure accurately at 7.3 cm and then use the given scale to correctly convert to give the actual distance required as 87.6 m, or measurements within the allowed tolerance. A small number gave answers of 7.3, or used incorrect conversions such as 0.73×12.

(ii) This part on the measurement of a bearing was not generally answered well with common errors of 67°, 113°, 157°, 293° and 7.3 cm frequently seen.

(iii) Candidates found this part quite challenging and it proved to be a good discriminator. Whilst many candidates correctly evaluated 102 ÷ 12 as 8.5 and scored partial credit for a point the correct distance from *B*, many were unable to place *C* on the required bearing from *B*. The most common error was to measure 157° anticlockwise from the north rather than clockwise. Some candidates measured the bearing correctly and appeared to just mark the point at the edge of their angle measurer, forgetting the distance criterion. It was also fairly common to see *C* somewhere along the line *AB*, or the line extended to a point *C*.

(b) By drawing a straight line on the diagram from *P* to *R*, many candidates realised that Pythagoras' theorem was the key to solving this problem. Clearly presented working was frequently seen and answers calculated accurately. Some using Pythagoras' theorem made the error of calculating $98^2 - 67^2$. Less able candidates either did not make the connection with the right-angled triangle or did not know Pythagoras' theorem and a variety of ideas were pursued. These included simply adding 98 and 67, finding the ratio of the given sides or attempting some trigonometry. Measuring the length and using the scale from **part (a)** was also seen despite the diagram stating 'not to scale'.

Question 7

(a) (i) This part was generally answered very well with most candidates able to give the three correct angles. If their angles were incorrect, they rarely totalled 360° meaning a full follow through was not possible in **part (ii)**. A small number appeared to draw the pie chart in **part (ii)** first and then to measure the angles drawn.

(ii) This part was also generally answered very well with most candidates able to draw the sector angles to the required degree of accuracy. Less able candidates often gained partial credit for one correct sector particularly with a follow through applied.

(iii) This part was generally answered very well with most candidates able to give the correct probability. There were many correct and fully simplified answers. Common errors included $\frac{1}{4}$, $\frac{1}{5}$, $\frac{54}{360}$ and $\frac{54}{144}$.

(b) (i) A significant number of candidates found this question very challenging and it proved to be a good discriminator although few fully correct answers were seen. Few candidates appreciated that the calculation to start with was 53 + 68 – 110 = 11 as this could then be placed onto the Venn diagram. Correct use of the three pieces of information would then complete the diagram. Many started with the figure of 53 (like soccer) but incorrectly positioned it usually in the (like soccer but not hockey) section, often followed by the figure of 68 (like hockey) positioned incorrectly in the (like hockey but not soccer) section.

(ii) This part was generally answered reasonably well particularly with a follow through applied. Common errors included 121 (from 53 + 68), or an incorrect value selected from their Venn diagram.

Question 8

(a)(i) This part was generally answered very well, although common errors included ‘obtuse’, ‘isosceles’ and ‘right angle’.

(ii) This part was generally answered very well, although common errors included ‘equilateral’ or ‘right-angled’ and ‘scalene’.

(iii) This part was generally answered well with many candidates showing full and correct working. Common errors included 180 – 36 = 144, 36, and assuming that angles *CAB* and *ABC* were equal arriving at an answer of 72°.

(iv) Candidates were generally able to state that the required angle was 36°, but only a minority were able to offer a correct reason. Common answers included comments about parallel lines, ‘opposite’ angles, ‘Z’ shapes or angles, and ‘alternative’ angles. A significant number did not offer a reason at all, but simply described their calculation process.

(b)(i) This part was generally answered well, although common errors included rhombus, trapezium and square.

(ii) This part was generally answered very well, although common errors included 14.5, 58, and attempts to find the area.

(iii) Candidates were again generally able to state that the required angle was 60°, but only a minority were able to offer a correct reason. Common errors included incomplete comments about straight lines, and reference to parallel lines or triangles. A significant number did not offer a reason at all, but simply described their calculation process.

(iv) This part was not generally answered well with the majority of candidates not appreciating that the interior angle of 120 or the external angle of 60 could be used to find the number of sides of the polygon. Whilst some attempted to use the formula for the angle sum of a polygon, many just wrote down a number with no justification or working.

(v) Candidates found this part very challenging and it proved to be a good discriminator. Few candidates appreciated that the use of trigonometry was the key to answering this show that question. Common errors included the use of reverse methods with the given value of 5.63 or attempting to use either the perimeter or the area. Of those who did use a correct method many did not show a more accurate value than the one given in the question. A significant number of candidates were unable to attempt this question.

(iv) This part was not generally answered well with the majority of candidates not appreciating that one of the required lengths had been given in the previous part. Common errors included 6.5 × 8, 0.5 × (8 + 6.5) × 6.5, 0.5 × (8 + 8) × 6.5, $6.5^2 + 8^2$, and a variety of other incorrect formulas.

Question 9

(a) This part was generally answered well with the majority of candidates able to draw the next diagram in the sequence, although common errors included a misalignment of the top line, and the incorrect number of blocks in the base line.

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

(c) This part was generally answered well, although the common errors included *n* + 3, 3*n* + 2, 3*n* and a number of purely numeric answers.

(d) This part proved more challenging. Many candidates started with the premise that 84 ÷ 3 gave 28 as the pattern number. A significant number used the simpler but longer method of continuing the sequence from 10, 13 until either 82 or 85 was reached, although numerical errors often lead to incorrect answers. Common errors included 3 × 84 – 2 = 250, pattern number of 28 with 56 blocks remaining, and pattern number of 29 with 1 block remaining.

MATHEMATICS

Paper 0980/42
Paper 42 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the extended syllabus.

The recall and application of formulae and mathematical facts to apply in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Candidates must learn to hold accurate values in their calculators when possible and not to approximate during the working of a question. If they need to approximate, then they should use at least four figures.

General comments

On the whole candidates were well prepared for this paper and demonstrated understanding of many areas of the syllabus. Some candidates were not sufficiently prepared for questions on new syllabus content such as graph sketching, application of differentiation to gradients and understanding asymptotes.

Candidates performed well on the more routine questions but had more difficulty when questions required interpretation of a topic or involved some element of problem solving.

Many candidates gave answers to the required accuracy, but some rounded intermediate values in multi-stage calculations which led to inaccurate final answers.

Most candidates showed full working with their answers and thus ensured that method marks were considered where answers were incorrect. This also included situations where candidates may show values on a diagram and where diagrams given are annotated, although care is needed to ensure for example when indicating an angle, the arc is clear and not covering more than the intended angle or if indicating a right angle then this is made clear.

If the variables in a question are given candidates should work with those variables or if not, clearly define the link between the variables given in the question and their own variables.

The areas that caused most difficulty were problem solving with bounds, asymptotes, reasoning with prime factors, solving equations involving indices, reasoning with median, problem solving with nets, sketching a cubic graph and harder sequence work.

The areas that candidates had the most success with were working with percentages and ratio, drawing algebraic graphs, rules of indices, drawing histograms, finding estimate of the mean, interpreting box-and-whisker plots, working with column vectors, using cosine and sine rule, rotating shapes, density and working with linear sequences.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to work out the reduced price. As the answer of \$11.61 was exact, it was not acceptable to round this to 3 significant figures and give an answer of \$11.6 which was an error for some candidates. A small number found the reduction in price and gave the answer \$1.89. A small minority of candidates calculated a percentage increase or a reverse percentage.

(ii) Many candidates answered this correctly, although rounding the exact answer to 3 significant figures was again done by some. Some candidates worked with the original price rather than the sale price and some did not appreciate that the original tin contained 2.5 litres, so just multiplied by 42.5 rather than by 42.5 ÷ 2.5.

(b) (i) Most candidates calculated the percentage correctly, although a small number misread the question and found the percentage of red, rather than white, paint. Some gave the answer 53 rather than giving the required three significant figures.

(ii) Most candidates were able to divide in a ratio correctly. A small number found the number of red or white tins rather than green tins.

(c) Candidates found this question challenging. To find the smallest number of tins of paint to ensure that all the wall is painted requires finding the maximum possible area of the wall. Those who appreciated that bounds were required almost always found the lower bound of the area using 20.45 × 2.35 rather than the upper bound of the area using 20.55 × 2.45. Many candidates, however, did not use bounds at all in their area calculation and simply found the area using the given dimensions. Having found an area, most candidates were able to use this to find the number of tins of paint that would be needed. Some candidates misinterpreted this requirement and found the number of litres rather than the number of tins and some gave a decimal answer without understanding that a whole number of tins was required.

Question 2

(a) (i) Almost all candidates found the two missing values correctly.

(ii) Many candidates plotted points accurately and joined them with a neat, smooth curve. In cases where points were not on a gridline, some candidates plotted them in the incorrect small square, particularly at (0.5, 0.41). Having plotted points correctly, some candidates drew a curve that did not pass through these points. It is easier for candidates to draw an accurate graph if they draw small crosses for their points and use a sharp pencil for the curve. A small number of candidates joined their points with a ruler or did not join them at all.

(b) The rearrangement of the equation to find the equation of the straight line was found to be a challenge. Many candidates did not identify the connection between the equation given in this part and the graph they had already drawn. Those who did reach $y = 2.5 - 2x$ usually drew it correctly and read the solution from the graph correctly. A common error was to draw the line $y = 2.5 - 2x$ or to attempt to draw the graph of $y = 2 \times 0.5^x + 2x - 3.5$ on the axes rather than a straight line as required by the question.

(c) Very few candidates were able to identify the highest possible value of k and many were clearly unfamiliar with the term asymptote. Answers such as 3, the highest value on the y-axis, or ∞ were common. For the equation, candidates often repeated the given equation or gave a word such as linear or curved.

Question 3

(a) (i) This was very well answered. Some candidates dealt with the powers correctly but also multiplied the numbers leading to an answer 49^{11}.

(ii) This was also very well answered. Some candidates dealt with the powers correctly but also divided the numbers leading to an answer 1^{10}.

(iii) Most candidates answered this part correctly, although some left the answer as 49 rather than as a power of 7 as required.

(b) It was more common to cube each term separately and then attempt to combine the terms rather than simplify the bracket to $10x^3y^4$ and then cube the result. This led to the common answer of $125x^6 \times 8x^3y^{12}$ because candidates did not realise that this could be simplified further. Some candidates were unable to cube the numbers correctly and others made an error dealing with one or more of the indices, often failing to cube x in $2xy^4$.

(c) (i) Candidates who understood the term highest common factor usually gave the correct answer here. Many candidates showed correct prime factorisation of 540 and gained partial credit even if they did not know how to use it to find the HCF.

(ii) Those who had the correct HCF usually also found the correct lowest common multiple, and some found this correctly even without the correct HCF.

(iii) This part was found to be very challenging and incorrect answers of 1, 2 and 8 were common. Few candidates understood that in a cube number the prime factors will all have powers that are multiples of 3. Using this fact, they could identify that the smallest cube number would be $2^6 \times 3^3 \times 7^3$ leading to $R = 2 \times 7^2$.

(d) (i) Most candidates were able to factorise the expression correctly. The most common error was to reverse the signs to give $(x-4)(x+7)$.

(ii) Few candidates were familiar with how to factorise this expression and many started by expanding the given brackets and often went no further. Some identified that (a + 2*b*) was a common factor of both terms but were not able to reach a correctly factorised expression. A common error was to give an answer of $(7+4a)(a+2b)$ or $(7+4a)(a+2b)^2$.

(e) The first step required here was to convert 9^x to a power of 3, then rules of indices could be used to combine the terms and set up a linear equation in *x* and *y*. Those candidates who identified this first step often went on to reach the correct answer. Some converted 9^x incorrectly to 3^{3x} rather than 3^{2x}. Other candidates did not convert the base and their final answer still contained the 9^x term. It was also common to see an attempt at multiplication by 9^x leading to an equation with base 27 on the left-hand side. Some candidates used index laws incorrectly which led to a non-linear equation in *x* and *y*.

Question 4

(a) (i) Most candidates drew the histogram correctly, although a few inaccuracies in drawing occurred, for example height 7.5 drawn at 7.4 or 7.6. Most candidates did not show any working apart from the graph.

(ii) Many candidates were successful. A few, who knew the method, made occasional errors with one or two of the mid-interval values. By far the most common error was to use the width of the interval as the value of *x* instead of the mid-interval value. Just a few candidates added the frequencies and divided by 5. Some gave answers to 2 significant figures of 3.7 or 3.8 without a more accurate value seen first and often without sufficient working shown to be awarded full method marks.

(iii) The vast majority of candidates gave the correct probability although $\frac{7}{40}$ was a common wrong answer.

(iv) This question proved difficult for many candidates. Most did not recognise that they were selecting from the parcels that were greater than 2 kg and so their first probability was $\frac{4}{40}$ instead of $\frac{4}{29}$. Many also did not realise the need to change the denominator for the second probability, ignoring the ‘without replacement’ information. The candidates with the correct approach were usually successful and recognised the need to include reverse of the order of events although others did not consider both of the products required.

(b) (i) This part was very well done. A few misread the scale giving 4.3 instead of 4.6.

(ii) This was also well done. Again a few misread the scale leading to 3.1 instead of 3.2 and some gave the range instead of the interquartile range.

(iii) Only the strongest candidates recognised that the median was unchanged and most of those gave satisfactory reasons. Most candidates thought the median was reduced due to the reduced total mass or number of parcels or because 2.4 kg was further away from the median than 5.8 kg.

Question 5

(a) (i)(a) This was well answered. Any errors were associated with the directed numbers, a few did **a** – **b**.

(b) Again this was well answered. The only errors were associated with the directed numbers.

(c) Most candidates were successful here in using Pythagoras' correctly to find the magnitude of the vector.

Some appeared to not understand the modulus sign.

There were some errors in the application of Pythagoras including -5^2 rather than $(-5)^2$. A few gave an answer 5.4 without a more accurate value in working.

(ii) There were many fully correct answers seen. Some scored partial credit for obtaining the value of *k* correctly. Some candidates did not manage to translate the vector equation into a linear equation form and were unable to proceed further.

(b) (i)(a) Almost all candidates answered this correctly.

(b) Many candidates were successful. The common error was in not considering the direction of the vector **q** resulting in $\mathbf{q} + \frac{\mathbf{p}+\mathbf{q}}{2}$. Candidates should note that methods marks are awarded for stating a correct vector route e.g. $\overrightarrow{CO}+\overrightarrow{OM}$, this was also the case in the next part.

(c) This part was done less well than the previous part. The error was again with the direction of a vector and a+ $\frac{2}{5}\mathbf{q}$ was very common.

(ii) Only a very small number of candidates gave a fully correct answer. A number gained partial credit for stating that $\overrightarrow{ON} = \mathbf{p} + \frac{3}{5}\mathbf{q}$ and for giving a final answer of the form $k\mathbf{p} + \mathbf{q}$.

Question 6

(a) Most candidates were able to correctly recall the cosine rule and show substitution of the values correctly. Where a question asks for a value to be shown, candidates are required to show the result of their calculation to at least one more significant figure than is given in the question to demonstrate that they have performed the calculation correctly. In this question, many gave no more accuracy than the 16.9 given in the question so were not given full credit. A small number of candidates used the sine rule to calculate angle *BCD* using the given value of *BD* = 16.9 and then used this angle to work back to 16.9: this is not an acceptable way to show the required result.

(b) To find the required angle, the most direct method was to use the sine rule to find angle *BCD* and then use the sum of the angles in triangle *BCD* to find angle *CBD*. Many candidates identified this method and reached the correct answer. Some candidates rounded or truncated values too early in the calculation and reached an answer of 74.4 which was outside of the acceptable range. A longer method of using the cosine rule to find *CD* and then the sine rule to find angle *CBD* was sometimes used, but the complex rearrangement of the cosine rule often led to errors or inaccuracies. Some candidates incorrectly treated *BCD* as a right-angled triangle.

(c) Most candidates identified that the area could be found using the sum of two triangle areas calculated using $\frac{1}{2}ab\sin C$. Some used trigonometry to find the perpendicular heights of each triangle then used the $\frac{1}{2}$ base × height formula. Many correct answers were seen or correct methods using an incorrect angle found in **part (b)** although some candidates had rounded prematurely which led to an inaccurate final answer. A small number of candidates used 75° in the area formula in place of angle *CBD* and some used an incorrect area formula.

(d) Many candidates identified that the shortest distance is the length of the perpendicular from *B* to *AD* and this line was often indicated on the diagram, however not all candidates clearly marked the right angle at the base and showed no working to indicate this was the case. The correct calculation of 16 sin 57° was often used to calculate this length. A common error was to assume that the perpendicular bisected *AD* which led to an incorrect use of Pythagoras' Theorem with 16 and 9.5.

Question 7

(a) (i) The translation was correctly drawn by only a small number of candidates. The majority did not take the axis scales into account and completed a translation by 2 squares across and 1 square down so an actual translation of $\begin{pmatrix} 1 \\ -0.5 \end{pmatrix}$. Partial credit was awarded for this. A small number of candidates were unable to decode the given vector correctly and drew the translation by the vector $\begin{pmatrix} -1 \\ 2 \end{pmatrix}$.

(ii) The vast majority successfully completed the rotation by 90° clockwise about the origin. Of those who did not, the most common error seen was rotation by 90° clockwise about a different centre or by a rotation of 90° anticlockwise about the correct centre.

(iii) There were a number of correct enlargements. Those who did not score both marks often drew an enlargement of scale factor $\frac{1}{2}$ rather than $-\frac{1}{2}$. There was a tendency for some candidates to draw the ray lines and complete one vertex or two vertices correctly but then guess incorrectly at the position of the remainder. A few candidates drew ray lines but then did not attempt to draw a triangle at all. There were a few candidates who marked the position of the centre of rotation but did nothing further.

(b) Most candidates correctly identified the transformation as a reflection. Of these many also correctly identified the mirror line as $y = -x$ or $x + y = 0$. There were a number who thought the mirror line to be $y = x$, or named a point rather than a line. A small number of candidates gave a combination of two or even three transformations.

Question 8

(a) The majority of candidates found this part very challenging. Many however were able to gain partial credit for showing at least one of the required equations involving *L*, *W* and *H.* The strongest solutions started with two equations in the variables *L*, *W* and *H* and used the relationship $L = 2W$ to rewrite their equations as two simultaneous equations. Some candidates introduced new variables such as *X* without linking *X* to one of the variables in the question. The most common error was to write $2L + 2W = 37.8$ instead of $2L + 2H = 37.8$ A small number of candidates incorrectly worked with the surface areas.

(b) (i) This was generally well answered. Among the errors were candidates that decided to work with their own formula for the volume of a pyramid or used an incorrect height for the pyramid. A mark was available for the correct units and most who used g and cm in their calculation gained this mark. A few candidates tried to convert from one unit to a different one e.g. kg and m and this caused unnecessary difficulty and usually errors

(ii) Most candidates gained some marks for this part by starting with a correct expression for the diagonal *BD*. On the diagram, some indicated the wrong angle and could not visualise the right-angled triangle required. To find the correct angle required the use of two numerical values which in some cases due to premature rounding led to an answer which was out of range. When compared to previous sessions an increasing number of candidates are using the exact (surd) functions on their calculator which enabled better accuracy.

Question 9

(a) (i) This part proved challenging for many. Candidates that were successful generally used one of two methods, either showing that the expression factorised to $x(x-2)^2$ leading to the answer of 2 when comparing it to $x(x-a)^2$ or alternatively $x(x-a)^2$ expands to $x^3-2ax^2+a^2x$ also leading to the answer of 2 when comparing to x^3-4x^2+4x .

(ii) Curve sketching is new to the syllabus and the sketching of the curve for the equation in **part (a)(i)** proved to be very challenging.

Candidates are expected to have knowledge of cubic graphs and also when a curve passes through the origin. Sketching a correctly shaped positive cubic passing through the origin was awarded two of the available marks. A significant number of candidates did not draw a cubic curve.

The other two marks were for the curve touched the *x*-axis at $x = 2$ and this being the only turning point on the *x*-axis. These two marks proved to be more difficult to achieve by most candidates.

(b) A significant number of responses did not make any use of differentiation and so were limited to at most 1 mark for determining the correct *y*-coordinate at $x = 4$. These attempts tended to find the gradient of a straight line passing through (4, 16) and a second point, sometimes the origin and sometimes a second point on the curve. Those candidates familiar with calculus and its application to the tangent to a graph found this to be a very accessible question. Many candidates gained full marks by correct use of differentiation and the equation of a straight line.

Question 10

The majority of candidates obtained 125 and 29 for sequences A and B, but fewer were able to obtain 25 or 25.25 for sequence D. There were two possible answers that were both given full credit for sequence D.

Similarly, many obtained the correct nth terms for sequence A and B, n^3 and $6n - 1$ (or the equivalent $6(n - 1) + 5$).

The *n*th terms for sequence C and D proved more difficult to find.

Some recognised the exponential nature of sequence C but made errors in the base for the *n*th term, with *n* or 0.5 with an incorrect power being the most common. The correct expression $0.25 \times 2^{n-1}$ was sometimes seen in working but in the answer space this was incorrectly written as 0.5^{n-1}. Many candidates did not spot that sequence D was sequence B subtract sequence C and of those that did, not all of them had the confidence to use their *n*th terms for B and C to write the *n*th term for D. Candidates who used differences to find 25.25 were unable to find the appropriate *n*th term.