MATHEMATICS

Paper 0581/11
Paper 11 (Core)

General comments

Most candidates showed understanding of the parts of the syllabus tested in this paper.

Candidates can improve by reading questions carefully and noting instructions about factors to be taken into account in their answers, for example, that their answer should be to 2 decimal places (**Question 15**) or as a mixed number (**Question 19**). Many candidates rounded too early in their calculations (**Questions 9** and **15**) or truncated their answers (**Questions 9, 10** and **15**). Candidates must make sure that their work is clear and should show the method used as well as the answer so they can access method marks if they have lost those for accuracy. Questions in context require that candidates should check the sense of their answers. Candidates would benefit from checking their work and answers carefully in order not to miss the opportunity to gain marks. There were occasions when questions were left blank but this seemed a problem over understanding what was required rather than a lack of time.

The questions that presented the least difficulty were: 1, 4, 5, 10**(a)**, 14, 17**(a)** and 17**(b)**.

Those that proved to be the most challenging were: 3, 6, 10**(b)**, 11**(b)**, 12, 13**(b)(ii)**, 16, 17**(d)**, 18**(b)** and 20.

Comments on specific questions

Question 1

For the vast majority of the candidates this was a good start to the paper with only a few giving 2, 8 or – 2 as their answer.

Answer: – 8

Question 2

Many candidates produced a correct answer but there were significant numbers who offered an answer with a positive power of 10. Common wrong answers of 3.87×10^{-5} or 3.87×10^{3} showed some understanding of the form the answer should take. Some candidates forgot that numbers in standard form should have one digit in front of the decimal point and so gave 387×10^{-5} as their answer.

Answer: 3.87×10^{-3}

Question 3

This question proved challenging. Many gave the name of a 2D shape, for example, a trapezium. A few gave octagon, maybe because there are eight external edges to the net. Other wrong answers included cube, polygon, decagon or pyramid. Often if prism was offered, it was more likely to be qualified with ‘rectangular’ rather than ‘triangular’.

Answer: (triangular) prism

Question 4

This question was well answered by most candidates. A few used division (either 5 ÷3.5 or 3.5 ÷ 5). A common wrong answer was 15.5.

Answer: 17.5

Question 5

For those that used simple interest, this was a straight forward question. Some candidates had problems dealing with the interest rate and either failed to deal with the 1.5% (giving $5400) or divided by 100 twice. Also, some candidates found the correct value for the interest and then added back the initial investment giving an answer of $504. There were some who tried to use compound interest either by the use of the formula or repeated multiplication.

Answer: 54

Question 6

This question did not use the phrase ‘perpendicular bisector’ as is common in these questions but rather gave a description of the locus required. Generally, this was done well with 2 correct pairs of arcs seen. Sometimes there was no perpendicular bisector drawn, only the construction arcs. A small number of candidates drew a ‘running track’ (two semicircles joined with two parallel lines).

Question 7

This question on bounds was better answered than some in previous years. The lower value of 11.5 was more often correct than the upper bound of 12.5. Wrong answers included the pair, 11.9 and 12.1. For the upper bound wrong answers of 12.4, 12.49 and 12.499 were seen. Occasionally, the bounds were reversed.

Answer: $11.5 \le h < 12.5$

Question 8

Many candidates answered this correctly and gained both marks. Those that got 2 from 230/115 sometimes went on to divide it into 7 instead of multiplying the two figures together.

Answer: 14

Question 9

Many candidates understood that this question called for trigonometric ratios. Some chose the incorrect ratio and some lost the accuracy mark by rounding their calculator value for tan 53° before multiplying by 6.3. Candidates should only round at the end of calculations. Notation was also a problem here with the incorrect 53 tan 6.3 seen a few times. Sometimes answers from using grads or radians were seen and these could only gain the method mark.

Answer: 8.36

Question 10

Almost all candidates got part **(a)** correct but their rounding in part **(b)** caused some problems.

(a) A few candidates misinterpreted the question by taking the decimal point (in 25.63) as multiplication and gave 39.68626967 as their answer.

(b) Many correct answers were seen but some candidates either truncated their answer to part **(a)** or gave a totally unconnected figure. As this was a test of significant figures, answers such as 5.06300 (with two trailing zeros) did not score. Some gave 5.0626, maybe confusing significant figures with decimal places.

Answers: **(a)** 5.062608 **(b)** 5.063

Question 11

(a) Many candidates drew the correct two lines of symmetry. Some then spoiled their answer by adding lines through the midpoints of the sides. A few stated that a rhombus has no lines of symmetry.

(b) This was less well answered with common wrong answers having two opposite corners shaded.

Question 12

This question to solve a pair of simultaneous equations was well answered by many candidates – an improvement on past years. Many candidates seemed to be aware of the need to equalise the coefficients of the x or y terms. Some did not multiply the entire equation and the inconsistent adding/subtracting of equations was common. Many more correct answers came from substitution of $y = 18 – 3x$ rather than other methods. This method gave some candidates problem with the handling of the negative signs, but that was after the first mark had been scored. This question had some answers without any working to support them which is fine if the answers are correct but a risky strategy if the values are wrong.

Answer: (x =) 7 and (y =) – 3

Question 13

Candidates did not appear to be totally confident with the topic in this question. Answers to part **(a)** and part **(b)** were sometimes written in coordinate form.

(a) Many candidates gained the mark but often this answer was given as a 2 x 2 matrix even though candidates were told it was a vector.

(b) (i) This was more successfully handled than part **(a)** and generally answered as a vector. Occasionally the vector, $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$, a version of the coordinates of S, was given as the answer.

(ii) More often than not, candidates who got part **(b)(i)** wrong, got this part right. This part and the preceding part could be done in either order. Some tried to place S at (– 6, 3), a position based loosely on their correct answer to the preceding part even though the grid did not extend that far.

Answers: **(a)** $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ **(b) (i)** $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ **(ii)** S plotted at (– 3, 4)

Question 14

The laws of indices were generally well known. Some candidates gave just the power concerned rather than the letter raised to the power. This is sometimes what is asked for in questions on indices, so candidates must recognise which form their answers must take.

(a) This was understood by nearly all candidates although wrong answers of 0 or 8 were seen.

(b) This caused the most problems with answers of x^7 and x^{25} given by some candidates.

(c) This was answered well. Wrong answers included p^{-12} or just p.

Answers: **(a)** 1 **(b)** x^{10} **(c)** p^{-7}

Question 15

This question was answered well by many. Multiplication of $900 by the exchange rate instead of dividing it was the main method error. As with other questions set in context, candidates should be checking their answer is reasonable – if €1 = $1.356, then candidates should see that (€)1,220.40 is far too big an answer as they need it to be smaller than 900. Candidates then had to round their calculated answer to 2 decimal places and this gave rise to some wrong answers including truncation at any choice of number of figures. Candidates were sometimes careless in writing down the exchange rate or inputting it into their calculators as digits were often seen switched around. Some did not show any workings so it was not possible to award a mark for the rounding of their calculated amount to 2 decimal places.

Answer: 663.72

Question 16

(a) Of those who knew what factors were, 1 was omitted the most frequently with 6 being the next most likely factor to be missing. This may have resulted from candidates believing that they were being asking about prime factors. Some gave additional numbers that were not factors. Time was wasted for some candidates who listed all the factors of each number. Some then did not make the right choices from their lists.

(b) There was some confusion between factor and multiple as 2 or 3 were often seen as the answer. Common wrong answers were 72 or 216 (12 x 18).

Answers: **(a)** 1, 2, 3, 6 **(b)** 36

Question 17

This probability question was generally well answered with part **(b)** being the most successful. However, some candidates gave answers greater than 1. Equivalent answers in decimals or as percentages gained full marks. That is not always the case - candidates must read the question to see if there are instructions about the form the answer must take. If a candidate intended to give a percentage answer then the %-symbol was needed in order to access the mark. A number of candidates are still using ratios or ‘in’, for example, for part **(a)** 1:10 or 1 in 10 were seen - these forms are not correct.

(a) Sometimes candidates gave the incorrect answers of 8/10, 1 or 8.

(b) This was answered well with 0/10 being accepted as a correct answer.

(c) Some candidates thought there were 4 odd numbers not 5. Others wrote $\frac{5}{10}$ then cancelled incorrectly to give $\frac{2}{5}$.

(d) 8/10 or 6/10 were common wrong answers. It was not clear if this came from a misunderstanding of multiple or just in counting them up.

Answers: **(a)** $\frac{1}{10}$ **(b)** 0 **(c)** $\frac{5}{10}$ **(d)** $\frac{7}{10}$

Question 18

Many candidates found this question challenging. Splitting the volume into two question parts seemed to confuse some. Many could not see that part **(a)** just asked for the area of a circle and part **(b)** simply required multiplication of their previous answer by 44.

(a) Many were successful in this part but some candidates squared all of π x 35 rather than squaring 35 only before multiplying by π. A few gave the volume here (the answer to the next part) and then went on to multiply that by another 44 in part **(b)**. A few worked out the calculation correctly as 3850 and then gave their answer as 385, a version of using 3 significant figures, perhaps. Some used a variation of the circumference of a circle formula as their method.

(b) Many candidates correctly multiplied their previous answer by 44.

(c) It was common to award a follow through mark here but many candidates did not divide by 1000, some even multiplied their previous answer.

Answers: **(a)** 3850 **(b)** 169000 **(c)** 169

Question 19

Generally well answered but some candidates seemed to be doing these types of questions using their calculator and then trying to force their written methods to come up with what they know is the right answer.

(a) There were a variety of correct methods which produced the right answer. Some started well by changing the mixed numbers into improper fractions but then went on to invert both fractions or to leave the division sign untouched rather than changing it to multiplication. The equivalent fraction $\frac{20}{42}$ was accepted, provided a full method was seen.

(b) This part seemed to be handled slightly better than part **(a)**. Some candidates interpreted mixed number as decimal number.

Answers: **(a)** $\frac{10}{21}$ **(b)** $1\frac{7}{15}$

Question 20

Candidates must use English Mathematical terms as stated in the syllabus to answer questions of this sort. Some leeway is given over spelling provided the intention is clear. When reasons are required in geometric problems, it is the general rather than specific that is required. For example, the reason that p = 32 is that 'it is an alternate angle to angle *ACD*' rather than 'it is equal to angle *ACD*'. These reasons can be quoted in an abbreviated form as long as it is clear.

(a) Many candidates gave a wrong answer of rhombus or parallelogram or left this part blank. The wrong answer of trapezoid was not given the benefit of doubt over spelling as that is a 3D shape so it cannot be correct.

(b) A very large proportion of candidates gained marks here but the explanations were sometimes poor. The follow though mark from angle p to angle t was often awarded. Some candidates decided angle t was 90° so worked backwards to angle p making it equal to 23°. Some got as far as 81° (for angle *ABC*) but did not take that away from 180° to give t. There were a few correct longer ways to explain the reason for angle p and the full explanation was needed to get the mark. Candidates were more likely to get angle w wrong than the first two angles. They did not recognise the isosceles triangle with most assuming w was an alternate angle to angle *ACB* and thus equalled 67°.

Answers: **(a)** trapezium **(b)** p = 32°, alternate, t = 99°, exterior angle (of) triangle, w = 74°, (base angle) isosceles triangle

MATHEMATICS

Paper 0581/12
Paper 12 (Core)

General comments

There were some very good, clearly presented and high attaining scripts.

Some questions required no working, but many did, and there were numerous instances where none or unsatisfactory and irrelevant working was evident. Most candidates did write clearly but there were instances of unclear figures and writing so small as to be difficult for Examiners to decide what was being written. If an answer is changed it is the candidate's responsibility to make clear the response they wish to be marked.

There was no evidence of candidates being short of time to complete what they could manage on this paper.

Comments on specific questions

Question 1

This question was well answered. A common error was to ignore the right-angle, leading to an answer of 224°. Also evident was using 180° instead of 360° for the total of the angles of a quadrilateral.

Answer. 134

Question 2

The vast majority of candidates realised the correct method and achieved the required answer. The only significant error made was division by 2.56 instead of multiplication.

Answer. 512

Question 3

Although generally answered well, quite a number did not interpret the wording of the question. Simply combining the –4 and 3 to give –1 was quite common and an answer of 7 also occurred with noticeable frequency.

Again part **(b)** was well answered although a follow through mark was often awarded.

Answers: **(a)** –7 **(b)** 6

Question 4

There was a combination of two skills in this question - rounding to 3 significant figures and standard form. Many candidates could manage either one or the other of these skills. A common error was to give 5 or –5 as the index.

Answer. 1.43×10^9

Question 5

While there were many correct answers to the upper and lower bound question, it continues to be a topic that candidates struggle with. Incorrect responses were varied and some examples were 899 and 901, 895 and 905, 899.95 and 900.05, and even 400 and 1400 (from 900 ± 500).

Answer. 899.5 and 900.5

Question 6

There were many correct answers. Many candidates thought this question was solved using Pythagoras or trigonometrical methods, but no right angle was shown on the diagrams. The most common error was 4 + 9 = 13.

Answer. 10

Question 7

Where compound interest was understood, the answer was usually correct. Although knowledge of the formula is not required, many used it successfully. However, some candidates attempted to use the formula but could not understand how to work out $(1 + \frac{3.4}{100})^3$. Many candidates are still attempting the question using simple interest.

Answer. 662.794 to 663.304

Question 8

In part **(a)** there were many candidates gaining one mark by finding one common factor, *p*, 2 or 4. The word 'completely' and 2 marks for the question should have indicated to candidates that there was more than one factor. However, there were many fully correct answers.

In part **(b)** it was expected and indicated that the change of subject should follow from part **(a)**. Unfortunately this was extremely rare resulting in very few correct answers.

Answers: **(a)** $4p(2q + 3r)$ **(b)** $\frac{s}{4(2q+3r)}$

Question 9

A common wrong answer for the bearing in part **(a)** was 295° from 360 – 65. Few indicated an understanding that a back bearing simply required an addition of 180°. It is apparent that many candidates have no clear idea of what a bearing is and some gave answers greater than 360°.

In part **(b)** many lost a mark by not correctly interpreting the question, finding 480, since that was $\frac{4}{7}$ of 840.

Answers: **(a)** 245 **(b)** 360

Question 10

The numerator of the probability fraction was usually correct in all parts. However, it was apparent that many candidates did not read the first line where it was clear that each fraction should have a denominator 43. The height range from the bar chart was commonly seen as the denominator, and there were cases of probability being given as whole numbers.

Part **(a)** was generally well answered. In part **(b)** a common incorrect numerator was 12, simply the height for 150–159. In part **(c)** a denominator of 43 was allowed, although just 0 was expected.

Answers: **(a)** $\frac{15}{43}$ **(b)** $\frac{42}{43}$ **(c)** 0

Question 11

This was one of the better answered questions on the paper.

In order to find angle x in part **(a)**, candidates needed to realise that the triangle had a right-angle and that the sum of the angles of a triangle is 180°. Although x was clearly a small angle and the triangle appeared to have a right-angle, many answers of 125° were given.

Many candidates who did not achieve the correct answer in **(a)** did get part **(b)** correct.

Answers: **(a)** 35 **(b)** 55

Question 12

Part **(a)(i)** was answered quite well with many correct answers, but part **(a)(ii)** was more of a problem for many candidates. There was little understanding of negative powers and 2 was a common response. Also candidates need to look carefully at the question which simply asked for x and so answers of 5^6 and 7^{-2} were not acceptable.

In part **(b)** many candidates realised that p^0 equals 1, but seemed to be confused by $3p^0$. Few realised it was simply 3 from 3×1. Many just ignored the 3 and gave the answer 1.

Answers: **(a)(i)** 6 **(ii)** –2 **(b)** 3

Question 13

Many candidates gained the first mark showing the method for adding the two fractions but then could not manage the next stage of showing subtraction from the whole. It was common to see just a +1 to the fraction $\frac{17}{35}$ to make the numerator become 18.

In part **(b)** two-thirds of $\frac{18}{35}$ was found quite often but few realised that one-third was required. However, many could not work out what was required and made little or no attempt. A common error was to add, rather than multiply, in response to the instruction 'of''.

Answers: **(b)** $\frac{6}{35}$

Question 14

Although there were some good, clear answers, there was a lot of confusion over what was required at each stage of this question. For those who knew what to do in part **(a)(i)** the main error was 1 rather than 0.5 for 0.53. Part **(a)(ii)** was more successful.

For part **(b)** many candidates did not use their calculators correctly, ending with an answer of 65.(….). Although accuracy was not specified in this part, if it was given to 3 figures, it needed to be correct.

Answers: **(a)(i)** $\frac{10 \times 8 - 0.5 \times 90}{5}$ **(ii)** 7 **(b)** 5.92

Question 15

Part **(a)** was well answered by many, although there are clearly some candidates who do not fully understand scatter diagrams. Part **(ii)** was more successful than part **(i)**.

There were a lot of errors in plotting points in part **(b)**, which was just coordinate plotting at clear junctions of lines.

Most who understood the topic realised the correct type of correlation.

Answers: **(a)(i)** 175 **(ii)** 70 **(c)** Positive

Question 16

Part **(a)** was well described by many candidates and few gave two transformations. However, many only gave a partial description. The mark allocation is generally a good indicator of the number of parts of the description required.

In part **(b)** many candidates gained both marks for this part. A significant number of candidates showed a reflection and some translated just 5 across.

Answers: **(a)** Rotation 180° about the origin

Question 17

The two vectors were quite well done by those who understood the topic, although the main error in part **(a)** was in the *x* component. In part **(b)** it was common to see the vector **AB** repeated.

Few candidates could draw the vector in part **(c)**, many attempts not even starting from the point *A*. Consequently it was rare to see a correct answer for the angle. In most cases the attempt was not an obtuse angle.

Answers: **(a)** $\begin{pmatrix} -12 \\ -3 \end{pmatrix}$ **(b)** $\begin{pmatrix} -3 \\ 3 \end{pmatrix}$ **(c)(ii)** 134 to 136°

Question 18

Candidates generally struggled with part **(a)**. Few realised that the square had an angle of 45° and so trigonometry could be used to find the length of the side. Pythagoras was an alternative but few could use this correctly. Many candidates recovered in part **(ii)** by squaring their answer to part **(i)** and so gaining the marks for a follow through answer.

Many gained the marks in part **(b)**, finding the area of the circle correctly. A common error in part **(b)** was to use 18, rather than 9, as the radius.

Answers: **(a)(i)** 12.7 to 12.73 **(ii)** 161 to 162.1 **(b)** 254 to 255

MATHEMATICS

Paper 0581/13
Paper 13 (Core)

General comments

The majority of candidates showed a good level of knowledge and understanding and attempted all the questions. The majority of candidates showed working, but there were several cases where working needed to be shown and was not. The importance of showing working, in the working space below the question, must be stressed to all candidates.

Comments on specific questions

Question 1

Many correct answers were seen. Candidates must ensure they read the question fully as several named the shapes square or triangle rather than the solid which was asked for. The most common incorrect answer was prism.

Answer: Pyramid

Question 2

Several candidates scored one of the two marks for naming two of the factors, usually 4 and 25. Few candidates named all four. Several candidates listed factors of 100 rather than factors which are square numbers.

Answer: 1, 4, 25, 100

Question 3

(a) This part was answered very well.

(b) This part was also answered very well.

Answers: **(a)** 2 **(b)** 2

Question 4

(a) This part was generally correct. The most common incorrect answer was 35.

(b) Although many candidates correctly answered this question it was not answered as well as part **(a)**. 7 was often seen, as was 34 from candidates using the noon temperature.

Answers: **(a)** 41 or −41 **(b)** − 7

Question 5

A large number of candidates did give the correct answer. Many candidates scored at least one mark for one correct term, usually xy. Common errors were $2x + xy$ and $2x^2 + y$.

Answer: $2x^2 + xy$

Question 6

Only the more able candidates were successful with this question. Candidates need to understand how to attempt the first step of solving an equation. Several attempted to solve this by using trial and error.

Answer: 5.5

Question 7

Many of the more able candidates gave the correct answer. Others clearly understood how to use a calculator correctly, but did not give the answer to 3 decimal places. Weaker candidates often appeared not to understand how to use their calculator. Candidates need to be familiar with their calculators and practice is clearly needed.

Answer: 6.489

Question 8

This was generally well answered. The majority of candidates scored both marks.

Answer: 35

Question 9

This question, being standard bookwork, resulted in a high number of candidates scoring full marks. Only a few weaker candidates misunderstood the question.

Answer: 46.4

Question 10

Many candidates changed this question to decimals, while others gave $18\frac{3}{4}$ as their answer. The other common incorrect answer was $\frac{18.75}{100}$.

Answer: $\frac{3}{16}$

Question 11

In a small number of cases, errors or incomplete factorisations were seen in the answers of more able candidates. Less able candidates often gave a single term or omitted brackets.

Answer: $3a(c - 2d)$

Question 12

More able candidates were able to give the correct answer but a lot of uncertainty was evident in this question about what was required. The method mark was rarely given, but some did gain the special case mark for writing the fraction the wrong way around.

Answer: $\frac{8}{27}$

Question 13

More able candidates were able to give the correct answer. Other candidates often did not realise that there was already a common co-efficient and attempted to multiply one or both equations often incorrectly. Others attempted to solve the equations without eliminating one of the variables.

Answer: x = 2, y = −1

Question 14

Some candidates lost marks on this question as they gave a choice of answers for one or more parts.

(a) There was confusion about prime numbers with 27 being a common answer.

(b) Several candidates did not appear to be familiar with irrational numbers.

(c) Several candidates gave the answer $\frac{5}{17}$ in addition to 0.294.

Answers: **(a)** 17 **(b)** $\sqrt{17}$ **(c)** 0.294

Question 15

The formula for compound interest was often used successfully by more able candidates. Some worked out the 2 years separately. Candidates sometimes gave the interest as the answer rather than the total amount. Other candidates appeared not to be familiar with the concept of compound interest and many used the simple interest.

Answer: 212.18

Question 16

Many candidates were successful in all parts of this question. There was some uncertainty about the two circle theorems applied.

Answers: **(a)** 90 **(b)** 45 **(c)** 45

Question 17

This question was very well answered suggesting basic order of operations is understood by the majority of candidates.

Answers: **(a)** (7+ 2) × 9 **(b)** 36 ÷ (6 ÷ 2) **(c)** 5 × (3 + 6) × 2

Question 18

(a) The majority of candidates attempted the question, and there were many fully correct responses. However there appears to be confusion by a significant number about the order and signs of components of vectors.

(b) This part was generally well answered. The most common error was giving the first sign as minus rather than plus.

Answers: **(a)(i)** $\begin{pmatrix} 4 \\ 5 \end{pmatrix}$ **(ii)** $\begin{pmatrix} 2 \\ -2 \end{pmatrix}$ **(b)** …. + …… =

Question 19

Few candidates scored all 3 marks and there were many candidates who did not attempt this question. Many did not give an answer in the form directed, $mx + c$. A mark was lost often for the gradient of $\frac{1}{3}$ rather than $-\frac{1}{3}$.

Answer: $-\frac{1}{3}x + 2$

Question 20

(a) (i) Many correct answers were seen.

(ii) This was generally well answered, although throughout some whole numbers for probabilities were seen in some answers.

(iii) This was a more challenging question, mainly due to candidates having to sort out both even numbers and factors. $\frac{3}{5}$ was a common wrong answer.

(b) Some poor reading of the question was evident, since a denominator of 5 was very common.

Answers: **(a)(i)** 4 **(ii)** $\frac{4}{5}$ oe **(iii)** $\frac{2}{5}$ oe **(b)** $\frac{2}{4}$ oe

Question 21

This was well answered by most candidates. Some candidates tended to mix up the averages and the median was the least successful of the three. Some candidates did not show any working.

Answers: (Mode) 0, (Median) 2, (Mean) 2.7

Question 22

(a) The majority of candidates scored all 3 marks. Some weaker candidates understood the concept but did not draw straight lines between the points.

(b) Time divided by speed was a common error and some used 25 minutes rather than 30 minutes in their correct (or incorrect) formula for the distance. Some answers were rather unrealistic.

Answers: **(b)** 1.65.

MATHEMATICS

Paper 0581/21
Paper 21 (Extended)

General Comments

The paper was such that all candidates were able to demonstrate their knowledge and ability.

There were challenging questions even for the most able, such as **Questions 5a** and **18a(ii)**. There was no evidence at all that candidates were short of time and almost all candidates attempted all of the questions.

Candidates can improve on giving answers to the correct degree of accuracy. Candidates should understand that instructions for a particular accuracy in a question over-ride the general accuracy instructions in the rubric.

Particular Comments

Question 1

Candidates need to ensure they read the instructions in the question to write the figures correct to 1 significant figure. Others needed to take note of the instruction to show their working.

Answer: 3 x 4 + 8 = 20

Question 2

Most candidates knew what was required and did well on this question. Some candidates needed to work with all the figures available in their calculator to achieve the correct answer. Candidates need to understand the significance of the word **exact** as some were prevented from scoring full marks by giving the answer correct to 3 significant figures.

Answer: 1.2496

Question 3

Many candidates answered this question accurately. Some candidates did not make the sign change when removing the brackets or they evaluated the expression incorrectly as (3x – 1)(3x – 3) instead of (3x – 1) – (3x – 3).

Answer: 2

Question 4

This question was very well done by most candidates. The main error was to treat $\sqrt[3]{0.9}$ as 3 x $\sqrt{0.9}$.

Answer: 0.9^3 0.9^2 $\sqrt{0.9}$ $\sqrt[3]{0.9}$

Question 5

Part **(a)** did not seem to be fully understood by the majority of candidates. Since 4 was the most common incorrect answer, it is likely that candidates recognised the planes of symmetry through the end face but did not count the plane of symmetry parallel to the end face. Part **(b)** was very well done across the ability range.

Answers: **(a)** 5 **(b)** 2

Question 6

This question was very well answered by the majority of candidates.

Answer: 1.152×10^{-2}

Question 7

Most candidates knew what was required for this question. Some had difficulty reaching the final answer, either because they did not have a single fraction or more commonly did not write it in the simplest form.

Answer: $\frac{5+x}{2x}$

Question 8

This question was very well done by the more able candidates. Many candidates did not appreciate how many sides a hexagon has. The majority of the errors came from finding the perimeter and then writing bounds for it, instead of finding the bounds for the length of the side and multiplying by 6.

Answer: 40.5

Question 9

Many candidates scored well on this question. The most common error was to use simple interest. Other errors usually resulted from premature approximation or incorrect rounding.

Answer: 674.92

Question 10

The majority of the candidates were successful on this question. What errors there were usually came from poor algebra rather than lack of knowledge.

Answer: $x = 4$ $y = -3$

Question 11

This was one of the best answered questions on the paper.

Question 12

This question was well done with most candidates gaining some credit for their work. The most common error made was to replace $(x + 3)^2$ with $x^2 + 9$. Candidates should be advised to carry out only one operation at a time and to make their working clear so that Examiners can award some credit if a mistake is made in the working.

Answer: $x = \sqrt{(5y)} - 3$

Question 13

This question was generally well done by most of the candidates. The most common error was either to reverse the inequality when it was not needed or not to reverse it when it was needed. Some candidates tried to work with an equal sign, which is not good practice.

Answer: $x < -3$

Question 14

This was one of the best answered questions on the paper, with part **(b)** presenting just a small problem to a few candidates.

Answers: **(a)** 10 **(b)** 2½

Question 15

Many candidates did not seem to fully understand what was required in this question. Large numbers of candidates subtracted areas. Some subtracted area from perimeter whilst others confused diameter with radius or forgot to divide by 2 for the semicircle. Many candidates also ignored the accuracy requirement.

Answer: 31.4

Question 16

The most able candidates were able to answer this question accurately. By far the most common error was to "cancel" the terms in x^2. Those that did factorise the two terms generally did it very well.

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

Question 17

Overall this question was reasonably well done. Many candidates just squared the numbers in part **(a)** instead of multiplying the matrix by itself. In part **(b)** there were difficulties in dealing with the negative numbers involved.

Answers: **(a)** $\begin{pmatrix} 8 & 0 \\ 0 & 8 \end{pmatrix}$ **(b)** $\begin{pmatrix} \frac{1}{4} & \frac{1}{4} \\ \frac{1}{4} & -\frac{1}{4} \end{pmatrix}$

Question 18

Many candidates were able to draw a tangent at t = 7. Some misread the scale and some did not draw a tangent at all. Of those that did draw a tangent, very few understood that they had to find the gradient of the tangent to find the acceleration. Speed divided by time was the most common error. In part **(b)**, the distance travelled, however, was very well done.

Answers: **(a)(ii)** 4.4 to 6 **(b)** 780

Question 19

This question was very well answered by the vast majority of the candidates.

Answers: **(a)** 20200 **(b)** 1260

Question 20

Most candidates understood that the question expected the use of the quadratic formula and so scored some marks. Some responses contained common errors, such as sign errors with "b", division by 2 only applied to the square root, misquoted formulae and the accuracy requirement not noted.

Answer: 0.84 7.16

Question 21

Parts **(a)** and **(b)** were generally well done. Part **(c)** was well done by some. Other candidates were unable to make much progress with the question.

Answers: **(b)** (4, 2) **(c)** y = –2x + 10

Question 22

Parts **(a)** and **(b)** were reasonably well done. In part **(c)** many candidates were unable to identify the region required containing 15, 6 and 2. Putting 60 into the diagram was a common error.

Answers: **(a)** 14, 0, 3 and 2 **(b)** 11 **(c)** 23

MATHEMATICS

Paper 0581/22
Paper 22 (Extended)

General Comments

The paper was such that all candidates were able to demonstrate their knowledge and ability.

There was no evidence that candidates were short of time as almost all candidates attempted the last few questions.

Candidates not giving answers to the correct degree of accuracy continued to be a concern this year. The general rubric needs to be read carefully at the start of the examination and candidates need to ensure that they have noted the accuracy requirements of particular questions in their checks at the end of the paper.

There were a significant number of candidates who did not use the available space in the answer booklet to show the necessary calculations for obtaining their answers. When there is only an incorrect answer on the answer line and no relevant working, the opportunity to earn method marks is lost.

Particular Comments

Question 1

Part **(b)** was one of the better answered questions on the paper and it was exceptionally rare to see an incorrect answer. Part **(a)** was also well answered. A number of candidates had the two answers in reverse. Occasionally an incorrect answer of 72° was seen in part **(a)**.

Answers: **(a)** 5 **(b)** 0

Question 2

This question was one of the less well answered questions on the paper, although most candidates did make some attempt. The candidates who knew how to use a Venn diagram to solve this question were usually successful in obtaining the correct answer. The most common incorrect answer was 8 but this did not always result in the method mark since there was often no working or incorrect working. The candidates who tried an algebraic method without drawing a Venn diagram often went wrong, either by missing out the *x*, or more commonly, the 5 in their equations.

Answer: 10

Question 3

The candidates who realised and knew how to factorise the right hand side of the equation were usually successful in obtaining the correct answer. The most common incorrect answers were $\frac{J}{v+u}$ or $\frac{v-u}{J}$.

Answer: $m = \frac{J}{v-u}$

Question 4

Part **(a)** was very well answered. The most common incorrect answers were 65° (incorrectly assuming that ∠OCB = ∠CBO) and 50° (incorrectly assuming that ∠BOC = ∠CBO).

Candidates found part **(b)** to be more challenging with 130° being the most common incorrect answer.

Answers: **(a)** 40 **(b)** 65

Question 5

Those candidates who used the relationship for sin (= opp / hyp) usually gained full marks.

Longer methods that used Pythagoras with cosine (= adj / hyp) or even the cosine rule were usually not successful. Candidates should note the rubric requires that answers in degrees should be to one decimal place. Some candidates incorrectly rounded their answer to 23.5°.

Answer: 23.6

Question 6

Whilst there were many correct answers to both parts of this question there appeared to be a number of candidates who did not understand the term 'in standard form' or what was required for answers 'correct to 2 significant figures'.

The most common incorrect answers for part **(a)** were 6.58×10^{-5}, 0.658×10^{-2} and 6.6×10^{-3}.

The most common incorrect answers for part **(b)** were 0.0067, 0.00660, 0.066, 0.0 and 0.1.

Answers: **(a)** 6.58×10^{-3} **(b)** 0.0066

Question 7

Many candidates did not fully understand what was required for this question and did not appreciate that the coefficient of **b** in the vector $\overrightarrow{AB}$ was equal to the coefficient of **b** in the vector $\overrightarrow{CD}$ thus giving the equation $t = 3t - 5$ to solve.

The most common incorrect answers were $\frac{5b}{2b}$, –2.5 and 2.5**b**.

Answer: $t = 2\frac{1}{2}$

Question 8

When the answer to a question is given it is vital that candidates show **ALL** the necessary steps in the working to obtain the answer. Most successful candidates chose to use a common denominator of 27.

The candidates who chose to use a common denominator of 243 were generally less successful.

The candidates who tried to use decimals to answer the question scored 0 marks.

Question 9

This question was not well answered by many with incorrect lower and upper bounds for 120 being seen. A lower bound of 115 was often seen and an upper bound of 120.4 or 125 was not uncommon.

A significant number of candidates calculated 120×20 and then tried to adjust the result by ± 0.5.

Answer: 2390, 2410

Question 10

Whilst many candidates scored full marks on this question there were also a significant number that did not know that the sum of the interior angles of a pentagon is 540°. Some incorrectly used the sum of the interior angles as 360° and then went on to obtain a negative angle for their answer. Candidates should be encouraged to consider if their answer is possible.

Answer: 60

Question 11

This question was well answered with many fully correct solutions seen. Some candidates tried to use inverse proportion and others omitted the 'square'. Some candidates correctly wrote $50 = k \times 100$ but then went on to incorrectly say that either $k = 2$ or $k = 50 - 100$.

Answer: 128

Question 12

The majority of candidates realised the need for a common denominator.

The minus sign between the two terms in the numerator posed a problem to a number of candidates with $3(x-1) - 2(x+2)$ being incorrectly expanded to give $3x - 3 - 2x + 4 = x + 1$.

Another common error was to say that $3(x-1) = 3x - 1$.

A few candidates obtained the corrrect answer but then incorrectly proceeded to simplify their fraction.

Answer: $\dfrac{x-7}{(x-1)(x+2)}$

Question 13

This question was one of the better answered questions on the paper with the vast majority of candidates realising that they had to subtract the area of the circle from the area of the square. Some candidates were unsure about the formula for the area of a circle and used $2\pi r$. Some also used 4×18 instead of 18^2 for the area of the square.

Answer: 245

Question 14

There were a small number of candidates who did not attempt an answer to this question.

The majority of candidates that did attempt the question were able to gain a mark for drawing at least two correct arcs. Completely correct answers were relatively rare.

A common error was to construct the perpendicular bisectors of each of the three sides of the triangle.

Question 15

Many fully correct solutions were seen. The vast majority of candidates correctly calculated 776.14 and scored the first method mark. Some candidates chose to work in RM and calculated 1900 – (740 × 2.448) giving 88.48 but then did not divide by 2.448 to give their answer in S$.

The most common incorrect answers were 36.1 and 88.

Answers: 36

Question 16

Candidates were generally more successful in simplifying the expression in part **(b)**.

In part **(a)** candidates often obtained x^8 but then did not evaluate the constant correctly. The most common incorrect values for the constant were $\frac{16}{81}$ or $\frac{8}{40.5}$.

In part **(b)** the expression was sometimes only partially simplified to $\frac{64y^6}{32y^7}$ or $\frac{2y^6}{y^7}$.

Answers: **(a)** $\frac{4}{9}x^8$ **(b)** $2y^{-1}$

Question 17

Part **(a)** was very well answered. The most common errors were with the numbers 68, 85 and 165 that were often given as 38, 55 and 135.

Candidates struggled with part **(b)**. The most common incorrect answers were 45/80, 45/225,90/255 and 90/225.

Answers: **(a)**

	Boys	Girls	Total
Asia	62	28	**90**
Europe	35	45	**80**
Africa	**68**	17	**85**
Total	**165**	**90**	255

(b) $\frac{3}{17}$

Question 18

Part **(a)** was well answered by those candidates who knew how to multiply matrices. Occasionally this was spoilt by numerical errors.

In part **(b)** the majority of candidates knew how to calculate the determinant but this was often spoilt by numerical errors such as $(2\times3)-(-4\times-5)=6--20=26$. Some candidates correctly worked out the value of -14 but then incorrectly proceeded to give the answer as $\frac{1}{-14}$. The inverse matrix was also sometimes given as the answer.

Part **(c)** was omitted by a significant number of candidates. The candidates that knew that the identity matrix was $\begin{pmatrix}1 & 0\\0 & 1\end{pmatrix}$ were usually successful. Some candidates used $\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$ as the identity matrix in their calculations.

Answers: **(a)** $\begin{pmatrix}-14 & 0\\0 & -14\end{pmatrix}$ **(b)** –14 **(c)** $\begin{pmatrix}-5 & 4\\5 & -4\end{pmatrix}$

Question 19

Part **(a)** was generally well answered. Those who used Pythagoras' Theorem (as opposed to trigonometry) in Δ ABD usually secured full marks, although in some instances their final answer was given to 2 significant figures.

Part **(b)** was less successful than part **(a)**. A significant number of candidates tried to use 8^2 + (1/2 their BD)^2 = PM^2. Premature rounding was often seen and this usually led to the loss of the accuracy mark.

Answers: **(a)** 14.1 **(b)** 3.74

Question 20

The majority of candidates scored at least one mark in part **(a)**. The line that posed the most difficulties for candidates was the line $y = 2x$. Some candidates attempted to draw the lines without using a ruler which is not acceptable.

Many of the candidates who correctly drew the three lines in part **(a)** were then unable to identify the correct region for *R*. (*R* was often incorrectly placed in the triangle surrounded by the three lines.)

Question 21

In part **(a)** the vast majority of candidates knew that the acceleration was determined by the gradient of the speed-time graph during the first seven seconds and were therefore successful.

Part **(b)** was also very well answered.

There were many excellent solutions to part **(c)**. Most candidates appreciated that they were required to find the area under the graph but this was occasionally spoilt by misinterpretation of the scales, failing to divide by 2 when finding the area of a triangle or incorrect values substituted into the trapezium area formula.

The most common incorrect error was to simply calculate 14×20.

Answers: **(a)** 2 **(b)** 6.7 to 7.3 **(c)** 203

Question 22

The most common incorrect answers in part **(a)** were (3.5, 7), (2, 7) and (7, 0).

Part **(b)** was generally well answered but a significant number of candidates showed a lot of unnecessary working and displayed a lack of confidence in using gradient and *y*-axis intercept properties.

In part **(c)** the majority of candidates earned at least one mark for obtaining $y = 5$. Candidates sometimes used the incorrect formula $\left(\frac{x_1 - x_2}{2}, \frac{y_1 - y_2}{2}\right)$ to find the midpoint.

Answers: **(a)** (0, 7) **(b)** $y = 2x + 3$ **(c)** (1, 4)

MATHEMATICS

Paper 0581/23
Paper 23 (Extended)

General comments

The paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence at all that candidates were short of time as almost all attempted the last few questions. To improve marks candidates should always ensure that they show full, clear working as there are still some cases where no working at all is shown. Most candidates gave answers to the correct degree of accuracy. For those that did not, they need to read the general rubric carefully at the start. They also need to make sure that they have noted the accuracy requirements of particular questions in their checks at the end of the paper. When checking through their working at the end of the exam candidates are advised to check the units within questions to ensure they do not lose unnecessary marks through not reading the question carefully.

Comments on specific questions

Question 1

This was generally a very well answered question by the majority of candidates. A small number of candidates misunderstood the question and found the difference between 3.6 and – 4.7 and therefore had a positive answer of 8.3. A very small minority computed the sum 3.6 – 4.7 obtaining an answer of –1.1. Reading the question more carefully would have helped in the latter two cases.

Answer: – 8.3

Question 2

This was generally a very well answered question by the majority of candidates. A small minority of candidates misread the question and thought that they were finding an arrival time with 2305 being the departure time, therefore occasionally 0015 was seen as an answer. Reading the question more carefully would have helped here. Also a very small number of candidates wrote the answer 2195 as if there are 100 minutes in an hour instead of 60.

Answer: 21 55

Question 3

This was generally well answered particularly by those candidates who read the question carefully, noting the accuracy requirements, and those who showed working by completing the calculation in stages e.g. writing $\sqrt[3]{4.3344...}$ as an interim stage in their working. A few candidates obtained 1 mark for the correct working but lost the accuracy mark for not correctly rounding.

The most common incorrect answer of 0.5795 was seen which arises from $\sqrt[3]{2.35^2} - 1.09^2$. If candidates do not have a calculator that will do $\sqrt[3]{2.35^2 - 1.09^2}$ all in one go they need to understand how to do this in stages or to insert brackets when typing it into their calculators i.e. keying in $\sqrt[3]{\ }\,(2.35^2 – 1.09^2)$. Candidates need to check the order of operations for their particular calculator.

Answer: 1.6305

Question 4

Many candidates were able to obtain at least 1 mark for this question, coping better with the two intersecting sets than the three. The most common errors were to shade in $A \cup B'$ or $(P \cup Q) \cup R'$. Those with clear shading and tidy diagrams, working in pencil, tended to do better on this question compared to those who left their working in the diagram or worked in pen then changed their minds making diagrams hard to follow.

Question 5

Those candidates obtaining maximum marks on this question were those that read carefully the instruction to "write down all the steps" in their working. The candidates with clearer working tended to be those who converted to improper fractions, then wrote a common denominator before completing the calculation. Those who added the whole numbers separately to the fractions $\frac{9}{12}$ and $\frac{4}{12}$ were less able to show clear stages in their working and occasionally lost one of the two marks as a consequence.

Question 6

The candidates showing the most success on this question were those who showed their working in converting all numbers to the same form, usually decimals, occasionally percentages. They were more able to go on to order the numbers correctly and if not, managed to score the method mark. The most frequent error was to convert 4.93% to 0.493. Candidates did generally appear to understand the meaning of the symbol <.

Answer: $4.93\% < \frac{20}{41} < 0.492 < \frac{80}{161}$

Question 7

This was generally a well answered question with the most success coming from those candidates showing clear currency conversion and subtraction. The most efficient method was to convert the French apricot price to pounds and then subtracting the two costs in pounds. Some candidates lost accuracy here by multiplying by the approximated reciprocal of 1.04, i.e. the calculation 3.38 x 0.96 = 3.24 was seen a few times. The most common error was to misunderstand the currency conversion, multiplying 3.38 by 1.04 instead of dividing. Other common errors were to find the difference in Euros or to subtract the two currencies without first converting them to the same currency.

Answer: 1.14

Question 8

The majority of candidates scored at least 1 mark on this question with many candidates dealing correctly with the two different units in the question. Candidates need to ensure they read the question carefully particularly when the different units are highlighted in bold. The majority of candidates knew the correct calculation to do and most were able to work completely in cm or completely in mm. Common incorrect answers of 12 or 120 or 120000 were seen, occasionally with insufficient working so they were unable to obtain the method mark for completing the calculation with mismatched units.

Answer: 1200

Question 9

Many candidates obtained full marks on this question with the most successful candidates scoring marks using the $\frac{x}{8} = \frac{12}{10}$ method. There were occasional problems with one of these fractions being inverted and when candidates did not use this layout, inverting one of the fractions was more common. There were a number of candidates who misread the question and found the length PB instead of AB. There were also a number of candidates who did not realise this was a similar triangle problem. These candidates attempted to use trigonometry or Pythagoras' theorem, making incorrect assumptions about certain angles e.g. they assumed angle BAC was a right-angle or that the triangles were isosceles. Candidates must be careful not to assume facts that are not given in the question.

Answer: 9.6

Question 10

This was a generally well answered question. Some candidates did not note the accuracy requirement stated in the question. Of those who understood compound interest and used stages to work it out, some followed the working 208 x 0.04 = 8.32 with the answer 208.32 or 8.32. Some candidates used simple interest.

Answer: 216.32

Question 11

This question proved difficult for some candidates. The most successful were those who used a Venn diagram method. When using this method, candidates needed to be careful not to ignore the 1 candidate who liked neither. The most common error was to calculate 21 + 15 – 24 = 12, then to subtract the 1 candidate instead of adding, or to ignore this candidate altogether. Therefore 11 or 12 were common wrong answers.

Answer: 13

Question 12

Candidates with the most success were those who showed their working. They were then able to pick up a mark for showing upper and lower bounds of the side length to be 6.25 and 6.35. There was a welcome absence of the incorrect 6.349 as an upper bound or recurring nines. Some candidates found the perimeter first using 4 x 6.3 and then attempted to apply bounds to this rather than calculating 4 x 6.25. There were fewer candidates than in previous years finding areas instead of perimeters. Part **(b)** proved more difficult with some candidates finding the difference between bounds of the side length rather than bounds of the perimeter. Therefore 0.1 was a very common wrong answer. Reading the question more carefully would have helped here.

Answers: **(a)** 25 **(b)** 0.4

Question 13

This question proved to be a good discriminator as there were a number of candidates who found this challenging. The un-simplified answer of $\frac{a \times 10^7 + b \times 10^6}{10^6}$ was common. Correctly dividing every term by 10^6 was sometimes seen but incorrect cancelling of the 10^6 was also seen. $\frac{a \times 10^7 + b \times \cancel{10}^6}{\cancel{10}^6}$ to obtain an answer of $a \times 10^7 + b$ was extremely common. Another common error was to incorrectly simplify $a \times 10^7 + b \times 10^6$ to: $a + b \times 10^{13}$, or $ab \times 10^{13}$, or some version of this with the power of 10 being 13.

Answer: 10*a* + *b*

Question 14

The majority of candidates correctly remembered that speed = distance/time and were able to obtain at least one method mark here. Those candidates with the most success showed full working and kept all decimal numbers to 4sf or better or converted the time into seconds and divided by 3600 to change it to hours or worked in fractions instead of decimals i.e. $55\frac{1}{3}$ for the time in minutes or $\frac{83}{90}$ for the time in hours thus maintaining full accuracy. Many candidates struggled with the time conversion due to the presence of the time in seconds with a large number of candidates using 55.2/60 = 0.92 instead of 55.3r/60 = 0.92r. Therefore the most common wrong answer arose from the working 10/0.92 = 10.9.

Answer: 10.8

Question 15

Many candidates successfully found the gradient using the formula $\frac{y_2 - y_1}{x_2 - x_1}$ and then substituted this into y = mx + c with one of the points to find the intercept. A few used the $y - y_1 = \text{m}(x - x_1)$ method equally well to find the equation of the line. Some went on to lose the final mark by just writing $-2x + 8$ instead of $y = -2x + 8$ on the answer line or did not fully cancel the gradient. Some spotted that they already had the intercept due to the point (0, 8) being given to them in the question and despite having an incorrect gradient were still able to score the mark for y = mx + 8. A small number of candidates used $\frac{x_2 - x_1}{y_2 - y_1}$ for the gradient or missed out the negative sign due to calculating $\frac{y_2 - y_1}{x_1 - x_2}$. Candidates need to take care that they subtract the y and x coordinates in the same order.

Answer: $y = -2x + 8$

Question 16

Many candidates were able to score at least 1 mark on this question. The most commonly gained mark was for the squaring step to get $\left(\frac{g}{2}\right)^2 = \frac{h}{i}$. Those most likely to gain full marks here were the ones whose next step was to take the reciprocal of both these fractions writing $\left(\frac{2}{g}\right)^2 = \frac{i}{h}$. Many who did not use the reciprocal did go on to correctly deal with the fact that i was on the bottom of the fraction with $\left(\frac{g}{2}\right)^2 i = h$ as their next stage in the working but then lost the final mark for leaving their final answer in a poor format such as $i = \frac{h}{\left(\frac{g}{2}\right)^2}$. Candidates should be encouraged to check they have not written a fraction within a fraction.

Many candidates wrote $\left(\frac{g}{2}\right)^2 h = i$ as their second step. A small number of candidates, when squaring, only squared the numerator of the g/2 and not the denominator as well.

Answer: $\frac{4h}{g^2}$

Question 17

This was generally a well answered question, with the most success coming from those using the elimination method. Many realised they were only required to multiply one of the equations by a constant. A few candidates used the substitution method equally well. A small number of candidates were unable to correctly deal with the negative numbers although otherwise their method would have been correct.

Answer: $x = -1$, $y = 5$

Question 18

This question proved to be a good discriminator. Some candidates were able to correctly deal with the information in the question with the most success coming from those who wrote arc length = $\frac{x}{360} \times 2 \times \pi \times 8 = 14\pi$ as their first line of working. Many candidates did not read the question carefully or misunderstood the perimeter information, believing that the perimeter was the arc length forgetting to subtract the 16 and therefore a very common incorrect first line of working was $\frac{x}{360} \times 2 \times \pi \times 8 = 16 + 14\pi$. This working went on to give them an answer of x = 429.6°, which candidates did not always spot was not possible as x was clearly less than 360°. There were also quite a few candidates who used the sector area formula instead of the arc length formula.

Answer: 315

Question 19

This question proved to be a good discriminator. Some candidates were able to correctly deal with the information in the question with the most success coming from those who showed full working: writing length scale factor = 40 so volume scale factor = 40^3 followed by 45 x 40^3 = 2880000 cm^3, then converting this to m^3 by dividing by 1000000. There were two distinct problem areas here. Firstly those who were unable to use volume scale factor: 45 x 40 = 1800 was a common incorrect answer. Secondly those who were unable to change cm^3 into m^3: many candidates divided by 100 instead of 100^3. The most common incorrect answer was 18, which incorporated both of these errors. Those candidates who attempted to use the method $\left(\sqrt[3]{45} \times 40\right)^3 \div 100^3$ were generally unsuccessful. There were also a number of candidates cubing the 45 instead of the length scale factor 40.

Answer: 2.88

Question 20

Part **(a)** was generally well answered by many candidates correctly using $\tan\theta = \frac{4}{2}$. A number of candidates, who also obtained the correct answer, made the question harder by working out the hypotenuse of the triangle, $\sqrt{20}$, and then using $\sin\theta = \frac{4}{\sqrt{20}}$, $\cos\theta = \frac{2}{\sqrt{20}}$ or the sine rule or cosine rule. When using this method sometimes premature rounding of $\sqrt{20}$ meant that the accuracy of their final answer was compromised. Some candidates either miscounted the number of squares or used the axes to work out side lengths, as it was quite common to see $\tan\theta = \frac{5}{3}$. Occasionally $\tan\theta = \frac{2}{4}$ was also seen. The answer of 1.1 was very occasionally seen, which is the answer in radians. Candidates are reminded to check that their calculator is in degree mode at the start of the exam. Part **(b)** proved to be very challenging for the candidates. Some candidates were enlarging or stretching the triangle with a scale factor of 3 or using the line y = 1 as the invariant line instead of the x-axis. A number of candidates did not attempt this part.

Answers: **(a)** 63.4 **(b)** vertices at (4, 1), (8, 1) and (10,3)

Question 21

In part **(a)** many candidates correctly found the deceleration, although a small minority performed the calculation wrongly as 12/5=2.5. A lot of candidates left the answer as – 2.4, which is the acceleration not the deceleration. This was condoned in this instance, but should be discouraged. In part **(b)** many candidates were able to obtain the full 3 marks with most realising that they needed to work out the area under the lines. There were fewer candidates writing distance = speed x time which of course is the incorrect method here. The problems that occurred were mainly to do with the scale, or dividing the area up into several smaller shapes and incorrectly working out one of the areas or missing one of the areas out. To improve marks on this type of question candidates need to be advised to make it clear what they are working out, as method marks were lost due to lack of clarity. For example candidates could improve working by labelling each area they are calculating on the diagram.

Answers: **(a)** 2.4 **(b)** 680

Question 22

The majority of candidates were able to score marks on this question, with 4 or 5 marks being quite common. Most were able to correctly find the equations of the lines as $y = 1$, $x = 3$ and $y = x + 5$. The main reasons for marks being lost were due to candidates occasionally reversing y and x, or using the wrong inequality sign, either the inequality sign was reversed or the strict inequalities < and > were used. Candidates need to be aware of the section in the syllabus that says lines will be broken for strict inequalities.

Answers: $y \geq 1$, $x \leq 3$, $y \leq x + 5$

Question 23

In part **(a)** many candidates were able to correctly give a reason for angle DBC to be equal to 50^o, writing angles in the same segment (or angles on the same arc). A number of candidates lost the mark due to talking incorrectly about isosceles/similar triangles or cyclic quadrilaterals and quite a few used the expressions "butterfly" or "bow tie" angles. Whilst useful for visually identifying the shape made by angles in the same segment, this should be discouraged as a mathematical explanation. In part **(b)(i)** many candidates used the fact that opposite angles in a cyclic quadrilateral add up to 180^o (knowing angle ABC was 80^o) to correctly identify angle ADC as 100^o. Some candidates identified angle ACD as 30^o using the fact it is in the same segment as angle ABD, then used the fact that angles in a triangle (ADC) add up to 180^o. In calculating angle BDC in part **(b)(ii)** the candidates who answered this correctly used the fact that the angle on the circumference was half the angle at the centre (angle BOC) to correctly obtain 43^o. A large proportion of candidates wrote 50^o as a very common incorrect answer, the misconception came from the assumption that there was an isosceles triangle on the side AD with centre at O, which of course it was not. Angle OBD in part **(b)(iii)** was generally calculated correctly as 3^o, with the majority of candidates correctly identifying angle OBC first as 47^o using the fact that triangle OBC was isosceles.

Answers: **(a)** angles in same segment **(b)(i)** 100 **(ii)** 43 **(iii)** 3

Question 24

Generally most candidates were able to score 1 or 2 marks for part **(a)** by correctly finding a common denominator and treating this algebraic fraction in the same way they would treat a numerical fraction. There were quite a few candidates who then went on to incorrectly simplify this answer and it was quite common to see this incorrect working following the correct answer:

$$\frac{\cancel{x}-2y}{\cancel{x}y} = \frac{1-2y}{y} \quad \text{or} \quad \frac{\cancel{x}-2\cancel{y}}{\cancel{x}\cancel{y}} = -2 \text{ or } -1$$ or other similar incorrect cancelling.

Part **(b)** proved to be more challenging for candidates. There were some who realised that this was an algebraic fraction needing cancelling with separate terms on the numerator and denominator and that the only way to cancel this fraction to its lowest terms was to factorise the numerator and denominator to get $\frac{x(x+1)}{3(x+1)} = \frac{x}{3}$. A small number obtained part marks for factorising either the numerator or denominator or both but then forgetting to cancel. It was quite common to see a number of misconceptions in the cancelling process with candidates cancelling one x in one of the terms on the numerator with one x in one of the terms on the denominator. For example $\frac{x^2+x}{3\not{x}+3}=\frac{2x}{6}=\frac{x}{3}$ would not score any marks, despite the fact that the final answer is correct (the mark scheme states without wrong working).

Alternatively it was also common to see misconceptions in simplifying the numerator and denominator before simplifying, for example $\frac{x^2+x}{3x+3}=\frac{2x^2}{6x}=\frac{x}{3}$ again would not score any marks due to the wrong working.

Answers: **(a)** $\frac{x-2y}{xy}$ **(b)** $\frac{x}{3}$

Question 25

Those candidates who answered part **(a)** well were those who completed the calculation in stages. They worked out g(½) = 2 then did f(2) = 4 – 7 to obtain the correct answer. There were less candidates than previously working out f(1/2) x g(1/2) although this was still evident. Those who answered the question less well worked out fg(x) and then attempted to substitute in the ½. This caused problems because they were writing fg(x) as $2\left(\frac{1}{x}\right)-7$ then writing $2\left(\frac{1}{2}\right)-7$ instead of $2\left(\frac{1}{1/2}\right)-7$. Part **(b)** was generally well answered by a large number of candidates. The most common misconception was those writing g(x) X f(x) or g(x) X f(x) X x with $\frac{1}{x}(2x-7)$ or $\frac{2x-7}{x}$, or $\frac{1}{x}(2x-7)x$, or 2x – 7 being common incorrect answers. Candidates need to be careful how they write their algebraic fractions since it was common to see a diagonal dividing line instead of a horizontal one and of course $1/2x-7$ is very difficult to distinguish from $\frac{1}{2x}-7$. Part **(c)** was well answered by a large number of candidates. Those who were most successful were the candidates who began with interchanging the x and y writing x = 2y – 7 as their first line of working. There were occasional slips in the rearranging or the order of rearranging with the two most common incorrect answers being: $\frac{x-7}{2}$ or $\frac{x}{2}+7$.

Answers: **(a)** –3 **(b)** $\frac{1}{2x-7}$ **(c)** $\frac{x+7}{2}$

MATHEMATICS

Paper 0581/31
Paper 31 (Core)

General comments

This paper gave candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates were able to complete the paper in the allotted time, but there were some candidates who omitted part or whole questions. The standard of presentation was generally good. However there were occasions when candidates did not score as they did not show clear workings. 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. Candidates should also be encouraged to fully process calculations and not leave them partially completed.

Comments on specific questions

Question 1

Most candidates scored well on this question.

(a) (i) This part was well answered. The most common incorrect answer was 12, demonstrating that candidates understood which number they were trying to find but were perhaps uncertain what the term "multiple" means.

(ii) This part was well answered with some candidates identifying both answers. Common errors were writing 33 and 35.

(iii) Some candidates could identify that 11^2 was the correct answer but did not evaluate it and therefore did not gain the mark. Another common error was writing 11.

(iv) A similar issue arose here with 5^3 identified but not processed to answer the question or just the answer 5 given.

(b) Many candidates did well ordering the numbers. Those that did not score 2 marks often missed the method marks as they did not write down the decimals to sufficient accuracy to enable them to identify the correct order. Some candidates listed high to low.

Answers: **(a)(i)** 84 **(ii)** 31 or 37 **(iii)** 121 **(iv)** 125 **(b)** 55% < 5/9 < $\sqrt{0.31}$

Question 2

This question proved testing for many candidates mainly because they did not write sufficient detail.

(a) Most candidates were able to identify 90° as the correct answer, but very few were able to explain why it was 90°. They knew it was a tangent but did not mention the radius or diameter. Some could describe the diameter but did not use the correct term. Some stated "it is a right angle".

(b) (i) Many candidates were successful here.

(ii) This proved challenging for many candidates. They often made too many assumptions about the initial step and many started with an assumption that 63° was the answer and worked backwards to justify it. A large number of candidates did not attempt this part.

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

(ii) Many candidates were successful here.

Answers: **(a)** 90° and justification referring to tangent and diameter **(b)(i)** 54° **(c)(i)** 90° **(ii)** 27°

Question 3

(a) (i) This was generally well answered by most candidates, with a good understanding of the mean demonstrated. The most common error was multiplying the rainfall and sunshine together and finding the mean of this.

(ii) Candidates need to appreciate that the range is found by subtracting the minimum value from the maximum value. Many candidates could identify these values but did not perform the calculation leaving their answer as "46 to 84".

(b) (i) Common errors were to give the largest value "7" or "February".

(ii) There was an improved approach compared to previous years, and many candidates obtained the method mark even if they did not get the correct answer. Common errors were to omit one value of "1.5" from their list or to simply add the middle values from the table i.e. 4.5 and 1.5 to give the answer 3.

(c) Many candidates calculated a percentage (22.2%) here instead of the angle, demonstrating they understood the concept of a pie chart but not completely understanding the requirements of the question.

(d) (i) Candidates were able to give part of the answer i.e. either "1" or "hour". These were not sufficient to earn the mark. Others gave "average hours of sunshine" as an incorrect answer.

(ii) This part was generally well answered.

(e) (i) Most candidates could complete the scatter diagram correctly with very few errors in plotting.

(ii) There was a wide range of answers given here. Many candidates were able to describe the correlation as "more sunshine, more rain" but did not use the word "positive".

Answers: **(a)(i)** 63 **(ii)** 38 **(b)(i)** 1.5 **(ii)** 4 **(c)** 80° **(d)(i)** 1 hour **(ii)** 4 ½ suns drawn **(e)(ii)** positive

Question 4

This proved a more challenging question and is an example of where candidates need to show full workings to earn method marks.

(a) A variety of answers was given here with answers of 49 and 56 not uncommon.

(b) (i) Many candidates attempted to use trigonometry to calculate this angle despite the question saying "write down" the angle. 45° and 90° were common errors.

(ii) A range of trigonometrical methods and Pythagoras was used, the most common error being the addition of the squares of the 2 sides of the triangle instead of a subtraction More able candidates were generally successful, and many scored method marks for correctly applying trigonometry to their answer to part **(b)(i)**. Common errors gave the answers 3.5 and 7.

(c) (i) Many candidates were able to apply the correct formula for the area of a triangle to their answer in **(b)(ii)** and earn 2 marks here. The common error was to calculate ½ x 7 x 7.

(ii) Many candidates could then go on to calculate the area of the shape using their answer to **(c)(i)**. Most candidates understood they needed to break the shape down into 3 areas. Some added on only 1 triangle to the square, and some cubed 7. Many scored one mark for the number "49" seen.

Answers: **(a)** 42 **(b)(i)** 60° **(ii)** 6.06 **(c)(i)** 21.2 – 21.4 **(ii)** 91.4 – 91.7

Question 5

This question proved challenging. Many candidates would have gained more marks if they had shown more workings.

(a) Some candidates appeared not to understand the terminology and what was required in such questions. Many candidates could correctly work out the profit per kilogram as $1.35 but then were uncertain what to do next. Some divided it by 5.1 (26.5%) or did not process it further. Others did 3.75/5.1 x 100 and gave the answer 73.5%.

(b) Candidates often scored 1 mark for correctly doing a division evidenced by the figure "4", but then could not convert it correctly to grams. Many did the division the other way up giving the answer 2.5.

(c) (i) Many candidates could calculate 70% of the $5.10 correctly but then did not recognise that this was the reduction, not the final selling price, and so left the answer as $3.57.

(ii) Many candidates multiplied their answer in **(c)(i)** by 3 and left this as their answer, not recognising that they also needed to add on the 7 kilos sold at full price. Many gave the answer $46.41 following on from their $3.57 in the earlier part. This, without working, did not score.

Answers: **(a)** 36 **(b)** 400 **(c)(i)** 1.53 **(ii)** 40.29

Question 6

(a) Completing the table was very well done by most candidates.

(b) Many candidates plotted the points and drew the curves successfully, with curves being a better quality than previously – less straight lines and less thick lines. Most candidates understood that the curves did not cross the axes. The points which caused the most difficulty were (-3,-1.3) and (3,1.3) but generally, if attempted, they were within the accuracy required.

(c) This was well answered by those who attempted it. However a number omitted the minus sign, or misread the scale as –2.4. A large number did not use their graph but calculated the value.

(d) (i) This was generally well done, but a large number did not attempt the question.

(ii) Again many candidates did not use their graph to solve the equation. A common error was 4 x 5 = 20.

(e) (i) Many candidates scored 1 mark for a ruled straight line going through one of the points, but in general it was well done.

(ii) Many candidates omitted this part. Those who used the points to calculate the gradient did not always apply it correctly or process it completely.

(iii) Candidates need to appreciate the meaning of the gradient and intercept as they appear in the equation. Candidates often gave a partial answer, and did not completely process it (e.g. gave + -6) or did not give it in the correct form. Again, many candidates omitted this part.

Answers: **(a)** –1, –4, 1.3,1 (**c**) –1.6 **(d)(ii)** 0.8 **(e)(ii)** 4 **(iii)** y = 4x - 6

Question 7

This question was well answered and in many cases clear workings were shown enabling candidates to score part marks even if they did not get the final answer correct.

(a) Generally well answered with many able to take the first step to simplification correctly. Common errors were, having got to 2x = 1, giving the answer 2 or confusion over minus signs leading to –1/2.

(b) Generally well answered with many scoring part marks for clear workings multiplying out the first bracket. The second bracket proved more difficult with the "-3" multiplier not always being applied correctly leading to –15x + 6y and a final answer of 6x – 22y.

(c) Many candidates could identify 3 and *g* as factors and therefore gained part marks.

Answers: **(a)** 0.5 **(b)** $6x - 34y$ **(c)** $3g^2(2 - g)$

Question 8

Candidates on this question showed a varied understanding of transformations with many partially attempting all of the three transformations that were to be drawn. Careful reading of the question would have eliminated some common errors. Several candidates transformed the previous part of the question rather than starting with the original *P* each time. Candidates need to appreciate the full components required to describe transformations, as in general, candidates recognise the type of transformation but cannot give the specific details.

(a) (i) Many candidates rotated the shape, but some were around the wrong point.

(ii) Similarly a correct reflection may have been performed but in the wrong horizontal or vertical line.

(iii) Many candidates understood the concept of a translation, but some did not apply the vector correctly in both directions.

(b) (i) Candidates could describe the reflection but some either did not give a line or gave an incorrect line of reflection.

(ii) Candidates could recognise that it was an enlargement (spellings of which were greatly improved), and many could identify "3", but few made any attempt at the centre of enlargement.

Answers: **(b)(i)** reflection, x=-1 **(ii)** enlargement, 3, (1,3)

Question 9

(a) A common error here was to attempt to apply Pythagoras by adding the squares of the 2 sides ($325^2 + 210^2$) rather than subtracting. A large number of candidates simply calculated 325 – 210 = 115.

(b) (i) Candidates did apply trigonometry, but often used cos instead of sin. Some gained credit for following through from their part **(a)**.

(ii) Many candidates did not appear to understand the idea of a "bearing". Many added their answer in **(b)(i)** to 180 and then took that from 360. Many measured the diagram and gave the answer 303.

(c) (i) Candidates were able to identify the time as 7 30 but often did not convert that to 7.5 hours and therefore the answer 210/7.3 = 28.8 was common. Candidates understood the idea of distance / time even if their time was incorrect.

(ii) Many candidates could perform 325/37 and get the answer 8.78 but were unable to convert this to a time interval giving the answer 9 hr 18 mins. Some did not gain marks for 8 h 48 m with no workings.

(iii) Many candidates scored for a follow through from an incorrect time interval in **(c)(ii)** but a large number subtracted their time from 1400, or gave their answer in an incorrect form e.g. omitting pm from 10 47 or giving 22 h 47 min i.e. a time interval not a time.

Answers: **(a)** 248 **(b)(i)** 40.3° **(ii)** 320° **(c)(i)** 28 **(ii)** 8 h 47 min **(iii)** 22 47

Question 10

(a) This part was very well done.

(b) A wide range of marks was scored here. Most candidates were able to complete the first column from their diagram. The second column was less well done but still many scored well. The last column involving "*n*" was more testing, and sometimes candidates did not complete the middle line. Sometimes it was an incorrect simplification that was the problem.

(c) This part proved challenging with common errors 10000, 999, 9998. Candidates did not appear to relate it to the earlier table.

Answers: **(b)** 25, 2500, n^2; 1,1,1; 24, 2499, $n^2 – 1$ **(c)** 100

Question 11

This question was answered well by more able candidates.

(a) This part proved challenging with candidates believing they needed to perform some sort of calculation or manipulation. Many came down to an algebraic expression, and could not relate the equation to the information given in the question.

(b)(i) Many candidates could go on to score well in this part. Again a lack of working sometimes meant marks were lost. Common errors were 8 x 75 and 40 x 35.

(ii) Many candidates completed this correctly. A common error was to add 288 to 24 and then divide by 8 to give 39 as the answer.

(c) More able candidates did well at this part, but a large number started to rearrange the equation as $8t = k – p$. They were able to earn one mark by dividing correctly by 8. Those candidates who did not show workings were unable to gain the marks for one correct step.

Answers: **(a)** 8 **(b)(i)** 355 **(ii)** 33 **(c)** $t = (p\text{-}k)/8$

MATHEMATICS

Paper 0581/32

Paper 32 (Core)

General comments

The paper gave most candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates were able to complete the paper in the allotted time, but there were some candidates who omitted part or whole questions. The standard of presentation was generally good, however there were occasions when candidates did not score method marks as they did not show clear working. 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. On construction questions candidates should clearly show all construction lines and arcs. Centres should also continue to encourage candidates to show clear working in the answer space provided. It should also be noted that in "show that" questions the given answer cannot be used in a reverse proof - this applied to **Question 1 (a)** and **Question 8 (a)(i)**. Centres should also encourage candidates to check their answers by applying a common sense approach. For example, an answer of "the polygon has 1260 sides" in **Question 6(a)(ii)** should inform the candidate that they have applied an incorrect method or made a calculation error.

Comments on specific questions

Question 1

This was generally a well answered question although part **(a)** caused quite a few problems.

(a) This was a "show that" question and unfortunately a significant number of candidates used the given value of 760 in a reverse method. The expected response would have included a percentage conversion followed by either 0.76 x 1000 or 1000 – 0.24 x 1000 to get the required 760. Common errors were 0.76 x 760, 0.24 x 760, and 76 x 10.

(b) This part was generally correct although a small number did not give the fraction in its simplest form. Common errors included starting with 240/1000, 760/100, 240/760 and 76/24.

(c) This part was answered well with many correct methods and answers seen. The common error was using an incomplete method of 6/38 or 760/38.

(d) This part proved more challenging with few candidates using a full and complete method. The first method mark was generally obtained for using (80-65=15) but the method was then spoilt by using 15/80 rather than 15/65 to obtain the percentage profit. Other common errors were using 65/80 and 65x80 or 15x80 or 15x65. There are a number of methods that can be used to answer this type of question but the method of using 80/65=1.231 to get 23.1% was rarely seen.

Answers: **(b)** 19/25 **(c)** 120 **(d)** 23.1

Question 2

(a) (i) This part was generally well answered with many candidates able to give two correct values. Common errors were 45 and 45; 90 and 1; 90/f and 90/g; 90-f and 90-g.

(ii) Generally candidates were able to list factors of 90 but often gave more than the correct 3 values. Frequently a complete list of all factors was given, or a list of all prime numbers less than 90. The number 1 was often incorrectly listed as a prime number.

(b) In this part some candidates thought that they could re-use cards within an answer, or use numbers not on the list. Others seemed confused over the meaning of a 2-digit or 3-digit number as the number of digits in their answers did not match that required by the question part. Other common errors were giving more than one answer, usually one correct and the other incorrect, or giving an answer that only fulfilled some of the conditions specified in the question part.

(i) This was generally correct but a few even numbers were seen.

(ii) This was less frequently correct with 840 being a common error.

(iii) Square numbers were generally seen but common errors were 64 (not using correct cards) and 49 (not greater than 50 as specified).

(iv) A significant number of candidates did not appear to understand the term "a cube number" with the common errors of 4 and 9 as frequently seen as the correct 1 or 8.

(v) This was generally correct but common errors were 65 (not using correct cards), 104 (not a 2-digit number) and non-multiples such as 94, 95 and 89.

(vi) Again the cube root caused problems with 8 being the common error.

(vii) Although the majority of answers were between 100 and 120, often a list of perceived prime numbers was given, 105 and 104 being common errors.

Answers: **(a)(i)** 2 and 45 or 3 and 30 or 5 and 18 or 6 and 15 or 9 and 10 **(ii)** 2, 3 and 5
(b)(i) 15 or 19 **(ii)** 984 **(iii)** 81 **(iv)** 8 or 1 **(v)** 91 **(vi)** 4 **(vii)** 109

Question 3

The information given both in the question and by the graph was not clearly understood or interpreted by many candidates.

(a) (i) This was generally well answered although 1520 and 1604 were common errors.

(ii) The distance from School was required here and this was not always appreciated with 4 and 2.4 being the common errors.

(iii) This part perhaps demonstrated candidates' misunderstanding of the situation described, as both 34 (time after 1530) and 20 (time from 1530 until he turned back) were the common errors. Also times, usually 1530 or 1550, rather than a time interval were sometimes given.

(iv) The majority of candidates correctly used their distance and time from the previous two parts but few were able to score full marks, probably due to the difficulty of converting from minutes to hours. It was generally common to award the first method mark for use of distance/time but candidates often stopped with units of km/min. Those who attempted to convert by dividing their minutes by 60 often lost the accuracy mark due to premature rounding. Other common errors here were the multiplication by 60, 100 or 1000 and division by 100 or 1000.

(b) (i) The majority of candidates were able to show the 6 minutes spent at School correctly by drawing the correct horizontal line. However a significant number failed to appreciate that the journey time home had to be calculated by using the given speed of 6 km/h and the distance of 4 km from the graph. This value of 40 minutes gives the arrival at home time of 1650. Common errors on the graph involved times of 1610, 1630 or more frequently 1700. A small but significant number stopped their line before it "reached home" which created problems for the rest of the question.

(ii) This was generally well answered particularly on a follow through basis.

(c) (i) Generally candidates were able to draw a straight line to show the travel graph for Julie. The majority started well by using the time of 1548 correctly but the use of the calculated 1634 was less successful.

(ii) This was again well answered with follow through applied.

Answers: **(a)(i)** 15 50 **(ii)** 1.6 **(iii)** 14 **(iv)** 6.86 **(b)(ii)** 1650 **(c)(ii)** Julie by 16(mins)

Question 4

This proved to be a challenging question for many candidates with many parts not attempted.

(a) (i) This construction was generally done well. As the question specified "using a straight edge and compasses only" candidates were expected to show two relevant pairs of arcs.

(ii) The majority of candidates were able to correctly position the point *S* although a common error was to place it at the intersection of the arcs or to indicate the perpendicular bisector itself rather than the particular point at the midpoint of *BC*.

(iii) This construction was again done well although weaker candidates often either omitted this part or lost accuracy. Again candidates were expected to show two relevant pairs of arcs.

(iv) A significant number of candidates failed to appreciate that *R* was to be marked at the intersection of the two constructed lines and many lost this mark even allowing for a follow through basis. This unfortunately caused problems in the later parts of this question although a follow through mark was awarded when possible.

(v) With a follow through mark available this was generally done well.

(vi) Again with a follow through mark available this was generally done well although a significant number of candidates omitted this part or drew a triangle rather than a quadrilateral.

(b) If the constructions in part **(a)** had been done correctly then the shape *BQRS* would have been a square and consequently an easier area to find than many candidates were faced with. The lack of working was also a significant problem, particularly when assigning follow through marks. A number of candidates also did not correctly convert their measurements according to the scale given to give an answer in square metres. A small yet significant number gave the perimeter of their shape or simply multiplied all the dimensions together.

(c) Many candidates failed to appreciate the use of bearings in this part and few correct diagrams were seen. Consequently the point *T* was rarely correctly marked.

(d) Of those who attempted this part, most recognised that the loci was a circle, although common errors included incorrect centres and incorrect or inaccurate radii.

Answers: **(b)** 829 to 974

Question 5

(a) (i) This was generally well answered although a number of candidates misread the scale, usually resulting in point *B* being incorrect.

(ii) This part was generally poorly answered with few candidates seemingly not appreciating that the two pairs of coordinates given for *A* and *B* in part **(a)(i)** could be used to find that *n*=12 in that 2x6 = -3x-4 = 12.

(b) (i) This part was better answered although common errors included 0,1,4, using angles or describing transformations.

(ii) This was generally well answered although a common error was to omit one of the two lines, usually $y=-x$. A small number of candidates lost accuracy marks or did not use a ruler.

(iii) It was expected that candidates would recognise these lines and be able to write down their equations but this was not the case and few correct answers were seen. A number attempted to use $y=mx+c$ to find the equations but again few were successful.

(c) (i) This was generally well answered particularly on a follow through basis, although again a number of candidates misread the scale resulting in incorrect co-ordinates.

(ii) This was only answered well by the more able candidates. Common errors included using the wrong line of symmetry, not going through (0,4) or not being parallel.

(iii) This was poorly answered even allowing for follow through despite the intercept being given as 4 (in that (0,4) was given) and the gradient being 1. Many candidates were seemingly unfamiliar with the form $y=mx+c$.

Answers: **(a)(i)** (2,6) and (-3,-4) **(ii)** 12 **(b)(i)** 2 **(iii)** y=x and y=-x **(c)(i)** 3.3 to 3.7 and -3.3 to -3.7 **(iii)** y = x + 4

Question 6

(a) (i) This was generally answered well with most candidates correctly substituting and evaluating.

(ii) This was generally answered well although a common error was using the value of 9 to obtain the answer of 1260.

(iii) This part was less successfully answered with few candidates able to show correct working. The expected method of using the previous two parts to obtain the equation of $(180n – 360) / n = 156$ was rarely seen or implied. The alternative method of using the given interior angle of 156 to obtain the exterior angle of 24 and then to use 360/24 to obtain the answer of 15 sides was also rare. The use of a "common sense" approach to check this answer would have allowed the candidates to discount a number of incorrect and unrealistic answers.

(b) This part on the solving of simultaneous equations was generally well done with the majority successfully applying the elimination method, although common errors did occur when dealing with the negative values. Those candidates who used the substitution method with $x = 4 – 2y$ were equally successful.

Answers: **(a)(i)** 140 **(ii)** $180n – 360$ **(iii)** 15 **(b)** x = -2, y = 3

Question 7

(a) The majority of candidates were able to name the given shape as a trapezium although common errors were triangle, isosceles, equilateral and 4-sided shape.

(b) Many candidates failed to recognise the need for trigonometry in this part. Recognising the necessity to first calculate the length of 20 cm also caused a problem in getting started. If trigonometry was attempted then the tangent ratio was generally used successfully although a common error was in using 20/50 instead of 50/20. A small number of candidates successfully applied a long method by finding *CD* using Pythagoras' theorem and then correctly applying the sine or cosine ratio. However these candidates often lost the final mark due to errors in accuracy usually caused by premature rounding.

(c) This part was answered poorly by many candidates with only a few attempting to find the required area by using the formula for the area of a trapezium despite the clue in part **(a)**. The majority used the equally valid but longer method of splitting the given shape into a triangle and a rectangle, but common errors were to not multiply the area by 1/2 for the triangle, using incorrect lengths, calculating the perimeter and simply calculating 65x50x85.

(d) A significant number of candidates did not appreciate that the required volume could best be found by multiplying the area of cross-section found in part **(c)** with the given length of 96. Common errors seen include 50x65x85x96 and 96x96x96. Although the question clearly stated "write down the units of your answer" many candidates omitted this part and few correct units were seen.

Answers: **(a)** Trapezium **(b)** 68.2 **(c)** 3750 **(d)** 360000

Question 8

(a) (i) This was another "show that" question and again a significant number of candidates used the given 10 games in a reverse method. The expected response would have included an angle measurement of 150 degrees followed by 150/360 x 24 to get the required value of 10. However this part was generally well answered showing a good understanding of pie charts.

(ii) Many candidates were able to score full marks on this part. Otherwise the first method mark for correctly measuring the 90° or 120° was generally earned.

(b) In this part the usual confusion over mode, mean and median was seen, although an improvement on previous years was noted.

(i) This part was generally well answered and the majority of candidates were able to find the correct frequencies. However a significant number put these values in the "tally" column and then often went on to use the "number of games" column for fx, cumulative frequency, percentages or pie chart angles.

(ii) The correct answer of 1 (goal) was generally seen for the mode but the common error was 7 (games).

(iii) This part on finding the median was less successful with the common errors being to put 0,1,2,3,4,5 in order (to get 2.5), to use the frequency table incorrectly as 5,7,6,3,2,1 (to get 4.5), or to put the frequencies in order of 1,2,3,5,6,7 (to get 4). Those who correctly used the 24 values, either from the original list or from the frequency table, generally were able to calculate the median as 1.5. It was disappointing to see incorrect calculator use resulting in (1+2)/2 becoming 1+2/2 = 2.

(iv) Some candidates struggled with the calculation of the mean. Although the majority of candidates were able to demonstrate some understanding of the calculation required, common errors of 41/6, 5x0=5, (0+1+2+3+4+5) divided by 6 or 24, (5+7+6+3+2+1) divided by 6 or 24 were frequently seen. The use of a "common sense" approach to check this answer would have allowed the candidates to discount a number of incorrect and unrealistic answers.

Answers: **(a)(ii)** (lost) 8, (drawn) 6 **(b)(i)** 5,7,6,3,2,1, **(ii)** 1 **(iii)** 1.5 **(iv)** 1.71

Question 9

(a) (i) Most candidates applied Pythagoras' theorem correctly. However answers of 3.8 and 3.81 were common, thereby losing the accuracy mark. A small number omitted the square root step. Less able candidates did not appear to recognise that a length was required and used a variety of addition, multiplication or area methods to obtain their answer.

(ii) Many candidates were able to score this mark. However a number merely repeated the information given to them or failed to appreciate that another descriptive property was required.

(iii) Many candidates failed to appreciate that part **(ii)** would lead them to the correct answer of 45°. A small number attempted complex trigonometrical methods usually leading to an inaccurate answer. Less able candidates seemed not to appreciate that an angle was required and gave a variety of lengths as their answer.

(b) (i) This was well answered by the vast majority of candidates although some did not show the dots which were an integral part of the pattern.

(ii) This was very well answered with most candidates able to give the correct answers.

(c) (i) Many correct answers were seen here often from a pattern or sequence continuation. The common errors of 25 and 31 were seen.

(ii) A number of candidates gave the correct position to term rule of $3n + 1$ or an equivalent expression. However the common error, as in previous years, of using a term to term rule to obtain $n + 3$ or just 3 was frequently seen.

(d) The correct answer was frequently seen but often without working, suggesting that candidates had employed a sequence continuation or counting back method. Few appreciated that the previous part would lead them to solve the equation of $3r + 1 = 76$. The other common error was to use 76 x 3 + 1.

(e) This part was poorly answered with many candidates omitting an answer or working. Few candidates appreciated that the number of dots was simply one more than the number of lines and so the correct answer was $(3n+1) + 1$ giving $3n + 2$.

Answers: **(a) (i)** 3.82 **(ii)** isosceles **(iii)** 45 **(b)(ii)** 10, 13, 16 **(c)(i)** 28 **(ii)** $3n + 1$ **(d)** 25 **(e)** $3n + 2$

MATHEMATICS

Paper 0581/33

Paper 33 (Core)

General comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of Mathematics. The majority of the candidates were able to use the allocated time to good effect and attempt all questions on the paper. It was noted that some candidates omitted a few part questions. The standard of presentation was generally good. Many candidates showed sufficient working although Centres should continue to encourage candidates to show clear working in the answer space provided, the formulae used, substitutions and calculations performed. This is of particular importance for those candidates who make a mistake in calculations and may be eligible for method marks if working is shown.

Comments on specific questions

Question 1

Candidates showed a reasonable understanding of statistics, especially completing a frequency table and the use of pie charts. Candidates can improve by understanding the difference between mean, mode and median and which calculation is required for each of these terms.

(a) Most candidates gave the correct answers showing a clear ability to read correctly from a frequency graph.

(b) (i) Candidates generally understood that the mode referred to the most frequently occurring item. However, candidates could improve by understanding that the mode is the item not the frequency of the item.

(ii) Candidates generally understood that the median required some form of ordering the items. The most common error was to give the mean.

(iii) Candidates understood the need to attempt a calculation for the mean. Candidates need to understand that the calculation requires the frequency times the item divided by the total number of items, as opposed to the sum of the frequencies divided by the number of items.

(c) (i) The majority of candidates were able to calculate the angles although some wrote down values without any calculations being seen.

(ii) The pie chart was generally annotated with the angles the candidate gave in the previous part.

Answers: **(a)** 10, 9, 5, 5, 1, **(b)(i)** 2, **(ii)** 2.5, **(iii)** 2.6, **(c)(i)** 81 and 45

Question 2

The majority of candidates showed a good understanding of calculating average speeds and currency conversions. The answers given sometimes had no working so method marks could not be awarded when wrong answers were seen.

(a) (i) Generally the correct answer was given.

(ii) Many correct answers were seen. The common error was to fail to convert the number of minutes into hours. If this was the case and no working was seen e.g. 4.18 given as an answer without writing down 230/55, no marks could be awarded for the understanding that average speed comes from distance over time.

(b) (i) Most candidates gave the correct answer. The common error was to multiply rather than divide by the exchange rate.

(ii) The majority of candidates gave the correct answer. Other candidates' solutions would benefit from recognising that three significant figures are required.

(iii) Most candidates understood and carried out the correct calculations. Their answers would have been improved if they had recognised that the answer was asked for to the nearest whole number.

Answers: **(a)(i)** 18 30, **(ii)** 251, **(b)(i)** 1400, **(ii)** 20.7, **(iii)** 91

Question 3

Candidates showed a reasonable understanding of transformations and were able to draw reflections well. The work would be improved if the candidates understood how the centre of enlargement related to the position of an enlarged shape. Fewer candidates lost marks this year for giving the names of two transformations when only one was asked for.

(a) (i) Candidates understood that the transformation was a translation but were less able to identify the column vector defining the translation.

(ii) Again candidates were able to identify the type of transformation but some said the line was x=4 instead of y=4.

(iii) The majority of candidates recognised that the transformation was a rotation. The answers would be enhanced if the candidates recognised that a rotation is determined by a centre of rotation and an angle of rotation.

(b) (i) Many correct answers were seen. The common error was to reflect in a vertical line other than the y axis (normally x=-0.5).

(ii) Most candidates drew the correctly sized enlargement. Some candidates placed it in the wrong position on the grid.

Answers: **(a)(i)** translation, $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$, **(ii)** reflection, y=4, **(iii)** rotation, 180°, (2,2.5),

Question 4

This question required an understanding of trigonometry and bearings. Candidates showed a good understanding of Pythagoras' theorem and trigonometric functions. They were less able to work with bearings. Marks were lost for not showing all working.

(a) (i) Many candidates were able to apply Pythagoras' Theorem. The three common errors were to not take the square root, give the answer after taking the square root but to insufficient significant figures, and to just add the two numbers rather than use Pythagoras' Theorem.

(ii) Some correct answers were seen. However, a large number of candidates did not recognise that the required angle came from a calculation of the tangent.

(b)(i), (ii) and **(iii)** The parts on bearings were not well attempted. It required candidates to use the angle determined in the previous part. This was not fully understood by the majority of the candidates.

Answers: **(a)(i)** 214, **(ii)** 20.6, **(b)(i)** 44, **(ii)** 224, **(iii)** 335

Question 5

This question involved constructions. Although many good answers were seen, marks were lost for a number of reasons. Candidates can improve their performance by clearly showing all construction arcs. Marks were also lost because of excessive solid shading of their attempt at the required region. This obliterated some previous parts of the question.

(a) (i) Many candidates understood how a perpendicular bisector is drawn. The construction could be improved by taking greater care with the accuracy. It was also apparent that some candidates did not recognise that a straight edge rather than a ruler was permitted and so measured the middle point and used one set of arcs rather than using two sets of arcs.

(ii) Slightly fewer candidates constructed the bisector of the angle fully correctly. Again the work would be improved by taking greater care over the accuracy and showing all necessary construction arcs.

(b) Some candidates gave the correct locus of points. A large minority of candidates did not attempt this part of the question.

(c) Although some correct shading was seen, many candidates shaded the wrong area because they used the lengths of their lines from part **(a)** which were not of the correct length to obtain the region. Greater care in shading would enhance the overall solution of the question. Some candidates just shaded arbitrary areas and on some occasions shaded in the entire interior of the quadrilateral so densely that the solutions to the other parts of the question were obliterated.

Question 6

In general candidates understood the basic concepts required for this question. However, greater care in using formulae and recognising when to divide or multiply by a constant would improve the results.

(a) (i) Some candidates used the formula for the area of the trapezium correctly. However, greater care needs to be taken in which of the three given lengths goes in each part of the formula. Longer methods of obtaining the area were seen which usually involved two triangles and a rectangle but errors often occurred in the numbers used.

(ii) Few candidates recognised that the volume was obtained by multiplying the previous part by 20.

(b) (i) Candidates understood that the mass was obtained by multiplying the previous answer by 8.5 but a common error was to follow this by dividing by 100 instead of 1000.

(ii) Many candidates gave the correct answer. However, two common errors seen were to divide by the cost rather than multiply and not to give the answer to 2 decimal places as required in this part of the question.

Answers: **(a)(i)** 60, **(ii)** 1200, **(b)(i)** 10.2, **(ii)** 23.05

Question 7

Many candidates were able to find a formula and some complete solutions to the question were seen.

(a) Many correct answers were seen. The most common error was misunderstanding "less than" to mean "less" to give an answer of 9-2*d*.

(b) Candidates who obtained the correct formula in the previous part invariably obtained the correct answer here. Some candidates recognised that they had to put their formula equal to 7.8 but others thought they had to replace *d* by 7.8 in the formula.

(c) The majority of candidates understood how to find the amount of money left. However, a number of candidates did not provide an answer.

Answers: **(a)** 2*d*-9, **(b)** 8.4, **(c)** 0.6

Question 8

This question concerned using and re-arranging formulae. The majority of candidates were competent in evaluating a given formula when given the values for the "letters" in it. However, the work would be enhanced if all individual steps were shown when attempting to re-arrange the formula.

(a) Generally correct answers were given for this part.

(b) Candidates understood the concepts of re-arranging a formula but some did not carry out the correct algebraic operations, e.g. dividing rather than multiplying or subtracting rather than dividing.

(c) This part was not well attempted. Many candidates did not recognise that they needed to use the formula they had obtained in the previous part.

Answers: **(a)** 35.3, **(b)** $\sqrt{\frac{5A}{\pi}}$, **(c)** 2.76

Question 9

The majority of candidates showed that they could obtain values of points from equations, plot them and draw curves. The results would be enhanced if greater care was taken in drawing curves rather than straight lines or using curves that were excessively thick. Points of intersection were in general understood although reading the different scales on the two axes could be improved.

(a) (i) Nearly all candidates calculated the values of the points from the equation correctly.

(ii) Many candidates plotted their points correctly but some joined the points with straight lines rather than a curve.

(iii) Some candidates were able to identify that the intersection of the curve with the x axis was required but an equal number did not.

(b) (i) Most candidates calculated the values of the points from the equation correctly.

(ii) Many candidates plotted their points correctly but some joined the points with straight lines rather than a curve. Some candidates appeared to have decided that the intersections of the two curves would be at integer values of *x* and *y* so drew their second curve accordingly.

(c) Most candidates were able to identify the intersection of the curves but failed to recognise there were different scales on the *x* and *y* axes.

Answers: **(a)(i)** 8,3, **(iii)** intersection of their curve with the x axis, **(b)(i)** 3, 2, 1.5, **(c)** two intersections of their curves

Question 10

This question required the knowledge of regular octagons. Whilst many candidates showed a clear understanding of the necessary properties, a large minority did not show the required understanding. Also, it would improve the answers if candidates were clear that when asked to show something, they cannot use the answer, show something else, or provide a circular answer.

(a) Some candidates used the relevant properties of an octagon to show the value of the angle. A large number of candidates, however, used the given value to obtain one of the relevant properties.

(b) (i) A small majority of candidates stated the angle correctly.

(ii) Many candidates correctly stated this angle.

(c) (i) Although many correct answers were seen, a majority of candidates understood the required formula for finding the area of a triangle but thought they had to use Pythagoras to find the hypotenuse and use this in the formula.

(ii) Some correct answers were seen. A large number of candidates omitted this part. Whilst many of the candidates who attempted this part understood that they were required to find the area of the square and subtract 4 times the answer to the previous part, many made mistakes in finding the necessary lengths. A common error was to find the side of the square as 12+8.485 rather than 12+2x8.485.

Answers: **(b)(i)** 45, **(ii)** 90, **(c)(i)** 36, **(ii)** 695

Question 11

Candidates had a good appreciation of sequences. They were able to identify the subsequent terms when given the rule and the first few terms. Some candidates were not able to extend this to situations in which the given values were not the first few terms. Candidates can improve by understanding better what is required for an n^{th} term.

(a) (i) This part was generally correct.

(ii) Candidates were able to obtain the correct answers for the first three sequences but had greater difficulty when the missing terms were not consecutive.

(b) Most candidates were able to obtain the next term in each of the three sequences but many were unable to find the n^{th} term.

Answers: **(a)(i)** 5+8, **(ii)** 12, 19; 10, 17; 7, 9; 3, 6: 4, 5; 3,2, **(b)(i)** 11, 2*n*-1, **(ii)** 36, n^2, **(iii)** 1/6, 1/*n*

MATHEMATICS

Paper 0581/41
Paper 41 (Extended)

General comments

The general standard and presentation of the work continues to improve.

Candidates appeared to have sufficient time to complete the paper. Omissions were due to lack of familiarity and difficulty with topics rather than shortness of time.

Many candidates would greatly benefit from taking note of the number of marks allocated to each question as an indication of the amount of work needed for a question.

Writing down the correct calculation to be performed on the calculator usually earned all method marks and many candidates did not do this. Marks were also lost by candidates who worked with only one or two significant figures.

Questions involving general arithmetic, trigonometry and drawing of graphs were very well answered. The questions involving descriptions of operations, functions, matrices and similar volumes proved to be more challenging

Comments on specific questions

Question 1

This question was usually well answered.

(a) (i) The majority of candidates worked out the number of child tickets correctly. A few misinterpreted the ratio and obtained 1666 as the answer. A few worked out the number of child and the number of adult tickets but did not identify which was which.

(ii) Many candidates were rigorous in showing a complete, clear justification that the total sales were $11392. Some candidates omitted to show either the working 1088 × 2 and 2048 × 4.50 or the correct evaluations of 2176 and 9216.

(b) Most candidates were well prepared in calculating the correct percentage increase to an appropriate 3 significant figure accuracy. Some candidates showed an increase of 12% but fortunately this was often accompanied by 112% or 11.9% in the working so some or all the marks could be awarded. A common error of using 12748 as the denominator was seen.

(c) The more able candidates dealt competently with this question. Others found 28% of $11392 and subtracted this from $11392. Candidates who start by writing

$11392 \longrightarrow 128$

$x \longrightarrow 100$

are advised to follow this by the calculation to be evaluated as this 2 by 2 array does not earn full method marks.

Answers: **(a)(i)** 1088; **(b)** 11.9; **(c)** 8900.

Question 2

At least one drawing was often correct as candidates realised that the vertices of the images should be at points of the grid lines but descriptions of transformations were rarely complete or correct.

(a) (i) The correct reflection occurred as often as the reflection in the *y*-axis.

(ii) The rotation was usually correct. The common error was to rotate clockwise.

(iii) Some candidates confused the lines $y = x$ and $y = -x$ when describing their reflection. A number of candidates did not recognise their reflection and gave a rotation as the solution.

(b) (i) The more able candidates achieved success in this question. The common error was to evaluate the determinant of the matrix as – 1.

(ii) Of those who knew that the inverse matrix represents the inverse operation, many lost a mark by omitting the centre of the rotation.

Answers: **(a)(iii)** reflection in $y = x$; **(b)(i)** $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$, **(ii)** rotation of 90° clockwise about the origin.

Question 3

The first part of this question challenged all but the very best candidates. Many candidates drew excellent graphs.

(a) This part discriminated between the high attaining candidates as only the most able could deduce from the information that the length of the enclosure was $72 - 2x$ and thus progress to show that $x(72 - 2x)$ gave the correct expression for the area.

(b) Most candidates factorised the expression completely. Some partial factorisation of $2(36x - x^2)$ or $x(72 - 2x)$ were seen. A few candidates spoiled the correct factors by proceeding to $2x(6 + x)(6 - x)$.

(c) This part was extremely well answered.

(d) Points were usually plotted accurately and most drew freehand curves of an acceptable quality through their points. Some marks were lost by candidates who did not join (0, 0) or ruled a section.

(e) (i) Values of *x* were read accurately from the graphs and were usually in the required range. Occasionally candidates found the value 8 and then assumed that the other required value must be – 8.

(ii) The most common answer here was 640 as candidates did not realise that to make the curve symmetrical, since it was a parabola, they should have drawn their curve above 640 for a value of *x* between 15 and 20.

(f) Most candidates correctly recognised the required solution was from 500 ÷ 12. The most common answer was 42 as candidates did not realise that the practical context meant that there would not be enough pasture for all the animals if they rounded up their calculator display to the next integer.

Answers: **(b)** $2x(36 - x)$; **(c)** 630, 640, 70; **(e)(i)** 7.5 to 8.5 and 27.5 to 28.5, **(ii)** 641 to 660; **(f)** 41.

Question 4

This question challenged most candidates. Many confused formulae for surface area and volume and few correctly converted from cubic metres to litres. When asked to show that a value rounds to 33 m^3, candidates needed to show the more accurate value of 32.97… from their calculator as part of their verification in order to gain full marks.

(a) Most candidates were successful in finding the value of *l*. Many who used a formula for the curved surface area of the cylinder omitted the 2 from $2\pi rh$. The addition of the area of 1, 2 or 3 circles was a very common misunderstanding of an open tank. The formula $2\pi r(r + h)$ was often used for the cylinder and this indicates that candidates did not think about this practical situation. They should be encouraged to learn that the curved surface area is $2\pi rh$ and then consider if any circles are required depending on whether the shape is hollow or solid.

(b) (i) This was well answered even though a significant number of candidates lost the final mark due to premature approximation of their calculator display. They should be encouraged to write down at least the first four significant figures from their display to ensure that the required accuracy is maintained.

(ii) Many candidates considered the cross-section to be a circle and consequently had 42 as the solution and some used the radius as 1.5 m. Of those who did use the correct method, many used premature approximation again to reach an answer outside the required range.

(c) (i) The most common answer was 3300 litres.

(ii) Full marks here were very rarely earned as correctly converting 18.33… minutes to the required solution was done by only the most able candidates. The decimal calculator display is not the same as a digital clock display and candidates should practice the correct conversions of time from their calculator at every opportunity.

Answers: **(a)** 49.5; **(b)(ii)** 84 to 84.1; **(c)(i)** 33000, **(ii)** 18 minutes 20 seconds.

Question 5

Many excellent frequency diagrams were seen. The drawing of histograms continues to be a problem for many candidates as they think it is the height of the block rather than the area that represents the frequency. Multiplication of probabilities has improved slightly but many candidates did not consider more than one possibility.

(a) The point (165, 115) was often ignored or plotted incorrectly by candidates of all abilities. Most candidates drew a correct diagram either ruled or curved through their points. A few candidates, after plotting the point (130, 0), did not then join their diagram to it. Some candidates superimposed their diagram with a bar chart which indicated that they were unsure as to which was required. There were fewer instances of plotting at mid-values than in previous years.

(b) Candidates who were well prepared in finding the median and quartiles usually scored full marks here. Other candidates did not correctly read the scales or did not fully understand where to look.

(c) (i) Almost all candidates gave the answer as a fraction. A significant number did not read the question carefully as they gave the probability that the height of the candidate was less than or equal to 170 cm. A few candidates gave an inaccurate answer as they used their graph instead of the table.

(ii) This proved to be an extremely challenging question. Many candidates gained a mark for multiplying their $\frac{55}{200}$ by $\frac{10}{199}$ but only a very small minority considered that there was another possibility and consequently needed to double this to give the complete solution.

(d) (i) This was often well answered. Some candidates gave only the final value of 20 perhaps because they deduced it from the diagram rather than using the cumulative frequency values from the table.

(ii) Many candidates who had the correct values in **(i)** completed the diagram as though all the blocks were of width 10. Others combined the first two blocks which should each have a width of 5 into a single block of height 4,5 or 6.

Answers: **(b)(i)** 161 to 162, **(ii)** 171 to 172, **(iii)** their **(b)(ii)** – 150; **(c) (i)** $\frac{55}{200}$,

(ii) $\frac{1100}{39800}$; **(d)(i)** 30, 35, 20;

Question 6

Candidates were well prepared in trigonometry but similarity applied to capacity or volumes continues to be very difficult for many.

(a) (i) Many correct solutions were seen. The common misconception was to assume that the difference between the corresponding sides was the same which resulted in the solution 19.5 – 5.5 = 14.

(ii) Almost all candidates correctly applied Pythagoras and reached a correct answer. A few omitted to find the square root of 108.

(iii) Many correct solutions were seen. Some candidates confused sine with cosine and others found the angle at *A*.

(iv) This question discriminated between the high attaining candidates as only the most able had a correct solution. The most common working was 32 × 0.02. A few candidates treated the capacity as area and evaluated $32 \times (0.02)^2$.

(b) (i) There were many correct applications of the cosine rule. Some les able candidates omitted the 2 in the formula and others incorrectly combined the terms to $1444\cos 143^{\circ}$.

(ii) The more able candidates scored well here. The less able confused lengths with angles in the sine rule and some did not realise that they needed to calculate angle DEF first.

Answers: **(a)(i)** 13, **(ii)** 10.4, **(iii)** 57.8°, **(iv)** 655 to 655.4; **(b)(i)** 164, **(ii)** 101.

Question 7

All parts of this question proved to be extremely challenging for the large majority of candidates. Geometrical reasons in part **(a)** were either not attempted or given as calculations by all but the most able. Column vectors and vector paths are perceived as difficult by many candidates.

(a) Many correct numerical answers for all the angles were seen but sufficiently clear reasons were rare. Numerical reasons or stating which angles were equal without justifying this by an angle theorem was very common. Candidates who did attempt a circle theorem as the reason for *y* often had ‘same chord’ which is incorrect as those on the same chord but on opposite sides of it are supplementary since a cyclic quadrilateral is formed. Candidates should be encouraged to use ‘same arc’ or ‘same segment’. Some candidates assumed that the lines *AC* and *DB* were perpendicular.

(b) (i) A 2×2 matrix as the answer was common here, with all arrangements of the coordinates of *A* and *B* being placed in it.

(ii) Many candidates did not attempt this or again gave a 2×2 matrix. Some candidates multiplied the coordinates of *B* and *C* to give $\begin{pmatrix} 0 \\ 28 \end{pmatrix}$ as the answer. Candidates who made better attempts had the signs reversed to give $\begin{pmatrix} 2 \\ -4 \end{pmatrix}$. The successful candidates often sketched the position of C on a diagram.

(iii) Those candidates who had some understanding of vector paths were often inconsistent with their recognition of directions by confusing $\overrightarrow{RT}$ with $\overrightarrow{TR}$ or misinterpreted a ratio.

(iv) The candidates who answered this part often did not appreciate that a line segment is not the same as a vector. References to similar triangles were common and few stated that the lines were parallel.

Answers: **(a)** 59° isosceles triangle, 31° angle in a semicircle, 62° angles in same segment, 28° angles in a triangle; **(b)(i)** $\begin{pmatrix}2\\3\end{pmatrix}$, **(ii)** $\begin{pmatrix}-2\\4\end{pmatrix}$; **(c)(i)** $\frac{1}{3}$**t**, **(ii)** $\frac{1}{3}$(–**t** +**r**), **(iii)** $\frac{1}{3}$**r**, **(iv)** *QP* is parallel to *OR*, $QP = \frac{1}{3}OR$.

Question 8

Many candidates found parts of this question very challenging as they did not fully understand composite function notation or inverse variation.

(a) (i) This was usually answered correctly.

(ii) This was usually answered correctly but – 4 was the common incorrect answer.

(iii) Many candidates correctly interpreted the notation to reach 2(2*x* – 1) – 1 but then some made errors in simplifying.

(iv) The more able candidates were successful here. Some candidates confused the inverse of the function with the negative power to obtain $\frac{1}{2x-1}$.

(iii) Those who understood the notation usually reached $(2x - 1)^2$ but only the very best proceeded by the shorter route of 2*x* – 1 = ± 2 to the answers. Many attempts to multiply 2*x* – 1 by 2*x* – 1 gave rise to sign errors and omission of terms. When candidates did obtain the correct quadratic equation they attempted, often incorrectly, to use the formula rather than to factorise.

(b) (i) Candidates who understood the terminology were able to write down the variation relationship but then some were unable to proceed to the equation $y = \frac{k}{x}$. Others omitted to evaluate the value of *k*.

(ii) This was usually correct after the correct equation in part **(i)**. Some candidates evaluated *k* here.

Answers: **(a)(i)** 3, **(ii)** 4, **(iii)** 4*x* – 3, **(iv)** $\frac{x+1}{2}$, **(v)** $-\frac{1}{2}$ and $1\frac{1}{2}$; **(b)(i)** $y = \frac{16}{x}$, **(ii)** 32.

Question 9

Most candidates scored well in the early parts of each sequence but found great difficulty with the later parts. Candidates should give full working when asked to show that something is true. The parts of this question discriminated well between the high attaining candidates.

(a) (i) This was mostly correct with a few who rewrote all the terms but demonstrated the next term was 21.

(ii) Nearly all candidates understood that it was necessary to substitute the value 6 into the formula but some did not evaluate any part of this to show this gave 21.

(iii) This was usually answered correctly.

(iv) and (v) The use of dots to indicate a continued sequence was misinterpreted by some candidates. In part **(iv)** many substituted their value of 1275 from part **(iii)** into the gap and then added to give

1470 and similarly in part **(v)** they substituted 1275 and calculated 1+2+3+4+5+1275+150 to give 1440.

(vi) Some candidates recognised the need to subtract their answers above. If this gave a negative value it was ignored by some rather than being an indication that they had done something wrong.

(b) (i) This part was usually well answered. The error seen was the omission of one of the terms 6×1 or 5×2.

(ii) Candidates again recognised the need to substitute 6 in the formula but again many did not show any further working to demonstrate that this led to 56.

(iii) Many correct answers were seen but some candidates replaced the dots with the continued sequence and did not evaluate the sum of the terms.

(c) This part was very well answered.

(d) This question allowed the most able candidates to excel as rigorous algebra skills were needed to obtain a fully correct justification. Good candidates replaced n by $n - 1$ to obtain S_{n-1} but only the very best used the common factor of $\frac{1}{6}n(n + 1)$ to give the most efficient proof. Sign errors or slips with one or more terms were very common and led to long and incorrect attempts.

Answers: **(a)(i)** 21, **(iii)** 1275, **(iv)** 3825, **(v)** 11325, **(vi)** 7500; **(b)(i)** 56, **(iii)** 1540;

MATHEMATICS

Paper 0581/42
Paper 42 (Extended)

General comments

Overall this paper proved to be accessible to the majority of candidates. Most candidates were able to at least attempt all questions and writing solutions on the question paper usually resulted in well-structured answers with clear methods shown. The questions/parts of questions on arithmetic (percentages, ratio etc.), interpreting cumulative frequency graphs and calculating an estimate of the mean, general trigonometry and drawing graphs of functions were very well attempted. The parts of questions involving functions, matrix transformations, similarity and volume, time calculations, solving equations from graphs and parts of the sequence investigation proved to be the more challenging areas.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least three significant figure accuracy unless specified was noted by most candidates with only a few approximating answers early mainly on the part of **Question 5** involving the use of the quadratic formula which then led to a slightly inaccurate final answer.

A final point to repeat is the use of the number of marks allocated for a question is a good guide as to how much work is required for that question, which many candidates had noted.

Comments on specific questions

Question 1

This question was well answered on the whole by the majority of candidates.

(a) Many candidates worked out the cost of Megan's holiday correctly. A number misunderstood the ratio and used \$756 as the total amount and so divided by 11 before multiplying by 4 to give an incorrect answer of \$274.90.

(b) (i) This was very well answered and the only common error was to misread the requirement and give the answer as 15% of \$7800 = \$1170 instead of the total earnings after a 15% rise.

(ii) This proved to be the most challenging part for candidates. Most chose to work with the value \$7800 and increase this by 10% and then 15% before finding the percentage increase. While many obtained the value \$9867, a common error was to then use this as the denominator of the fraction rather than the original amount \$7800. It was anticipated that more able candidates may use the multiplier method here e.g. $1.10 \times 1.15 = 1.265$ so a 26.5% increase, but virtually all worked with the amounts in dollars.

(c) Many candidates were well prepared for this part, recognising the reverse percentage method required to find the original amount before the increase. Some misinterpreted the question and found 20% or 80% of \$9720.

(d) In the final part, many were well prepared for compound interest and showed a clear concise method of using the multiplier 1.04 to the power of 3 to give the correct answer. Fewer this year did a staged calculation which can result in rounding errors. Some misinterpreted and did a simple interest calculation and others obtained the final amount and then went on to either give the interest only of \$62.43 or add on \$500 to the final amount to give \$1062.43.

Answers: **(a)** 432; **(b)(i)** 8970, **(ii)** 26.5; **(c)** 8100; **(d)** 562.43.

Question 2

This question proved challenging to some, particularly in understanding the composite function notation and the order of substitution.

(a) Both parts were well answered. The second part produced more errors however with a few being unable to square –4 correctly and arriving at an answer of –10 from 6 + – 16.

(b) This produced a range of responses with many arriving at the correct answer and showing a clear staged method. A number gave answers such as $\frac{y+1}{4}$ and did not interchange the variable *y* for *x* as part of the method. A few made an error in subtracting 1 from *x* instead of adding 1.

(c) This was well answered by many who showed a clear substitution of $4x - 1$ into $6 + x^2$ before expanding and simplifying correctly. A few were unable to expand $(4x - 1)^2$ correctly as part of the method, sometimes giving $16x^2 + 1$ or making a sign error in the products. A common misconception was to do gf(*x*) however.

(d) This proved to be challenging for many, with a common error to try to substitute the value 3 into the function gg(*x*) arriving at an incorrect answer of 43. The more successful candidates showed a full algebraic substitution of $4(4x - 1) - 1 = 3$ before solving the equation correctly.

Answers: **(a) (i)** 11, **(ii)** 22; **(b)** $\frac{x+1}{4}$; **(c)** $16x^2 - 8x + 7$; **(d)** 0.5.

Question 3

This question was generally well answered on the whole.

(a) (i) The majority of candidates understood the term ‘median’ and were able to take an accurate reading from the graph. A few gave incorrect answers of 50.

(ii) The lower quartile was also answered well. A few candidates gave answers of 25.

(iii) The interquartile range was also well answered but less so than the first two parts. Understanding the term ‘interquartile range’ was a challenge for a few candidates.

(b) This was very well answered with almost all candidates understanding how to take the reading at 60 kg and then knowing to subtract it from 80. A few misread the vertical scale as 27 rather than 34 and some gave an answer of 34 thus giving the number of boys with a mass of 60 kg or less.

(c) (i) Many candidates were successful here but some misunderstood the notation used in the table, which indicated that the frequency of a 10-mark interval was required, and gave answers such as 20 and 70 which were the cumulative frequencies. A few appeared to misread the vertical scale when taking the readings.

(ii) This part was very well answered by the majority of candidates who were well prepared for an estimated mean question and showed clear use of the products of the frequencies with the mid-interval values and then division by the sum of the frequencies. Some used the strategy of showing their working as an extra column to the existing table.

Some common misunderstandings were using the upper or lower class boundaries instead of the mid-interval value for the calculation. Others found $\sum fx$ correctly but then divided by 6 which was the number of intervals instead of the total frequency.

Answers: **(a)(i)** 63 to 63.5, **(ii)** 50 to 50.5, **(iii)** 21.5 to 22.5; **(b)** 46; **(c)(i)** 12, 14, **(ii)** 61.5.

Question 4

This question was answered quite well in parts with many candidates demonstrating good use of the formulae for the cone and the cylinder.

(a) (i) This part was well answered. The majority of candidates showed a correct substitution into the cone volume formula before evaluating correctly. Some showed 3.14 in the working when the rubric requires 3.142 or the π value from the calculator to be used. A few, having obtained the correct answer, went on to spoil this by multiplying by 2.3 g to find the weight.

(ii) Almost all were successful in multiplying their volume from part **(i)** by 2.3 g. A few chose to divide by 2.3 g.

(iii) This part proved more challenging. Most candidates realised that the 50 kg weight should be divided by the weight of the soil in the cone. Some were unable to convert the weights to the same unit before division however and 50 kg = 5000 g was a common error. Those that did convert correctly often gave the answer 100 and did not interpret the question which asked how many cones could be filled *completely*.

(b) There were some excellent answers using the volume scale factor of $\left(\frac{32.5}{13}\right)^3$ to multiply the volume of the cone in part **(a)(i)** by. A few others were able to enlarge the radius of 4 by the linear scale factor to get 10 cm and then use this correctly within the volume of a cone formula to obtain the correct answer.

The majority of candidates misunderstood the use of the word similar however and used the volume of a cone formula with the false assumption that the radius was 4 cm with the given height 32.5 cm to obtain an incorrect answer.

(c) There were some excellent answers beginning with a statement $\pi r^2 h = 550$ and then proceeding correctly to find r. Some did not give answers to at least three significant figures here with 3.8 cm often seen.

Others made a correct start but then left out the final square root stage needed to obtain r.

A number of candidates were unsure of the volume formula for a cylinder and began with incorrect formulae such as $\frac{1}{3}\pi r^2 h$ or $2\pi r^2 h$ or even a surface area formula for example.

Answers: **(a)(i)** 218, **(ii)** 501, **(iii)** 99; **(b)** 3400 or 3410; **(c)** 3.82.

Question 5

(a) (i) Many candidates recognised the use of Pythagoras' theorem here in setting up an algebraic equation in x involving the 3 sides before attempting to simplify. Many were able to show correct working involving expanding the brackets $(x + 7)^2$ correctly before collecting the terms on one side of the equation and finally showing division by 2. A few made errors with the brackets or omitted a term such as '= 0' within one of the steps.

Some did not recognise the use of Pythagoras' theorem and attempted either an area or perimeter calculation.

(ii) Many candidates successfully factorised the given equation. Some made sign errors such as $(x - 15)(x + 8)$ for example. For some, there appeared to be unfamiliarity with the term 'factorise' and the recognition that a three term quadratic expression could be factorised to two brackets. A common misconception was to give an answer of $x(x + 7) - 120$.

(iii) Many candidates were successful here either from their solutions to part **(ii)** or for a few, a restart to the question without considering part **(ii)**.

(iv) Those that were successful with part **(iii)** almost always selected the positive root and then added 7 to obtain the correct length here.

(b) (i) Most recognised the areas approach to begin with and were able to set up a correct equation involving the area of the rectangle and the square. The brackets were usually expanded correctly and correct collection of terms to one side of the equation was seen regularly. Some made errors with the collection of terms, a sign error with one of the terms or an omission similar to part **(a)(i)**. A few attempted to set up an equation involving the ratio of sides. Perhaps this was misunderstood as a similarity problem.

(ii) The use of the quadratic formula was recognised by many in this part. Most were able to recall the formula correctly and a few chose to use the completing the square method. Some were very clear in their working ensuring all signs were shown carefully and the full division line in the fraction was shown. This was not the general case however and candidates should note that care needs to be taken with the substitution of the correct coefficients including the correct signs and the division needs to be clearly shown as a numerator all over a denominator.

Many candidates were able to obtain the solution but fewer of them rounded correctly to 2 decimal places as required and answers of 8.05 and –0.55 were common errors.

(iii) Many chose their positive root and were able to use this to find the perimeter correctly. Some left the answer in the general form $8x + 12$ however.

Answers: **(a)(ii)** $(x + 15)(x – 8)$, **(iii)** –15, 8, **(iv)** 15; **(b)(ii)** –0.56, 8.06, **(iii)** 76.5.

Question 6

This question was well answered in parts by many candidates.

(a) (i) The majority of candidates recognised the use of the cosine rule.

Some stated the explicit version of the formula for finding sides immediately while others gave the angle version of the cosine rule. This version does present difficulties for candidates in that they then have to rearrange the terms correctly to find the required side.

Although most were able to earn the method marks, fewer were able to earn both of the accuracy marks for the question as they went straight to the answer 8710 km without giving a more accurate value e.g. 8709.5... This was required as candidates were asked to justify the answer given to the nearest kilometre.

(ii) This part was answered particularly well with the clear use of the sine rule which was then correctly rearranged to find the required angle. Accuracy was very good here.

Some chose to use the cosine rule again with the value 8710 km that was given in part **(a)(i)** and most were successful using this approach. A few candidates found the incorrect angle *LCD*.

(b) Candidates found this time calculation difficult, both in terms of adding the 13 hours 45 minutes to the starting time 01 50 and then taking the time difference in to consideration, but also in recording the answer as a specific time and not a time interval. The more common errors involved errors with the addition of both hours and minutes and also giving answers such as 22 hours 35 minutes or 10 hours 35 minutes or subtracting the 7 hour time difference instead of adding.

(c) Candidates also found this part challenging. Most recognised that dividing the distance by the speed would give the time for the flight. Many calculated a time of 10.88… hours but then incorrect conversions of this time to hours and minutes were common and 11 hours 28 minutes was frequently seen. Some recognised that the time for the other flight was 13 hours 45 minutes but many used their answer to part **(b)** as the time duration for the first flight e.g. 22 hours 35 minutes.

There were some excellent answers that worked entirely in hours as decimals until the final stage.

Answers: **(a)(ii)** 5.6; **(b)** 22 35; **(c)** 2 h 52 mins.

Question 7

The graphs question was well received by many in terms of the calculation of the points and the plotting of the points. Analysing the graph and solving the related equations proved more challenging.

(a) This was well answered with the only common errors being –1 or –3.75 for the first two values, coming from errors in processing the negative values of x in the table.

(b) Candidates were able to interpret the scales of the graph well and generally plotted accurate points. The more difficult points to plot proved to be (–0.2, –10.0), (0.2, 10), (0.5, 3.75) and (1, 1) which was often placed at (1, 0).

Candidates were able to join their plotted points with a smooth curve generally and most did not join the two sections of the curve together, recognising that the function had no value for $x = 0$.

(c) (i) This was usually correct but omitted by a few candidates. Some attempted to find f(2), rather than solve $f(x) = 2$.

(ii) There were mixed responses to this part. A number of candidates recognised that a horizontal line below $x = -3$ was needed and gave an appropriate k value. Others appeared to guess or omit this part.

(d) This part proved challenging and many candidates were unable to interpret the algebra to realise that the line $y = 5x$ should be drawn to solve the equation. This line was omitted by a significant number of candidates who were unable to then give the correct intersections. Those that drew the line invariably scored all 3 marks.

(e) Most candidates who attempted to draw the tangent at x = –2 drew a good tangent and many found the correct gradient with a few misreading the scales. There were also some who drew the tangent at the wrong place or did not draw it at all.

Answers: **(a)** –3, –4.25, –3; **(c)(i)** 0.7 to 0.85, **(ii)** $k \leq -3$; **(d)** $y = 5x$ drawn and values –0.6 to –0.75, 0.55 to 0.65; **(e)** tangent drawn at $x = -2$ and gradient in the range 2.7 to 4.3.

Question 8

The early parts of this question were well answered. The enlargement and the work with matrices discriminated achievement.

(a) (i) The translation was usually drawn correctly. A few confused the horizontal and vertical components of the column vector in the translation.

(ii) The reflection was done well with only a few either reflecting in $y = 3$ or being one square out from the correct reflection.

(iii) The rotation was done reasonably well but a little weaker than the first two transformations. Some rotated 90° clockwise or even 180°, and a few attempted the correct rotation but were unable to place the three vertices accurately.

(iv) There were only a few correctly drawn enlargements of scale factor –4. Many candidates omitted this part. Some attempted an enlargement but with an incorrect scale factor of 4 or –3 for example.

(b) This part again proved challenging with only a few correct answers. The most common errors were to give answers of 4 or –4.

(c) (i) There were a number of candidates that drew the correct transformation often without any working shown. They appeared to recognise the matrix as a shear.

Only a few candidates used the matrix to calculate the coordinates of the image and so a number of incorrect answers were seen. It was quite common to see an attempt based on a reflection or on a translation.

(ii) Many candidates understood that the transformation was a shear. If the invariant line was given it was usually the *x*-axis although the *y*-axis was also seen. The scale factor was often given and it was nearly always correct. Common errors were to give the transformation as a reflection or enlargement usually following an incorrect part **(c)(i)**.

(iii) This part was well done by many candidates who knew how to find the inverse of a 2 x 2 matrix. A few wrote down the determinant as 1 x 1 – 3 x 0 = 1 – 3 = –2 but most gave it as 1 and then gave the correct matrix.

Answers: **(b)** 16; **(c)(ii)** shear, factor 3 with *x* - axis invariant, **(iii)** $\begin{pmatrix} 1 & -3 \\ 0 & 1 \end{pmatrix}$

Question 9

Virtually all candidates were able to score some marks on this question with the final parts being discriminatory.

(a) Many completed the tree diagram correctly. Errors were common with the second stage probabilities on the lower two branches where errors included getting the probabilities the wrong way around or giving $\frac{6}{10}$ instead of $\frac{7}{10}$ for the second stage lower red branch.

(b) (i) This part was very well answered and candidates showed clearly the products of the two fractions before giving the answer. A small number added the fractions.

(ii) Most candidates again did well selecting the two routes from the tree and correctly finding the two pairs of products before adding them. A few chose only one of the correct routes or chose a correct route and an incorrect route from the tree. A small number added the fractions again.

(c) (i) This was answered correctly by many candidates, even by those who had made earlier errors.

(ii) Some candidates spotted that there was one combination that was not required, i.e. green, green, green, and proceeded to find this probability and then subtract it from 1. Others attempted the longer method by trying to find the seven combinations giving at least one red and this often led to errors. A common misunderstanding was to find the probability of exactly one red sweet.

Answers: **(a)** $\frac{4}{11}, \frac{4}{10}, \frac{7}{10}, \frac{3}{10}$; **(b)(i)** $\frac{42}{110}$, **(ii)** $\frac{56}{110}$; **(c)(i)** $\frac{210}{990}$, **(ii)** $\frac{966}{990}$.

Question 10

Most candidates were able to understand the nature of the sequences in this question and scored some marks.

(a) This was very well answered generally. A few candidates made clear arithmetic mistakes with the addition giving answers such as 20 and 33. Some looked for patterns in the differences and gave answers such as 20, 29.

(b) This required candidates to work backwards and the inclusion of a negative value for one of the solutions may have been a distraction or cast doubts for candidates here. Many were successful however. Others were able to find the second term as 8 but often could not give the first term as –5. Common errors included answers of 1 and 2 or 5 and 8.

(c) (i) Many recognised that 4 and 6 fit the missing values without extensive working and in some cases with no working at all. Most did not resort to algebra here to solve the problem. Credit was given to those that attempted an algebraic approach, giving $2 + d = e$ and $d + e = 10$ before attempting to combine the two equations.

(ii) This proved to be the most challenging part of the question. The more successful candidates either used a clear algebraic approach, forming three equations with the variables x, y and z, before attempting to combine them into simultaneous equations in two unknowns or used systematic trial and improvement, often in a table.

There were many that did not attempt either strategy but were given some credit for giving three values that fitted part of the pattern required.

There were a number of candidates who thought the numbers were in an arithmetic sequence and answers such as –20.25, –7.5 and 5.25 (based on a common difference of 12.75) were seen occasionally.

Answers: **(a)** 21 34; **(b)** –5 8; **(c)(i)** 4 6, **(ii)** 28, – 5, 23.

MATHEMATICS

Paper 0581/43
Paper 43 (Extended)

General comments

Overall this paper proved to be accessible to the majority of candidates. Most candidates were able to attempt all questions and writing solutions on the question paper usually resulted in well-structured answers with clear methods shown.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. Presentation was good, neat and legible and candidates generally followed the rubric instructions.

Candidates should think carefully before deleting any work when they appear to reach unsatisfactory answers as many marks can be earned for correct methods even when an arithmetic error occurs.

A final point to repeat is the use of the number of marks allocated for a question is a good guide as to how much work is required for that question.

Comments on specific questions

Question 1

(a) This part was very well answered. Very few candidates did not score both marks.

(b) This part was also very well answered by all those who read the question carefully. A few candidates worked with \$21 instead of the remainder of the \$60 after the book was purchased.

(c) The essential idea here was to realise that \$36.80 is 80% of the original price. Many candidates were well prepared for this and used the reverse percentage approach to solve the problem correctly. Others worked with 20% of \$36.80 and scored no marks.

(d) Candidates who took an algebraic approach scored two marks immediately for variations of $2p + 5(p + 12) = 64.2$, before attempting to solve their equation. Many candidates attempted an arithmetic approach. Some divided 4.2 by 2 at the final stage, instead of 7.

Answers: **(b)** 65; **(c)** 46; **(c)** 0.60.

Question 2

In parts **(a)** and **(b)**, candidates were given the answers so that in part **(c)** they would be using correct and sensible values. It is extremely important that candidates understand that if a question asks them to show that an angle rounds to 110.7°, then giving an answer of 110.7° alone will not score full marks. We believe that many good candidates used the correct method and correct calculator technique to get 110.74… on their calculator display but then only wrote down 110.7 on the paper. It is essential that candidates show and write greater accuracy than the answer they were asked to verify in these cases.

(a) This called for the use of the cosine rule and those who recognised this usually went on to use it correctly to obtain 110.74… or made the error outlined above and did not give sufficient accuracy.

(b) The best method was to use the sine rule here. Many recognised this and were able to apply it correctly. Those that wrote the answer 4.516…. instead of 4.52 only, scored full marks.

(c) The most successful candidates used the formula, $A = \frac{1}{2}ab\sin C$ and were able to apply it correctly to the triangles. Some candidates dropped various perpendicular lines and used extensive trigonometric calculations with $A = \frac{1}{2} b \times h$. A small minority assumed that *RQPS* was a trapezium or even an isosceles trapezium. If the two lengths *RQ* and *SP* were parallel the question would have stated this and shown it on the diagram. There were a few candidates who omitted the question completely.

Answers: **(c)** 21.4

Question 3

(a) Most candidates could expand $x(x + 3)$ but a number had difficulty in either expanding the bracket $4x(x – 1)$ or with the collection of like terms after both brackets had been expanded.

(b) The correct answer of $27x^9$ saw many variations on 27 and x^9. The simple approach of writing $3x^3 \times 3x^3 \times 3x^3$ would have helped many.

(c) (i) The majority of candidates did well on this part and scored both marks.

(ii) Many candidates achieved the partial form $x (y + w) + 2a (y + w)$ without completing the full factorisation and were given partial credit.

(iii) The majority of candidates recognised the difference of two squares and were successful. Some candidates did not recognise the pattern or recognise the form given.

(d) This part was generally answered well. A small minority quoted the incorrect formula and a similar number quoted the correct formula but were unable to apply it correctly. Some correctly substituted the values but then made errors such as using a short division line, or did not evaluate the numerator before dividing by 4. Many did everything correctly as far as the values –2.280… and –0.219… but then did not round correctly to two decimal places as requested in the question.

Answers: **(a)** $5x^2 – x$; **(b)** $27x^9$; **(c)(i)** $7x^7 (1 + 2x^7)$, **(ii)** $(y + w) (x + 2a)$, **(iii)** $(2x + 7)(2x – 7)$;
(d) – 2.28 and –0.22.

Question 4

A number of candidates were well prepared for the use of matrices and scored full marks. Many appeared unfamiliar with them and did not score at all or scored partial credit.

(a) (i) Those that did not score both marks usually made the error of trying to give the result as a 2 by 2 matrix.

(ii) There were several common errors made here such as giving the matrix $\begin{pmatrix} 2 \\ 14 \end{pmatrix}$ or the value 16 not in matrix form. Some candidates appeared to think that a 1 by 1 matrix for the answer was not an acceptable form.

(iii) Many candidates recognised the method needed to find the inverse of a 2 by 2 matrix and were successful. There were some common errors made however. A number either made errors in finding the determinant or omitted it completely and occasionally the operations on the four elements of the matrix were confused.

(b) The matrix was only occasionally recognised as a reflection and the majority did not appear to use a method for finding its effect e.g. $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} x \\ -y \end{pmatrix}$ or equivalent was seldom seen.

(c) Some candidates were successful but many attempted this showing no method. A common incorrect answer was $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$.

Answers: **(a)(i)** $\begin{pmatrix} 25 \\ 43 \end{pmatrix}$, **(ii)** (16), **(iii)** $\begin{pmatrix} -2.5 & 1.5 \\ 2 & -1 \end{pmatrix}$; **(b)** Reflection in x – axis; **(c)** $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

Question 5

Many candidates made excellent carefully constructed drawings and identified the various areas required. A number showed expertise with all aspects of the question.

Some appeared to be unfamiliar with the term 'locus' and were unable to make any progress with the question.

Many scored marks for either recognising where the garden was or for partially drawing one of the required loci without constructing them accurately.

Many more recognised the locus of points equidistant from two fixed points than the second standard locus of points equidistant from two fixed lines.

Many drew the perpendicular bisector of *DC* but not the bisector of angle *A*, and without the latter, they were unable to access some of the later marks for the shop or the car park.

Candidates should note that if ruler and compasses are specified then they must draw construction arcs that can be seen and they should not try to erase them.

Question 6

(a) (i) This part was very well answered. Almost all candidates recognised that the calculation $\frac{3}{5} \times 55$ was required.

(ii) Many recognised that $\left(\frac{3}{5}\right)^5$ was the correct method and were able to correctly evaluate this. Some appeared hesitant when evaluating this fraction to the power of 5 however. Common errors included $\frac{3}{5} \times 5$, $\frac{3}{5}$ squared or cubed, $1 - \frac{3}{5}$ or $\frac{5}{55} \times \frac{3}{5}$.

(b) (i) The tree diagram was completed very well.

(ii) The majority of candidates correctly used the product rule with the probabilities from their tree diagram to find the correct answer.

(iii) Many calculated this correctly recognising that two routes were required from the tree diagram before using the product rule to find each route (or using their answer to **(b)(ii)**) and then adding the two resulting probabilities. Some having answered **(b)(ii)** correctly, appeared to restart and simply took the probabilities $\frac{1}{4}$ and $\frac{1}{8}$ from the tree diagram before adding or multiplying them for an incorrect answer.

Answers: **(a)(i)** 33, **(ii)** $\frac{243}{3125}$; **(b)(i)** $\frac{2}{5}, \frac{3}{4}, \frac{1}{8}, \frac{7}{8}$, **(ii)** $\frac{1}{20}$, **(iii)** $\frac{1}{5}$.

Question 7

(a) This part was answered very well with both values in the table correctly evaluated.

(b) The plotting of the points was very good generally. A number of candidates made one error in plotting (–2, 0.2) at (–2, –0.2). There were many excellent curves and candidates have generally noted that ruled sections on the graph do not score the curve mark as this was seldom seen.

(c) This was answered very well with all three values correctly evaluated.

(d) Many drew excellent graphs in this part. Occasionally the point (3, 1.3) was incorrectly plotted usually at (3, 0.3). A few did not recognise the nature of the function and attempted to join both sections of the graph.

(e) (i) Most candidates recognised that the solution could be found by reading the intersections of the two graphs. A few, in attempting to do this, made errors such as misreading the scale or giving coordinate form answers which included the *y* components.

(ii) This part proved an effective discriminator for the higher attaining candidates. The most successful candidates removed both fractions first before collecting the terms to the left-hand side of the equation.

Answers: **(a)** – 5.4, 3.7; **(c)** – 2, – 4, 4; **(e)(i)** – 2.9 to –2.8 and 2.05 to 2.15, **(ii)** $a = 10$, $b = -40$.

Question 8

Many candidates were successful in this question and scored full marks. They showed clear methods in dealing with each part of the composite solid and recalled the required formulas for the cylinder accurately and were able to use the other given formulas well.

A common error was to find surface areas and volumes of spheres instead of hemispheres.

(a) (i) Most candidates could recall the correct formula for the volume of a cylinder and used it correctly. Many attempted to use the volume of sphere formula given in the question but then forgot to halve this volume for the hemisphere. There were some substitution errors where candidates had used $V = \frac{4}{3}\pi r^3$ as $V = \frac{4}{3}\pi 3^2$.

(ii) This part was very well answered and candidates usually scored full marks.

(iii) Many candidates were again successful here. Some did not read the question carefully enough and gave only the volume of the box.

(b) (i) Many good answers were seen with candidates showing clearly in working the surface areas of a hemisphere, a circle and the curved area of a cylinder before adding. For some, there was confusion as to how many circles were needed for the total surface area. Some added three circles – both ends of the cylinder and a face of the hemisphere, others added two circles – both ends of the cylinder. A few did not include any circles at all.

(ii) This part was well answered. Most candidates correctly divided their surface area by 8 and then multiplied by 0.09 correctly.

Answers: **(a)(i)** 396, **(ii)** 3.13, **(iii)** 144; **(b)(i)** 311, **(ii)** 3.50.

Question 9

(a) (i) This part was well answered generally. A few candidates did not recognise that in the vector $\begin{pmatrix} a \\ b \end{pmatrix}$, *a* represents the *x* – component and *b* represents the *y* – component and gave an answer of $\begin{pmatrix} 5 \\ 9 \end{pmatrix}$.

(ii) This part was also well answered. A common error was $\begin{pmatrix} 7 \\ 4 \end{pmatrix}$.

(iii) This mark was awarded for a correct vector i.e. $\overrightarrow{BA}$ or $-\overrightarrow{AB}$. Many candidates appeared unsure about what was being asked for.

(iv) Most candidates recognised the notation and used Pythagoras' correctly to find the magnitude of the vector. A few did not recognise the notation and made no further progress. A few did not consider their answer to **(a)(i)** at all and thought that angle *CBA* was 90° and then incorrectly attempted to use Pythagoras' in triangle *CBA*.

(b) (i) This part was nearly always correctly answered.

(ii) Some recognised that $\overrightarrow{BM} = \frac{1}{2}\overrightarrow{BC}$ but then were often unable to obtain a vector in terms of **t** and **u** for $\overrightarrow{BC}$. This part proved accessible to the more able candidates with a good knowledge of vectors.

(iii) A follow through was allowed for simplifying 2**u** plus their expression for part **(b)(ii)** or alternatively for **t** + **u** minus their expression for part **(b)(ii)**. A number of candidates were successful with one of these approaches.

Answers: **(a)(i)** $\begin{pmatrix} 9 \\ 5 \end{pmatrix}$, **(ii)** $\begin{pmatrix} 4 \\ 7 \end{pmatrix}$, **(iii)** $\overrightarrow{BA}$, **(iv)** 10.3; **(b)(i)** 2**u**, **(ii)** 1/2 (**t** – **u**), **(iii)** 3/2**u** + 1/2**t**.

Question 10

(a) An interesting problem that was well analysed by many candidates. Many formed at least one of the two possible sets of values. The idea that the set must contain 9 (for the median) rather than the middle two values must add to 18 caused the most errors.

(b) (i) This part was very well answered by the majority of candidates who were well prepared for an estimated mean question and showed clear use of the products of the frequencies with the mid-interval values and then division by the sum of the frequencies.

Some common misunderstandings were using the upper or lower class boundaries instead of the mid-interval value for the calculation. Others found $\sum fx$ correctly but then divided by 5 which was the number of intervals instead of the total frequency.

(ii) By using the second column as a guide on the histogram, nearly all candidates drew the third column correctly. Many knew that the area was proportional to the frequency and successfully completed the histogram. Those that had limited knowledge of histograms made the common error of using 4, 4 and 1.5 for the remaining three heights.

Answers: **(a)** 7 8 8 10 11 16 and 8 8 8 10 10 16; **(b)(i)** 94.7, **(ii)** fd's 4, 2 and 0.5.

Question 11

Candidates of all abilities were able to access this question and most scored well.

(a) Using differences, candidates recognised the three patterns and completed the table well.

(b) (i) Nearly all candidates were successful in substituting $n = 50$ into the expression for the n^{th} term and then evaluating correctly. A few needed to be more careful with the arithmetic e.g. $50 \times 51 = 2250$ was seen.

(ii) The correct answer was arrived at by various methods here. Many used a trial and improvement idea. Some attempted an algebraic approach, $n\ (n + 1) = 930$, but they were generally less successful in solving the equation successfully.

(c) This part proved more challenging for some. Many attempted trials often unsuccessfully. Those that recognised that the sequence was related to a quadratic function had more success and many correct variations of $(n + 1)\ (n + 2)$ were seen.

(d) (i) The relevant formula is $2n^2 + pn + 1 = T$, where T is the total number of lines. Those that used a substitution method for n and T from their table and solved the resulting equation for p were the most successful and the most convincing. Others who substituted for n, T and p to end up with e.g. $17 = 17$ were less convincing but if they indicated that one 17 came from the arithmetic and the other from the table then they scored both marks.

Those who substituted for p and T had to solve a quadratic equation in n and this needed some delicate algebra and was a rare method.

Some started with $2n^2 + pn + 1 = 0$ and made no progress.

(ii) Most candidates were successful in substituting 10 for n into the expression.

(iii) The most common method by far was to use a trial and improvement technique and nearly all using this method found the correct solution. There was a method mark for those attempting the algebraic approach and stating $2n^2 + 4n + 1 = 337$, but then solving this proved difficult.

(iv) Those attempting to find the relationship using the previous algebraic expressions, $n(n + 1)$, $(n + 1)(n + 2)$ and $2n^2 + 4n + 1$ had a difficult time especially where their answer to part **(c)** was incorrect. Many were more successful by studying the numbers in the table e.g. $7 = (6 + 2) – 1$, $17 = (12 + 6) – 1$ etc.

Answers: **(a)** 30 42; **(b)(i)** 2550, **(ii)** 30; **(c)** $(n + 1)\ (n + 2)$; **(d)(ii)** 241, **(iii)** 12; **(e)** $L = A + D – 1$
42 56
71 97

MATHEMATICS WITH COURSEWORK

Paper 0581/05

Paper 5 Coursework (Core)

General comments

Few Centres chose to submit coursework for this session and therefore the comments below are drawn from a relatively small sample of work.

Centres offered a variety of tasks to their candidates. This was clearly advantageous as the choice enabled candidates to pursue mathematical topics which they understood well. The best coursework was where the tasks were developed beyond the initial plan, the work was described clearly, and the results were analysed correctly. The candidates drew conclusions based on their results and considered the limitations of their work.

As in previous years the use of computers has aided candidates in the analysis of data, although some candidates still produce many handwritten pages of calculations using the same formula which could be completed much more quickly using a spreadsheet. The time saved would almost certainly allow these candidates the time to extend their work and draw more informed conclusions.

MATHEMATICS WITH COURSEWORK

Paper 0581/06

Coursework Paper 6 (Extended)

General comments

Few Centres chose to submit coursework for this session and therefore the comments below are drawn from a relatively small sample of work.

Centres offered a variety of tasks to their candidates. This was clearly advantageous as the choice enabled candidates to pursue mathematical topics which they understood well. The best coursework was where the tasks were developed beyond the initial plan, the work was described clearly, and the results were analysed correctly. The candidates drew conclusions based on their results and considered the limitations of their work.

As in previous years the use of computers has aided candidates in the analysis of data, although some candidates still produce many handwritten pages of calculations using the same formula which could be completed much more quickly using a spreadsheet. The time saved would almost certainly allow these candidates the time to extend their work and draw more informed conclusions.