MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

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

General comments

This paper proved accessible to many candidates. There were a number of questions that were standard processes and these questions proved to be well understood. Other questions were more challenging, for example finding when bus times coincide and the radius of a circle from the circumference. Most candidates showed some working with the most able candidates setting their working out clearly and neatly.

The questions that presented least difficulty were **Questions 3**, **7(a)**, **7(b)(i)**, **9** and **10**. Those that proved to be the most challenging were **Questions 1(c)** quadrilaterals, **12** rounding, **13(b)** lowest common multiple in context, **15** a volume conversion and **19** radius of a circle found from the circumference.

Comments on specific questions

Question 1

(a) The majority of candidates gave acute as their answer but there were some that gave obtuse. Other incorrect answers seen were right angle or reflex. A small number gave a numerical example of an angle less than 90°, for example, 40° rather than the name.

(b) The most common incorrect answer was hexagon or polygon or again a value, for example, 72°.

(c) This part of the question was found challenging. There was no diagram or list of names for the candidate to pick from. The majority of answers seen were names of quadrilaterals but other shapes such as triangle were also seen. Words such as perpendicular, isosceles or congruent were also given – these were from the list given in the following question.

Question 2

This question was not attempted by many candidates. Many other candidates identified two answers instead of one. The word ‘two’ did appear in the question, suggesting that some may not have read the question correctly.

Question 3

This was answered well by most candidates. Occasionally, candidates had not simplified far enough and so gave $\frac{12}{21}$ as their answer or gave a decimal, 0.571...

Question 4

The most common incorrect answers seen were –54 (implying an incorrect order of operations, i.e. $\sqrt{\frac{1}{0.01}} - 8^2$) and 36 (from omitting the square root).

Question 5

(a) This part was not answered as well as the next part. Candidates drew in horizontal lines, vertical lines or lines parallel with the sides, either instead of, or as well as, the correct diagonals. Sometimes only one diagonal was drawn showing the candidate did not fully understand what was required.

(b) Most candidates shaded two squares only as required, with the right-hand square being the one most likely to be correct. Some appeared to be producing a diagram with reflective symmetry rather than rotational.

Question 6

There were some excellent responses to this problem solving question that were fully correct and well presented. However some candidates were unable to start correctly. A number of candidates recognised that the simplest way to solve this problem was to first calculate 19 × 7 = 133. Many candidates could not proceed past this. The most common errors seen included the adding of the sides or multiplication of three or more of the sides. Many just divided the shape into two rectangles or offered no response to the question.

Question 7

(a) Nearly all candidates gave the correct answer of 10 10. There were a few who gave 10 00, 10 15 or 11 10.

(b) (i) Most candidates answered this part correctly. A very small number gave the time when Hua stopped for a rest rather than the distance from home.

(ii) The most frequent incorrect answer was 30 minutes from a misunderstanding of the scale – each square represented 10 minutes not 15.

(c) The correct answer was a horizontal line at 12 km from 11 10 to 11 20 then a diagonal line down to the axis at 11 50. Many candidates drew the diagonal line correctly but drew nothing to indicate her stay in the library. Some candidates had Hua incorrectly arriving home at 12 00, the last time on the axis, without any calculations to show how they decided this. There were a few candidates who had the return home at 10 30 or 10 50 depending on in which direction they drew the stay in the library – candidates should understand that times always move to the right but lines showing distance can go up and down. If a candidate did not gain any marks from completing the travel graph, there was a mark for showing that the journey home would take Hua 30 minutes; not many candidates showed this working and so were unable to benefit from this mark.

Question 8

This question was answered well, with many accurate drawings with the construction arcs visible. Some candidates did not appear to be able to set their compasses accurately. Nearly all managed the conversion as indicated by lines the correct length drawn if not by calculation.

Question 9

This question was answered well with many correct answers seen. Candidates who realised the need to divide 1190 by 7 almost invariably went on to arrive at the correct answer. Common incorrect answers came from dividing by 5 or 2. A few candidates gave Beth’s amount of money.

Question 10

Most candidates were successful in this question, with the majority of candidates showing good understanding. Most errors were either arithmetic slips or sign errors. A small number of candidates appeared to think this question involved fractions, evaluating $-\frac{2}{3}+-\frac{5}{1}$ in the first part usually leading to the answer $\left(-\frac{17}{3}\right)$, usually shown with a fraction line. Similar errors involving fraction calculations were made in the second part.

Question 11

This problem solving question required candidates to analyse what they are being asked, to recognise what information they have and to work out their method. There were some excellent answers seen using clear and efficient methods. Many candidates reached the stage of finding that the total cost for potatoes was \$6.30 but some did not know how to proceed from here – this gained a method mark for a partial method done correctly. Some candidates struggled to start the question with many working out only 2.8 × 2.65. Some picked the wrong figure to work with, for example 3.6 kg instead of 2.8 kg, when working out the cost of the leeks.

Question 12

This question proved challenging for the majority of candidates but a reasonable number of fully correct solutions were seen. A few candidates rounded 49.2 to 2 significant figures, (49), or to 5 or down to 40. Occasionally 4.085 became 5 instead of 4. Many candidates found the exact answer and attempted to round that, showing that they did not read the whole question before starting work. Some candidates had trailing zeros in their values corrected to 1 significant figure, which in this instance, was credited with a mark but using trailing zeros is not correct and must be discouraged.

Question 13

(a) This part was answered reasonably well by many candidates. There were others who listed the factors of 18 rather than 18 as a product of prime factors. Many candidates showed correct working to find the prime factors in a tree or ladder diagram which gained a mark when the answer was incorrect. Some candidates included a 1 in their product – this was not correct as 1 is not a prime number.

(b) The previous part was a lead-in to this question in context to encourage candidates to find the prime factorisation of 24 and so go on to find the LCM but this connection was often not seen. The LCM equated to the number of minutes after 10 47 when the two buses would next leave at the same time. There were other ways to approach this problem, such as listing the times of the two buses. Candidates made various errors, for example, arithmetic slips in listing the times or not noticing when 11 59 was in both lists and giving another time when the buses left together.

Question 14

There were some good answers to this fractions question seen. Many candidates showed clear working and all of the relevant steps required to evaluate the product. Most candidates who were able to convert the given values to vulgar fractions went on to multiply these correctly. A few candidates who got as far as $\frac{88}{12}$ and then cancelled down to $\frac{22}{3}$, stopped without giving the answer as a mixed number as asked for in the question – it is always important to check what form the answer should take. Some had difficulties with the multiplication by inverting a fraction or even adding the vulgar fractions. Candidates who attempted to evaluate the product by converting to decimals did not gain credit as did those candidates who gave the correct answer with no or incorrect working.

Question 15

This proved to be a challenging question for many candidates. Most answers included the figures 437, but not in the correct place values. Some candidates cubed 4.37 to give 83.45.

Question 16

The first step in this question was to successfully deal with the – 7 or the division by 5, giving $5x = 2y + 7$ or $x - \frac{7}{5} = \frac{2y}{5}$, with not many choosing this second approach. Candidates who completed the first step correctly usually went on to give a fully correct rearrangement. There were a considerable number who thought that $2y + 7$ was $9y$, spoiling otherwise good work. Many made sign errors in their first step so gave answers of $x = \frac{2y-7}{5}$.

Question 17

Many candidates knew the compound interest formula and often could write it correctly. Some incorrect versions of the formula were seen such as $16000 + \left(1 + \frac{5}{100}\right)^4$ or $\left(16000 + 1 \times \frac{5}{100}\right)^4$. Only a very small number attempted long methods, working out the value of the investment at the end of each year. The most common error was to round the answer. The full answer was exactly \$19 448.10 but there were many who gave \$19 448 or \$19 500. As the answer is an exact figure, then all the digits must be given. A few candidates gave the interest accrued. Some thought that the formula worked out the interest only so added on another \$16 000.

Question 18

(a) A large number of candidates did not plot any of the points. Many were not consistently accurate with their plotting or the use of the scale. Many candidates used a pencil that was too thick or a pen which could not erased if mistakes were made.

(b) The answer to questions asking what type of correlation is shown in a scatter diagram is only positive, negative or zero (or none). Some incorrectly gave positive but many other words or phrases were given, for example, decreasing, estimates, perpendicular, inverse, irregular, congested, good correlation or strong correlation.

(c) A ruled line of best fit was drawn reasonably well by many candidates. Occasionally, a line was too short (it should be long enough to cover the data points). Some candidates joined the top left of the grid to the bottom right – this was not an accurate enough line. Some drew a line with positive gradient or joined the points up with individual line segments.

(d) Many candidates gave an answer within the acceptable range.

Question 19

This was a challenging question for candidates. For those that attempted this question, the methods employed showed that it was not generally understood. Some guessed values and substituted them in the circumference formula to get as close to 56 mm as possible – mostly this meant that 8.9 cm was their answer for the radius. As this only has 2 figures, this did not gain the accuracy mark and the working was not acceptable for a method mark. Some started correctly, dividing 56 by 2π, but then went on to divide by 2 again or to square root. Some rounded after dividing by π before dividing that by 2 – this gave an inaccurate answer. Candidates must not round during a calculation. A few used the area formula or inaccurate values of π.

Question 20

This question was often left blank by candidates but conversely, there were some very good answers as well. Candidates who found the correct gradient often went on to give the correct equation. Those who recognised the need for a gradient generally used co-ordinates rather than triangles. Less able candidates often drew a triangle on the diagram (often not very accurately) or used values which were not co-ordinates on the line. Some candidates calculated the gradient by incorrectly using change in *x* over change in *y*. A frequent error was to give the answer, y = 1.5 + 3. Many were able to identify the constant as 3.

Question 21

(a) Most candidates realised the need to use trigonometry but not all were able to identify the correct trigonometric ratio to use. The errors that subsequently arose included being unable to rearrange $\tan\ x = \frac{10}{18}$ or using $\tan\ x = \frac{18}{10}$. Premature rounding was an issue, with a large number of candidates rounding their value of tan *x* to ether 0.5, 0.55, or 0.555, resulting in a significant degree of error in the final answer. Some candidates only gave their answer to the nearest degree and so did not gain full credit. There were a few long, indirect methods when candidates found the hypotenuse then used sin or cos or even stopped after finding the hypotenuse. These were rarely successful, as again, premature rounding did not give an accurate result for the angle. Candidates should analyse a problem to work out the most efficient method to use.

(b) This part was generally well attempted with many candidates correctly using Pythagoras' theorem and reaching the correct expression and answer. Incorrect responses included using tan again.

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

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

General comments

There were many good scripts seen with working set out clearly. Problem solving questions, for example **Questions 15, 19** and **20** required more careful reading, recognising what information they have and deciding on an appropriate method.

Candidates must consider if their answer is sensible for the context, for example, would the number of sweets a person had be anything other than a whole number or more than the total number of sweets? Where questions have diagrams, particularly for finding angles, candidates are more likely to find correct answers if they show working on the diagrams.

Comments on specific questions

Question 1

While this question was well answered, a common error was for the incorrect number of zeros to be written, usually two of them. Some mistook 17 for 70 and others started with 217.

Question 2

A common error was to write the figures 87 but with the place value incorrect by missing the zero. Even though the number was beyond half-way through the 60's some candidates rounded down to 860. Others took the value to the nearest 100 instead of 10.

Question 3

Rotational symmetry seems to be a challenging concept for a significant number of candidates. With a drawing and statement that the shape was an octagon, many could not state the correct answer. 4 was the most common error but 6 and 9 were also seen. A few candidates gave a name, for example pentagon.

Question 4

For some candidates, it seemed to be a big step to go from finding a simple probability to marking it on a probability scale. Arrows at 0.2 and 0.3 were often seen and quite a number did not attempt the question. Some drew arrows at 0.5 or 1.

Question 5

Nearly all candidates could work this out correctly but there were some incorrect answers seen, with anything from 5 to a number in the thousands. $3 \times 24 = 36$ or adding instead of multiplying were seen.

Question 6

While there were many candidates giving a fully correct order, a significant number didn't gain full credit as there were just 3 in the correct order. 41% and $\frac{16}{39}$ in the incorrect order was the most common error due to the fraction being written as just 0.41, the same as 41%. It is necessary to write items to as many decimal places are needed to distinguish between them.

Question 7

This linear equation was well understood and solved correctly by the majority of candidates. Some wrote $3x - 2x$ instead of $3x + 2x$ as the first stage while others worked out the final stage as $5 \div 6$ instead of $6 \div 5$.

Question 8

While a number miscounted, usually resulting in a difference of 10, this was correct from nearly all candidates since the negative value was condoned. Just a few were confused by the signs and worked out 6 – 5 or 5 – 6.

Question 9

The common error in this question was to multiply 3 by 6 before squaring, leading to an answer of 81. Other often seen errors were from squaring 36, or misreading the fraction as $\frac{1}{2}$. Some did gain the method mark from showing a correct substitution but then working it out incorrectly.

Question 10

Very few candidates showed working on the diagram but the simple property of angles on a straight line was well known. Most who gained marks found *y* first, often correctly, but some then assumed that the two angles next to *y* were equal, leading often to an angle of 50°. A few candidates ignored the straight line property and assumed the triangle was isosceles.

Question 11

A significant number of candidates worked with the surface area instead of volume formulas. Some tried to work with scale factors but this tended to lead to an incorrect answer of 6. Many did work out the volume of cuboid *A* and, where they interpreted the question correctly, usually resulted in a correct height of cuboid *B*.

Question 12

(a) Apart from a few errors in the numbers, this was very well answered.

(b) While no drawing was required for this pie chart question, many candidates could not successfully find the correct angle. Instead of multiplying by 360, many multiplied by 100, finding the percentage rather than the angle, while a few multiplied by 180. Some did not seem to understand that an angle was required and instead gave just the probability as the answer.

Question 13

Many candidates did not gain full credit on this basic percentage question due mainly to not reading the question with understanding. Seeing just the command word 'increase' many assumed that it was the increase, 6.72, that was required and not the result of increasing. Other errors often seen were 42 ± 0.16 and 262.5 from 42 ÷ 16%.

Question 14

(a) (i) Very few errors were made in finding the next term of the sequence.

(ii) Quite a number of candidates were confused between a term to term rule and the general rule of a sequence. Expressions involving *n*, for example *n* – 7, were often given.

(b) The general term of this sequence was not successfully answered by many candidates. It was quite common for the difference in the terms, 4, to be recognised but the constant term seemed to be more challenging for candidates. Other common errors, perhaps related to the first 2 terms, were 2*n* – 4 or −2*n* − 4, while *n* – 4 and *n* + 4 were also quite common.

Question 15

This question was challenging for most candidates even though it simply needed a correct application of the area of a triangle formula. The main problems in this case were an obtuse angled triangle and the reverse problem of a given area to find the height. Some did make the common error of omitting the half from their calculation but many did not start with $\frac{1}{2}\times 6\times h = 27$. The calculation $\frac{1}{2}\times 6\times 27$ was often seen as was 27 – 6 = 21. Quite a number of candidates thought that Pythagoras' theorem was needed and occasionally the correct answer was first found but then regarded as the length *BC* or even *AC* leading to a further calculation.

Question 16

(a) (i) While reversing the co-ordinates was occasionally seen, nearly all candidates were successful.

(ii) Not quite so many candidates plotted the point (2, −3) correctly. (−3, 2) and (−3, −2) were seen plotted as well as a number of blank responses and more than one point plotted.

(iii) The equation of a line was found challenging with many showing a lack of understanding that *m* is the gradient and *c* the intercept on the *y*-axis. The letter *m* was at times left in the equation instead of *x*. Working out the gradient, often by $\frac{y_2 - y_1}{x_2 - x_1}$, produced an incorrect, sometimes, negative result. The diagram should have indicated a positive gradient and the commonly seen 2 for the gradient could also have been eliminated by considering 2 points on the line to work out rise divided by run. Many did gain partial credit from a correct value of *m*, or, more often, *c*. There were also a significant number who did not attempt this part.

(b) Very few candidates gained credit for this part and many did not make any attempt at an answer. Some did know that the gradient had to be the same and occasionally a correct intercept was quoted. Many seemed to think it was related specifically to values in the previous part or produced calculations to work out, unnecessarily, gradient and intercept once again.

Question 17

While the question was well answered by most candidates, some did not give an answer as a fraction in its simplest form. Most changed the mixed number to an improper fraction but some then multiplied by that instead of first inverting the fraction. The division method with a common denominator was often used, mostly resulting in a correct answer.

Question 18

(a) There were quite a few candidates who did not attempt this standard question. Incorrect responses were usually 17.95 with 18.95 and 17 with 19. There were some who reversed the two correct values.

(b) (i) Changing from standard form to an ordinary number was very well answered. Some wrote the incorrect number of zeros, usually three, or moved the point 5 places in the opposite direction to give 0.00009314.

(ii) This part involved multiplying and then giving the answer in standard form. Many candidates only gained partial credit as the final answer was not in standard form. Some introduced errors by changing both parts to ordinary numbers before multiplying them. At that stage quite a number rounded to three figures, or even two figures, while many could not get back correctly to standard form. 36.49×10^4 was a particularly common answer.

(c) This calculator question was quite well answered even though a decimal index, a square root and order of operations were contained within the operation. Many did manage the operation of entering the whole problem presumably as one stage, since no working was shown and the correct answer was often seen. While no specific accuracy was requested there were some who only giving a two figure answer. Once again those who split up the calculation into parts often made errors in accuracy such as 7.833.

Question 19

This question was found to be challenging. Many did not read the question carefully and thought they just had to multiply 12 by 13. Very few drew a rectangle with the data inserted which would have made it clear that a Pythagoras' theorem calculation was required. Basic errors of perimeter instead of area and area of a triangle were seen from a number of candidates. Of those who found the side correctly, some thought they had completed the question at that stage.

Question 20

This was a more challenging ratio question and only the most able candidates made progress and reached the correct answer. A few realised that a difference of 20 between the shares could be seen from progressively multiplying the ratio by increasing numbers. The key was 20 divided by 4, the difference between the ratio data. Most felt that it was simply a case of dividing 20 in the ratio 7 : 3, leading to a common incorrect answer of 6. Others divided 20 by 7 and then multiplied by 3 to give an answer of 8.57, which is an unlikely number of sweets. Algebraic methods were rarely successful due to errors but it was a good way to find the solution when worked well.

Question 21

Many candidates understood product of prime factors resulting in a good response to this question, even though some included 1 as a prime number. Others showed a probability tree or a table but some did not know how to complete the question, just writing a list of factors as the answer. Factor trees were often incomplete, for example leaving 33 not divided into 11 and 3. Some included only one five in their answer.

Question 22

This reasonably straightforward trigonometry question was found challenging by many candidates. In 'show that' questions the calculation must not include the given value of x, but must show a value to more figures than that given. Many who made correct progress with the calculation only gave the given answer, 27.2. Those who chose to find the opposite side followed by Pythagoras' theorem often lost accuracy due to premature approximation

Question 23

While less able candidates often showed subtraction between lengths, for example 54 – 12 = 42 followed by 63 – 42 = 21, an attempt at proportion was generally seen. Performing the calculation in two stages sometimes resulted in an accuracy error.

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

Read the questions carefully and make sure answers are relevant to what the question asks.

Do not round or truncate in the middle of a question.

Show working in a clear and logical way.

General comments

The majority of candidates attempted to answer all the questions. Working was generally shown to ensure method marks could be accessed where the answer was incorrect. For **Questions 15**, **20** and **23**, it was clearly stated that working must be shown. Candidates will not gain full credit if no or insufficient working is given. Several candidates didn't show this required working.

Candidates need to ensure their answer meets all the requirements of the question, for example, in **Question 6**, many candidates had drawn a triangle but without construction arcs.

Comments on specific questions

Question 1

(a) This part was almost always answered correctly.

(b) Many candidates compared the two charts and gave a correct answer. Others wrote about why the most rainfall might not mean the greatest number of days it rained without relating this to the charts. Others simply compared the numbers of days in each month.

Question 2

This question was answered correctly by the majority of candidates. There were a small number of arithmetic errors; of those who had an incorrect value for 2.8, several were then able to score the follow through marks.

Question 3

(a) The majority of candidates gave the correct answer. The common incorrect answers were 97.42, 97.4 and 97.423.

(b) Many candidates understood the term reciprocal. The common incorrect answers were 1, 2.5, $\frac{2}{1}$ and –2.

Question 4

Candidates found this rotational symmetry question challenging and it appears to be a topic candidates are not confident with. The correct answer was often given for the first shape. However, 4 was often seen again as the answer to the second. Worded answers such as left and clockwise were seen, as was 90°.

Question 5

Many candidates gave the correct answer, some coming from trial and improvement rather than from multiplying 7 and 16. The median of the six numbers was sometimes seen as the answer.

Question 6

Most candidates gave the correct triangle but many did not have arcs. The majority of candidates used a ruler and there were few errors on measurements.

Question 7

(a) Very few errors were made on this question.

(b) This question was also mainly correct. –16 was sometimes given as the answer.

Question 8

The majority of candidates were able to calculate the correct answer.

Question 9

The majority of candidates gave the correct answer. The most common incorrect answer was 4040404 from division rather than multiplication.

Question 10

Although many candidates gave the correct answer, several had not read the question correctly and had used compound interest instead of simple interest. Others had tried to work out 2.6% in stages without a calculator and made an error. Some candidates scored partial credit for 499.2 but had not then added this to 6400.

Question 11

(a) Candidates generally found this part challenging and the topic was not one which some candidates appeared familiar. Common incorrect answers were 12, 17 and 5*x*. Several did not attempt the question.

(b) Candidates again found this part challenging and the correct answer was rarely seen. The most common incorrect answers were (5,12) and (0,12). Working was rarely seen and many did not attempt the question.

Question 12

(a) This question was generally well answered by those who understood the term net. Some candidates had not considered the equality of joined edges. Several appeared not to understand the term net and drew a 3D solid.

(b) Many candidates were able to find the volume of the cuboid, although a small number confused volume and surface area.

Question 13

Many candidates found this question challenging and it was rare to award full credit. Many scored partial credit for correctly finding the area of the parallelogram. Some then divided 72 by either 7 or 11 with few knowing how to correctly equate the area of the trapezium to 72.

Question 14

This type of bounds question is usually well answered although it appears that having to go to the second decimal place for limits was not well understood. 18.2 and 18.4 were common incorrect answers. 18.34 was also seen as the upper limit. Some candidates had both the correct values but had placed them incorrectly.

Question 15

Many candidates did not read the question carefully enough and made no attempt to write each number in the calculation correct to 1 significant figure. It was treated as a calculator question and the exact answer was worked out. Those who understood the need to round usually scored full credit.

Question 16

The correct answer to this expectation question was often seen. Common errors were dividing 140 by 5 leading to an answer of 28. A small number of candidates rounded after dividing 5 by 14 and so didn't gain the accuracy mark.

Question 17

Bracket expansion and collecting terms were well answered by most candidates. Errors with negative signs in the second bracket often led to –10 and a final answer of $3m + 2$, which gained partial credit.

Question 18

This question involved knowing that speed is found by dividing distance by time as well as converting units of distance and time. Many candidates made an attempt at the question and often scored partial credit, most commonly for 2460 ÷ 33 but also for 0.55 in their working. Some lost accuracy during working as 60 ÷ 33 was rounded to 1.8. It was rare to award partial credit for the figures 4472.

Question 19

Many candidates were unable to give the correct answer to this question. The most common error seen was 180 ÷ 20. A significant number of candidates did not attempt this question.

Question 20

Many candidates showed full working and scored full credit. Some did not convert their final answer to a mixed number and left the answer as $\frac{12}{5}$. A small number of candidates did not appear to know that a common denominator is not necessary when multiplying fractions.

Question 21

(a) Most candidates made an attempt at completing the Venn diagram. Many had written 19 in the 'just rabbit' part of the Venn diagram, usually with the overlapping section left blank. It was rare to award partial credit for the two values adding to 19.

(b) Few candidates appeared to understand the notation and many did not attempt this question. Of those who did, a variety of values from the Venn diagram were given as answers.

Question 22

Many candidates were able to correctly apply Pythagoras' theorem with only a small number adding rather than subtracting. Some candidates only gained partial credit as an answer of 8.9 was given without a more accurate answer shown.

Question 23

A small number of candidates were able to gain full credit on this simultaneous equations question. The elimination method was the most common and the most successful, although there were some who were unsure whether they needed to add or subtract in order to eliminate a variable. Those who rearranged the equations sometimes scored partial credit but were unable to make further progress as they could not deal with the fractions in the equation they had created. A significant number scored the special case mark.

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key messages

To succeed in this paper candidates need to have covered the full syllabus, remember necessary formulae and definitions and show all working clearly. They should be encouraged to spend some time looking for the most efficient methods suitable in various situations. This was particularly important in **Questions 12** and **20**.

General comments

The level and variety of the paper was such that candidates were able to demonstrate their knowledge and ability. There was a high rate of no response on the final question but this seemed to be due to the vectors topic rather than a lack of time.

Working was well set out. Candidates should ensure that their numbers are distinguishable, particularly between 1 and 7 and between 4 and 9 and should always cross through errors and replace rather than try and write over answers.

Candidates still need to be reminded that prematurely rounded intermediate answers bring about a lack of accuracy when the final answer is reached. They should also be encouraged to check their work carefully as marks in more complex questions were often lost through basic errors such as manipulating algebra which had been done correctly in other questions or numerical and sign errors.

Comments on specific questions

Question 1

The vast majority of candidates made a good start to the paper, gaining both marks. Those who scored one mark usually made the error of giving a instead of $-a$. Some centres clearly encourage the grouping of the coefficients, however they must remind candidates of the need to evaluate, as the most common answer for those who did not score was $(3-4)a + (7+1)b$.

Question 2

This question proved to be straightforward for most candidates. The majority showed their construction arcs and lines drawn were usually with the tolerance allowed. Candidates who did not show construction arcs could score a maximum of 2 marks which many did manage to do, however this approach often led to one of the lines being inaccurate. The occasional blank answer space may have indicated that candidates did not have the correct equipment with them.

Question 3

This was a well attempted question, with the majority of candidates gaining full marks. There were a number of arithmetic errors and occasional miscopying of numbers, but working was clearly set out and so method marks could be awarded in these cases. Some candidates got to $13.72 - 2.8 \times 2.65$ but then did not go on to the division or did the division the wrong way round. Among those who did not score, a common incorrect first step was 3.6×2.8. A relatively common misconception was to assume some kind of direct relationship between the potatoes and leeks, as methods involving cross multiplying and ratios were often attempted.

Question 4

Most candidates plotted all four points correctly in **part (a)**. There were many who scored one mark which indicates that any mis-plotting was a careless mistake rather than not interpreting the scale on the axes correctly. There were a significant proportion of candidates who did not attempt to plot the points. The majority of candidates knew the correct terminology in **part (b)** and this was often accompanied by additional descriptors such as strong or weak. Those who did not score were often describing the relationship or simply wrote speed/distance. There were many good lines of best fit drawn in **part (c)** but candidates should be reminded that the line should cover the whole range of plotted points. Some did not draw a line and a very small number joined up all the points or the points they had plotted. In **part (d)** the overwhelming majority of candidates either gave a value which was in tolerance or followed through correctly from their line of best fit.

Question 5

There were many fully correct answers to this question but there still remains much confusion when being asked to estimate a calculation. Most of the errors arose from a lack of understanding surrounding significant figures. Some candidates rounded consistently to 1 decimal place, or to the nearest integer, which was a common way to score one mark, as three of the values were correctly rounded. Some decided to carry out the accurate calculation but rounded at the end whilst others worked out the numerator and denominator and then rounded those to 1 significant figure. A few candidates did not follow the instruction to estimate, suggesting that they had not read the question properly. Candidates should be reminded to maintain place value when rounding, as 5 rather than 50 was often seen in the numerator. They should also be reminded not to add in unnecessary zeros as it was quite common to see trailing zeros after the decimal point, often to maintain the number of decimal places as in the original number.

Question 6

Most candidates understood what was expected of them for this question, both in terms of showing their working and giving their answer as a mixed number in simplest form. The vast majority of candidates were able to turn the two mixed numbers into improper fractions as a first step. Most candidates multiplied through to an interim fraction of $\frac{88}{12}$ rather than cancelling before multiplying, but the numbers involved were such that few arithmetic mistakes were made. One common misconception was that denominators need to be the same in order to multiply and so $\frac{32}{12} \times \frac{33}{12}$ was often seen. This was often multiplied correctly and then cancelled down again, but it was also common to see a result of $\frac{1056}{12}$.

Question 7

Candidates demonstrated an excellent grasp of basic algebra in this rearrangement with the vast majority gaining both marks. By far the most common error was to subtract 7 from 2y rather than add it as a first step. Many candidates are keen to get the subject on to the left hand side of the formula but this often led to errors with the signs. Centres should encourage candidates to look for the most efficient ways of dealing with rearrangements and emphasise that they can reverse the sides of the equation without doing any processing.

Question 8

The problem solving element of **part (a)** proved to be challenging. The answer of 5 was common in recognition that multiples of 5 end in a 5 or 0, but the fact that it was an even number had been missed. It was common to see any of the numbers in the question as the answer, along with 10 or a multiple of 10. Many candidates multiplied all the numbers to give an answer of 210 and some gave two numbers as the answer, indicating that they had not recognised that a single digit was required. The more familiar **part (b)** was much better attempted and the majority gained both marks. Both factor trees and repeated division were used. Working was clearly shown and there was a good understanding that the factors should be shown with multiplication signs. Some lost the final mark because they gave the factors as a list or included the number 1. The vast majority of errors though were arithmetic errors when dividing, which could have been rectified had the factors been multiplied to check that they gave the correct value.

Question 9

Part (a) proved to be the worst attempted question on the paper, even among the strongest candidates, demonstrating a lack of understanding of how to increase an amount by a percentage greater than one hundred in one step. The majority of candidates gave the wrong answer of 40×3, the increase rather than the final value. The next most popular wrong answer was 40×300. **Part (b)** was much better understood with a significant majority selecting the correct calculation. The popular incorrect choices were $2^2 + (-3^2)$ and $\sqrt{2^2 - 3^2}$.

Question 10

The majority of candidates understood that this was equivalent to compound interest and could quote and use the formula correctly. A significant proportion gained two out of the three marks available because they either rounded incorrectly or did not round at all. Some subtracted the initial value of 45 000, giving just the increase which was condoned for the method mark. Candidates should be encouraged to use their calculator efficiently and carry out the whole calculation in one go as some lost accuracy marks by prematurely rounding 1.016^5, writing it down and then calculating the answer. There were many answers of 48 600 seen from $45\,000 + 45\,000 \times 0.016 \times 5$, demonstrating a misinterpretation of the question.

Question 11

The problem solving aspect of this made, what was otherwise a fairly straightforward inequalities question, quite challenging. Successful candidates used the information given to write the missing coordinates on the diagram and often scored full marks. A mark of one was commonly awarded for two or three correct values where the most common incorrect value was for the reflected value of b, often given as 4 rather than 5. Many reversed the answers for c and d. Candidates should look carefully at the notation given in the question, as many gave answers as coordinates or included inequality signs which was incorrect. There were many weaker candidates who did not attempt the question.

Question 12

The most successful strategy in this question was to find the exterior angle and then divide this in to 360. Many candidates could get no further than finding the exterior angle of 24. The majority of candidates who got this question wrong used the interior angles formula incorrectly. The equation $180(n-2) = 156$ was seen many times, instead of $180(n-2) = 156n$. As a result, an inappropriate answer of 2.86 sides was extremely common. Many of those who did state the correct formula were unable to manipulate it to get to the correct answer.

Question 13

The majority of centres appear to have taught the method of multiplying the recurring decimal by powers of 10 and subtracting to find a fraction over 9, 90, 99 and so on. These were by far the most successful candidates as working was clear and well set out, demonstrating an understanding of the method employed. Other successful methods were seen and awarded full marks but it was far more common for candidates to make errors or not show full working on these alternative methods and it was clear that they did not always understand the method which they had been taught. Some candidates did not show any method and so could only gain 1 mark for a correct fraction, presumably gained from the calculator. Some candidates misinterpreted the recurring notation and wrote the number out as 0.1717…. Weaker candidates ignored the recurring symbol and simply wrote the fraction as $\frac{17}{100}$.

Question 14

Successful candidates rearranged the equation in to the form $y = mx + c$ in order to find the gradient. There were many who did this correctly to gain a mark but then gave an answer of $\pm\frac{1}{2}$. Many made a start to this first step but stopped at $8y = -4x + 5$, hence many answers of ±4 and $\pm\frac{1}{4}$ were seen. Following a correct rearrangement with the gradient as $\frac{-4}{8}$, some candidates left the final answer as $\frac{8}{4}$, which candidates should be aware will not score the answer mark as this is not processed. Again, candidates should check that they have answered the question, as an answer of $2x$ or $y = 2x + c$ does not give the gradient of a line and did not score the answer mark.

Question 15

Part (a) was well attempted but there was much confusion among many candidates. Some showed the division the wrong way round and there were many who gave the answer as the reduction of speed from 18 m/s to 6 m/s = 12 m/s. A small number of candidates also wrongly worked out the area under the line of deceleration, resulting in answers of 240 m/s and 480 m/s. A variety of answers were given for **part (b)**, as was expected due to the number of area calculations possible. Some candidates found efficient methods of trading off areas which were the same, but the most successful were those who found the whole area under the graph for the car and subtracted the 1200 for the motorbike. While the correct answer was seen frequently, the most common mark given here was one method mark for calculating one or more relevant areas, usually including 1200, but most could not give a fully correct area statement for the car. There was little working seen on the graph which may have helped candidates to identify the different areas which they were calculating. There were numerous errors in finding the different areas. One common starting point was to find the area of the rectangle 18 × 60 = 1080. Errors after this were to treat the remaining trapezium as a triangle and calculate $\frac{1}{2}(40 \times 18)$ or to split the remaining trapezium into a rectangle and triangle but to omit one of these. It was also common to see areas which were not a trapezium being treated as one, for example the whole area for the car was given as $\frac{1}{2}(60 + 100) \times 18 = 1440$ and the area under the motorbike and the car as $\frac{1}{2}(80 + 100) \times 12 = 1080$. Weaker candidates did not use the area under the graph and subtracted speeds, while others ignored the deceleration of the car and calculated 1800 – 1200.

Question 16

Strong candidates had no problem factorising the quadratic expression with little need to show any working although some did show splitting the $7x$ into $15x - 8x$. A minority of candidates gained 1 mark, usually for reversing the signs within the brackets. Many candidates used the quadratic formula or their calculator to solve the equation when equal to 0 but then could not make the final step of finding the factors and so $\left(x \pm \frac{4}{3}\right)\left(x \pm \frac{5}{2}\right)$ was a common answer. The other common answer was $x(6x + 7) - 20$. Many candidates had no strategy to attempt this question and so this is an area for centres to work on.

Question 17

It is clear that centres have worked hard on teaching functions as candidates demonstrated a very good understanding throughout the question. **Part (a)** was particularly well answered with the vast majority of candidates substituting correctly. By far the most common error was to omit the brackets for $(-2)^2$. Many candidates gained the method mark for a correct substitution but then calculated $(-2)^2$ as -4 and others added 12 to 19 rather than subtracting. Some confused the $x = -2$ and $f(-2)$ values while others did not know what the 19 represented. **Part (b)** caused more difficulty, particularly among weaker candidates, but was still well attempted. In **(b)(i)** it was a shame that many spoilt their answer by dividing through by 3 rather than factorising. The most common errors within the method were to calculate $hg(x)$, $g(x) \times h(x)$ and to solve $g(x) = h(x)$. There were a significant number who did not attempt **(b)(ii)** so finding the inverse function was slightly less familiar. The majority of candidates gained at least one mark for a correct first step of either reversing x and y or for a correct step in the rearrangement. A common error was to add 7 rather than subtract in the rearrangement and candidates often left their answer in terms of y, perhaps demonstrating a lack of understanding of what they were finding.

Question 18

Successful candidates were those who could correctly recall and substitute into the appropriate area formulae. The correct final answer was only achieved by the strongest candidates who worked methodically through each area. Most candidates gained a proportion of the marks by working out either the correct area of the sphere or hemisphere or the curved surface area of the cylinder. Most errors in recalling the correct formulae were in the curved surface area where 2 or 2π were often omitted. There were two very common misconceptions. The first was to use the surface area of a cylinder formula and include the area of two circles without thinking carefully about the given shape on the diagram. The other was to find the area of the circle but then turn it into a volume by multiplying by 12.

Question 19

This question caused some difficulty with a minority gaining the mark. There were two very common errors, the first being to omit the shading outside the sets. The second was to omit the shading of sections $M \cap P$ and $M \cap N$. This suggests a misunderstanding of the union symbol and is perhaps an area for centres to consolidate with candidates.

Question 20

This is the type of question where candidates need to take a minute to think about their approach and generate a sensible strategy. Many wrote out the addition of all the angles, putting them equal to 360 but then could progress no further than having an equation in terms of *x* and *y* or gave the answer of *y* in terms of *x*. Those who recognised that it was a cyclic quadrilateral and recalled the properties correctly usually gained full marks showing clear working. A few chose the rather inefficient method of using the 2 opposite angles which contained both *x* and *y*, along with the total angles adding to 360 and solved the pair of simultaneous equations. This usually led to more errors and was a far more time-consuming method. A large number of candidates mixed up which angles should add to 180 and so it was common to see $4x - 87 + 2x = 180$ leading to an answer of 44.5 and $4x - 87 + x + 60 = 180$ leading to 41.4.

Question 21

This question was well attempted by candidates across a whole range of abilities. A large proportion identified the correct triangle containing angle *PVT*. It would be advisable for candidates to draw and label the correct triangle as many angles marked on the diagram were ambiguous and could not score a method mark if they then continued incorrectly. Those who had identified the correct triangle usually went on to use the correct trigonometric function of sine 43, although some errors were made using cosine. There were some who used the inefficient method of finding *TV* and then used Pythagoras to find the required sign, adding an extra unnecessary step which often led to inaccuracy due to rounding. Premature rounding of sine 43 also led to inaccurate answers. Candidates who did not score were usually identifying an incorrect triangle, often *PVW*. The existence of a right-angled triangle also led to a number of candidates trying to use Pythagoras even though they only had one given side.

Question 22

There were many completely correct simplifications given and the majority of candidates were able to score some marks. The most common marks to award were for showing $x(x - 5)$ in the numerator and for $2(x^2 - 25)$ in the denominator. Many candidates did not then spot the difference of 2 squares and did not continue any further. Weaker candidates were crossing out x^2 from the numerator and denominator and also dividing the 5 and 50 by 5.

Question 23

Vectors continue to be a challenge, with only the strongest candidates making good attempts, particularly in **part (a)**. Giving a correct route is a mark accessible to most candidates and so this should be encouraged as a first step. Centres should reinforce the importance of direction as it was very common to see for example, the error $AC = \frac{1}{3}CF$, FC = n – m or CF = m – n, with all other work then following on from this correctly.

Missing brackets also cost many candidates marks, with $\frac{1}{3}\text{m} - \text{n} + \frac{1}{2}\text{m}$ very commonly seen; resulting in candidates losing marks due to basic algebra, with the vectors concept itself being understood. Similarly, the answer mark was often lost due to mistakes with signs when multiplying out the bracket and adding the fractions to simplify. Many candidates did not attempt the question, particularly **part (b)**. Successful candidates understood that vectors are defined by their magnitude and direction and wrote a fact about each of these. There were many completely correct responses describing that the vectors were parallel and that $\overrightarrow{GH}$ had a greater magnitude than $\overrightarrow{JK}$, with or without the actual ratios. The most common misconception was that the vectors were collinear so candidates should understand the extra piece of information required

in order to show this. Some wrote down the ratio in reverse, thinking that $\frac{5}{18}$ is 3 times bigger than $\frac{5}{6}$.
Candidates who could not interpret the question wrote down trivial facts comparing the fractions and said, for example, that they both contained **2**p **+** q**.**

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

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

General comments

There were a significant number of excellent scripts with many candidates demonstrating a strong mastery of the content and showing good mathematical skills. There was no evidence that candidates were short of time, as almost all attempted the last few questions. The majority of candidates were able to cope with the demands of this paper with very few low scoring papers. Candidates showed particular success in the basic skills assessed in the earlier questions on the paper. The most challenging questions on the paper were the questions involving standard form, bounds, differentiation and vectors. Candidates were very good this year at showing their working and it was rare to see candidates giving answers with no working present. There were some marks lost due to rounding or truncating prematurely within working, or giving answers to less than the required 3 significant figures. This was particularly evident in the bounds question and the early percentage increase question.

Comments on specific questions

Question 1

Most candidates were able to write the given number in figures correctly. There were however a significant number of incorrect responses. The most common of these contained the incorrect number of zeros. A few candidates misread seventeen as seventy, giving their answer as 200070. There were also a small number of standard form answers offered, most of which were correct.

Question 2

Most candidates had little trouble with this. Some did not implement the complete demand by making the statement correct without using brackets, usually by changing the – 3 to +3.

Question 3

This equation was very well answered by nearly all candidates. A few cases were seen with the correct rearrangement $5x = 6$ followed by the incorrect answer $x = \frac{5}{6}$ or the decimal equivalent. A small number of candidates had a sign error and reached $3x - 2x = 6$, giving $x = 6$ as the answer.

Question 4

There were a large number of correct answers seen here. The candidates were confident at using the properties of angles on a straight line and angles in a triangle and virtually all who scored 2 marks here did so for finding a correct value for the angle *y*. Angle *x* proved more challenging for some and $x = 50$ was frequently seen as an incorrect answer, obtained by assuming symmetry around the angle y at the top of the diagram. Others offered an obtuse angle for *x* which was not possible given the diagram. $x = 140$ was also often seen, likely from candidates believing that *x* was alternate with the 140º angle. Other common incorrect answers included $x = 100$ and $x = 40$. It was rare to see *y* incorrect.

Question 5

This question was answered well. A small minority of candidates demonstrated a valid method but truncated their answer to 48.7 without writing the correct answer of 48.72. Candidates are advised that the front of the exam paper asks for them to round non-exact answers and that exact answers should be given otherwise. A few found 16% of 42 = 6.72 and forgot to add it on, or they decreased by 16%. A small number treated it as a reverse percentage question, calculating 42 ÷ 0.84 = 50.

Question 6

This was generally well answered with 4(1 – 2x) as a common correct answer. The most common error was to factorise to 2(2 – 4x), but not factorising completely as instructed in the question.

Question 7

The majority of candidates correctly applied the formula $\frac{1}{2} \times b \times h = 27$ to find the height. Another common correct approach was to set up the equation $\frac{1}{2}(6+x)h - \frac{1}{2}xh = 27$ which when correctly evaluated leads to $3h = 27$, $h = 9$. The question did cause some confusion for a sizeable number of candidates because the perpendicular height was shown outside the triangle. Incorrect responses generally followed on from not understanding that 6 was the base value, or from assuming that $6 + x$ and h formed the sides of an isosceles triangle. Another method often seen was to attempt to use $\frac{1}{2}$ $ab\sin C = 27$ with an assumed angle but this generally led to finding the length of *AC* rather than the perpendicular height. Some candidates showed overly complicated responses, such as finding the perpendicular height from *B* to *AC,* or the length *AC,* or both in terms of sin *BAC,* then substituting and eliminating *AC* and sin *BAC* to successfully arrive at $3h = 27$ and the correct answer.

Question 8

There were many correct answers seen. Some candidates correctly identified each exterior angle as 90, but then stopped, or found the sum of the interior angles and then stopped at 6840. Other errors mainly involved incorrect or incomplete formulae leading to working such as 180 × 38 ÷ 360 = 19.

Question 9

This question was well answered by most candidates. The most successful and most popular method was to add the two equations to find x and then substitute. The most common error was a sign error when using a substitution such as $y = 7 – 2x$, giving a final answer such as $x = 1$, $y = 5$.

Question 10

This equation was very well answered by nearly all candidates with the majority showing the full working required in the demand. Nearly all changed the second fraction to an improper fraction correctly for the first mark. The majority then took the standard route of inverting it to make a product. These generally reached the correct answer. Sometimes candidates forgot to cancel, the better responses were usually using this method but cancelling before multiplying. A smaller number used a common denominator method such as $\frac{5}{6} \div \frac{8}{6}$, with many then going on to a correct answer but this method was very slightly less successful overall.

Question 11

This question was answered well with very few incorrect answers seen. A few candidates multiplied the indices to give $10x^{10}$. Occasionally the answer 10^7 was given and the x omitted in error.

Question 12

There were a number of correct solutions seen here, but a significant number of candidates misread the question. Some believed that Chris received 20 sweets instead of 20 **more** sweets. This led to a common incorrect answer of 8.57 or 9. Others believed there were 20 sweets in total and found that Alex had 14 sweets and Chris had 6 sweets. On a few occasions, candidates correctly found that Alex had 35 sweets but gave this as their final answer instead of the number of sweets Chris had. The most successful methods were those that found the difference in shares was 4 and compared this to the 20 to work out 1 share = 5. Many overcomplicated their working by setting up and solving an equation such as $\frac{x+20}{7}=\frac{x}{3}$. If an equation was set up, the variable was often not clearly defined. For example, sometimes $\frac{4}{10}x=20$ was used and in this case, *x* stands for the total number of sweets rather than the value to be found. Some were not sure what method to use and had a trial and improvement approach of multiplying the ratio 7: 3 by various values until the difference in the ratios was 20. Whilst this was often successful, it was a time-consuming method.

Question 13

Many candidates answered this well. Some realised that use of Pythagoras was required to find the side length of 5 but followed it by $\frac{1}{2}\times 12\times 5=30$, or in some cases used Pythagoras to find $\sqrt{13^2+12^2}=17.7$ and then using that as the length of the side. The most common wrong methods and answers were to calculate 12 × 13 = 156, or 12 × 13 × $\frac{1}{2}$ = 78.

Question 14

This question proved challenging for many candidates. Some candidates were unable to do a standard form question that could not be done on their calculator, indeed some thought that it could not actually be done at all and gave the answer a calculator would give, such as 'math error'. The most common wrong answers were 5×10^{400} or 6×10^{400}. There were also some answers with extra zeros e.g. 2.003. A significant number of candidates gave an answer of 3.02×10^{x} or $x \times 10^{199}$ with varying values of *x*.

Question 15

Most candidates were able to correctly calculate $\frac{60}{360}\times\pi\times 7.5^2$. A few candidates attempted to find $\frac{60}{360}\times 2\pi r$ or used $\frac{1}{2}r^2\theta$ with θ in degrees instead of radians. The instructions on the front of the paper ask candidates to use π as the calculator value or 3.142, however some candidates used 3.14 which resulted in an inaccurate final answer. Use of the formula Area = $\frac{1}{2}ab\sin C$ was also occasionally seen.

Question 16

This question was among the more challenging questions for candidates. The most common error was where candidates found 6% of 26.50 and subtracted i.e., finding 94%, consequently $24.91 was the most common incorrect answer. Another common error was $\frac{94x}{100}=26.50=28.19$.

Question 17

(a) This was attempted by almost all candidates and many gave the right answer. The most common incorrect answer was to calculate 4 – 2 = 2 for the change in speed and writing this as the answer. Other incorrect responses included 20 ÷ 2 = 10, 40 – 20 = 20.

(b) Where the candidate showed clear working, this question was well answered with the majority calculating area under the graph as 90. The majority of incorrect responses came from missing a section of the area, often the triangle at the top of the graph, leading to an answer of 70, or from missing the rectangle at the end of the graph, leading to an answer of 50. The use of trapezia generally led to the right answer as this reduced the chance of missing a section of the graph. 4 x 40 = 160 was seen a number of times.

Question 18

This question proved challenging for many candidates, but there were still a large number of candidates scoring at least 1 or 2 marks. The hardest part was fulfilling the twin demand of using upper bounds and recognising which side to double for the maximum perimeter. Common errors leading to no marks were to add 0.5 or 0.005 instead of 0.05, or to use e.g. 9.44 instead of 9.45. Some candidates did not recognise the demand for an upper bound, instead finding the perimeter using the given lengths to reach a common incorrect answer of 27. Some candidates using the correct bounds doubled the shorter side instead of the longer. Of those candidates who did arrive at the correct answer of 27.15 cm, some then lost a mark because of rounding the answer to 27.2 cm which is out of the possible range. Candidates are advised they should not be rounding exact answers.

Question 19

(a) In most cases the sine rule was used accurately in this question. Other longer methods were sometimes seen, including use of the cosine rule or other attempts at trigonometry. Candidates need to remember the importance of showing all steps of a method as well as the final value to avoid losing unnecessary marks from arithmetic slips. The answer was sometimes seen as 61, rather than 61.1. Candidates are advised that the front of the paper specifies one decimal place should be used for angles in degrees. For some this also meant loss of an accuracy mark in **part (b)**.

(b) This was a less well answered question. Fairly common errors were the use of $\frac{1}{2}\times 8\times 9\times \sin 100$ or $\frac{1}{2}\times 8\times 9\times \sin x$ without finding a value of x or simply $\frac{1}{2}\times 8\times 9$. Since the angle used must be the angle included between the two sides it was necessary to calculate the third angle of the triangle, using $180-100-x$. Candidates are advised that to obtain the appropriate 3 significant figures accuracy they should be working with interim values correct to 4 significant figures or better.

Question 20

This was well answered with most candidates realising the need to convert the ratio for the volume into a ratio of lengths before proceeding. Those who simply set up the ratio, ignoring the dimensions, ended up with an unrealistically tall model of 13 500 cm. A common slip was to take the square root of the ratio rather than the cube root. Some inverted the ratio and attempted to solve $\frac{l}{4}=\sqrt[3]{\frac{12}{40500}}$ instead of the correct $\frac{l}{4}=\sqrt[3]{\frac{40500}{12}}$.

Question 21

(a) A new topic, this question was not as well answered, although the correct answer was often seen. Occasionally there were a few slips to give incorrect answers such as $4 - x$. A significant number of candidates did not know how to differentiate and often attempted to complete the square or factorise. Some weaker candidates omitted it altogether. Some candidates did not seem to know what the word differentiate meant; they were clearly able to differentiate as some then differentiated in **part (b)** to work out the turning point.

(b) This question was one of the more challenging questions on the paper. Some candidates who did not score in **part (a)** were still able to gain both marks in **part (b)**, with a variety of methods seen. Those candidates who put their answer to **part (a)** = 0 and solved for x usually reached a correct x coordinate for the turning point. A small number of candidates lost a mark, however, by not substituting $x = 2$ correctly into the given equation to obtain the y coordinate. Others completed the square to find the x-coordinate of the turning point, or used $\frac{-4}{2\times -1}$ from $\frac{-b}{2a}$. These candidates were often successful in attaining full marks. A large number of candidates attained no marks. Common errors included substituting $y = 0$ into the given equation and solving for x.

Question 22

(a) This was generally well answered, even by weaker candidates. Those that did not score were most often due to incorrectly dealing with the direction e.g. **a** – **b**, though there were also a variety of incorrect answers demonstrating no understanding of vectors at all.

(b) This question proved challenging for many candidates and a full score was only achieved by the very strongest candidates. Incorrect responses often gave 3**a** – $\frac{1}{2}$**b,** coming from a misunderstanding of the ratio *OA*: *OC* = 2: 5. A large number of candidates gained credit for indicating a correct route, often $\overrightarrow{MA}+\overrightarrow{AC}$. There were a significant number of candidates that only has a one term answer and many that were wrong due to direction e.g. $\overrightarrow{AM}+\overrightarrow{AC}$ or thinking that $\frac{1}{2}\overrightarrow{AB}$ = $\overrightarrow{MA}$ rather than the correct $-\frac{1}{2}\overrightarrow{AB}$ = $\overrightarrow{MA}$.

Question 23

The majority of candidates understood need for a common denominator and many chose to start with two separate fractions $\frac{2(x+1)}{x+1}-\frac{2x-1}{x+1}$. Following on from this there was a split between those who correctly reached 2x + 2 – 2x + 1 as the numerator, and those who did not deal with the negative correctly and reached 2x + 2 – 2x – 1. The correct answer $\frac{3}{x+1}$ and the incorrect answer $\frac{1}{x+1}$ were both equally common. Candidates were more likely to be successful in this question if they used a single common denominator $\frac{2(x+1)-(2x-1)}{x+1}$, as this less frequently resulted in a sign error. The first bracket was sometimes not expanded correctly, leading to 2x + 1 – 2x + 1, which meant that $\frac{2}{x+1}$ (and very occasionally $\frac{0}{x+1}$) was also seen as the final answer. However, almost all candidates identified that x + 1 was the common denominator and hence a score of 0 was rarely seen.

Question 24

This question was one of the more challenging questions for candidates. Many were able to access some of the marks. Some candidates did not know the relationship between the gradients of lines and perpendiculars and making $\frac{1}{3}$ negative was a common error. Substituting (2, 3) into their equation was often seen and credited. Of those that reached *y* = – 3x + 9, subsequent errors were made, or candidates were unable to proceed, because they did not realise that the two equations had to be solved simultaneously. A number of candidates tried to solve the two equations graphically which did not yield accurate enough results. A common error was for the coordinates 2 and 3 to be substituted into an equation separately, often the originally given equation rather than an attempt at a perpendicular. There were some candidates who attempted to use a midpoint rather than using (2, 3). A significant number of candidates scored all 4 method marks with arithmetic errors preventing the final mark being awarded.

Question 25

This question was a challenge for some candidates although the answer of 63.4 was often seen and at least one mark scored. Many also gave 243.4 for the second angle and scored both marks. Some candidates subtracted 63.4 from 360 to give 296.6 as their second value, and some gave a second value of –63.4. Occasionally candidates lost a mark by rounding to 63 but secured 1 mark for the second answer of 243. Some weaker candidates appeared to have used a method of trial and improvement and tried different angles on their calculators and gave the two answers as 63 and 64. A small minority found tan (2).

Question 26

This question was among the more challenging questions for candidates. Common errors leading to the loss of some marks were not recognising and factorising the difference of two squares in the denominator, or correctly dealing with the denominator but making a sign error when factorising the numerator. Weaker candidates did not realise that cancelling had to be of common factors top and bottom i.e. that factorisation was the starting point. Very common misconceptions were these two methods:

$\dfrac{x(u-1)-2(u+1)}{(u-1)(u+1)}$ followed by $\dfrac{(x-2)(u-1)(u+1)}{(u-1)(u+1)}$ then the answer $x - 2$ or just stopping at $\dfrac{x(u-1)-2(u+1)}{(u-1)(u+1)}$.

Or correctly reaching $\dfrac{u(x-2)-(x-2)}{(u-1)(u+1)}$ or $\dfrac{x(u-1)-2(u-1)}{(u-1)(u+1)}$ then stopping or incorrect cancelling such as just crossing out $u - 1$ on the numerator and denominator to give $\dfrac{x-2(u-1)}{(u+1)}$ with or without brackets around the $x - 2$.

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

It is very important for candidates to give the answers in the form requested by the question. If a form is not requested then algebraic answers should be given in their simplest form and numerical answers should be fully simplified if given as fractions, or written to three significant figures if given as decimals.

General comments

It is essential for candidates to work to more significant figures in working than is required in the final answer and candidates should keep to at least four significant figures in all working. We have seen many candidates leave only two figures in their working.

Many candidates demonstrated that they know how to manipulate expressions with brackets but they did not then use them in writing expressions for areas. Candidates need to apply their knowledge to unfamiliar contexts.

When manipulating equations candidates need to remember that any action must be applied to each term in that equation.

Comments on specific questions

Question 1

This was well answered but some candidates incorrectly gave the answer as 4^3 or 81.

Question 2

This question was answered very well.

Question 3

This construction was completed accurately in most papers. Some candidates did not show their construction arcs, as was requested, whilst a few drew a reflection of the triangle with *BC* as 6.2 cm and *AC* as 7.6 cm.

Question 4

Most candidates either gave the correct answer or a^4.

Question 5

This was well answered. A common error was to work out 40 000 ÷ 0.0099, giving an answer of 4040404.04.

Question 6

(a) Many candidates did not know the name of this shape. Common incorrect answers included parallelogram, isosceles, diamond, rhombus, trapezium and polygon.

(b) This was answered better than part **(a)**. The most common error was to give an answer of 40, without the multiplication by 2. A small number of candidates calculated the 40 and then added 58 to get 98 because they treated the shape as a parallelogram.

Question 7

Many candidates only used the linear property of 100 centimetres in 1 metre and divided by 100 to give 4570.

Question 8

Some candidates gave answers of 18.2 and 18.4, or very occasionally 18.3 and 18.4. A small number gave their answers in millimetres, 182.5 and 183.5, but without the units stated.

Question 9

Most candidates were able to convert both fractions into improper fractions and then correctly multiply them. The final answer given was often $\frac{12}{5}$ as many candidates did not understand how to convert it to a mixed number, or did not realise that the question had requested the answer in that form. Some candidates attempted to work in decimals and a few just gave the correct answer with no working shown at all.

Question 10

The most common correct method was elimination. Those who correctly reached $20y = -10$ sometimes gave the value of y as -2. The method of substitution was seen less and when seen, was less successful. Most candidates who did not resolve the equations correctly scored credit for giving two values that solved one of the equations.

Question 11

(a) The most common error was to do 140 ÷ 14. Candidates then attempted 10 × 7 and not 5, so giving an answer of 70.

(b) This part was not answered well. Some candidates did convert $\frac{2}{7}$ to $\frac{14}{49}$ but they did not then know what to do with 49. A common answer was 28 where candidates had not taken away the initial 2 pink discs.

Question 12

(a) This was answered well, with some candidates giving the answer in the form $\frac{5}{1}$. A few gave the answer $5x$.

(b) Many correct answers were seen, usually in decimal form. Incorrect responses often gave the answer of (0, 12) from the working 5(0) + 12.

(c) This was not answered as well as the previous two parts, with common incorrect responses being an answer of 5 or −5.

Question 13

As well as the expected correct answer of $A' \cap B$, we also saw $(A \cup B) \cap A'$ and $(A \cap B)' \cap B$. Few candidates showed working, with usually only an answer was seen. The most common incorrect answer seen was $A' \cup B$.

Question 14

There was very little working shown by most candidates and very few attempted to use the indices. Some wrote $2^4 \times 3^2 \times 7^6$ or $\sqrt{2^4 \times 3^2 \times 7^6}$. Common answers which gained some credit were 50421, 201684 and $\frac{1}{806736}$.

Question 15

Subtracting $2p$ first was the most common approach which then invariably led to the two correct steps resulting in the correct answer in the form $y(m-2p)^2$. The expanded form of the correct answer, $m^2y - 4mp + 4p^2$ was sometimes seen, though it was unnecessary to go to this stage. The most common error was attempting to square each term independently as a first step. Another common error was, having attempted squaring, candidates then multiplied only two of their terms by *y*. We often saw first the stage $m^2 = 4p^2 + \frac{x}{y}$ and then the step $m^2y = 4p^2 + x$. Sometimes they did not make the length of their root sign $\sqrt{\frac{x}{y}}$ long enough and this then caused an error in the next step.

Question 16

The most common answer given was 67.2, found by 38.4 × 7 ÷ 4. Only a few candidates gave the correct answer. Some used the cube root rather than the cube and some attempted to use the square of the scale factor, giving 117.6.

Question 17

Nearly all the candidates who wrote the correct answer gave it as 492.2 rather than 492.20. The most common incorrect method was an answer of 489.79 or 489.8 arising from $427.80 \times 1.07 = 457.746$ leading to $457.746 \times 1.07 = 489.79$. A few calculated 7 per cent of 427.80 as 29.946, doubled this and added the total to 427.80 giving an answer of 487.69.

Question 18

(a) Many candidates gave the correct answer without any working shown. Most incorrect answers showed at least one of the three terms correct such as $4xy^6$ and $12x^3y^6$.

(b) $\frac{2}{3}$ was the most common form of the correct answer. In decimal form, we needed to see at least three correct figures. For example, 0.67 was not accepted as a correct figure.

Question 19

(a) Some candidates left the answer as an unsimplified fraction, usually $\frac{10}{24}$, and many others gave an answer involving *v* such as $\frac{v+10}{24}$.

(b) Many candidates wrote appropriate expressions for the areas under the graph but they did not use brackets and hence they made errors. One example of this is the area of the triangle where they would write $\frac{1}{2} \times 16 \times v + 10$ which they simplified to 8*v* + 10 instead of 8*v* + 80.

Question 20

Many left this expression partially factorised such as 3*x* + 8*y* – 2*a*(3*x* + 8*y*) without realising that there is a common factor in 3*x* + 8*y*. Some wrote the sign inside the bracket as a minus and then they did not have a common factor.

Question 21

(a) This part was generally well answered with a good number of candidates able to find the required length, often by the method given in the mark scheme. Where candidates did not score full marks, it was common to see *OP* calculated, but then not subtracted from the radius, *OA*, to find the required length. Another common issue was a lack of accuracy in values. Candidates should be encouraged to keep a greater number of figures in their working than they require in their final answer.

(b) Some candidates used alternative correct approaches such as reflecting the shape in the line *OA* to find the area of the segment created before then halving. A common issue was loss of accuracy in calculations where candidates had rounded earlier in their working. Incorrect answers came from those who used incorrect trigonometry, treated the required area as a circle with radius AP or treated the required area as a right-angled triangle.

Question 22

(a) There were many fully correct answers with a smaller number showing fully correct working but with arithmetic errors. Common errors included using the end points of the intervals and working out the total frequency from the table and obtaining a total other than the 100 (which had been given in the question). Some candidates worked with class widths rather than values within the intervals or with frequency density.

(b) This question proved challenging for most candidates with many unable to make a meaningful start on the calculations. Where incorrect attempts were seen it appeared that these did not take into account the use of frequency density and worked as though the question related to a bar chart, or showed attempts at pattern spotting based on the three heights already completed.

Question 23

There were many fully correct answers. Common errors included arithmetic errors in otherwise correct working, using direct proportion rather than inverse proportion, working with y inversely proportional to x or to the square of x, rather than to the square root of x.

Question 24

This was answered well. Candidates found the numerator reasonably easy to factorise. The common problem was in factorising the denominator where they needed to get $x – 5$ as one of the factors to get the correct answer.

Question 25

A small number of candidates gave both correct answers. Some incorrect answers were found from working with $\tan x = −4$ or from trial and improvement. Some candidates were able to find one angle but struggled to find the second, sometimes giving −53.1 as one answer.

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

To be successful in this paper, candidates had to demonstrate their knowledge and application of various areas of mathematics. Candidates who did well consistently showed their working out, formulas used and calculations performed to reach their answer.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Candidates generally showed their workings.

Areas which proved to be important in gaining good marks on this paper were; calculating with money, time and negative numbers, probability, calculating averages from a frequency table, calculating surface area and volume and constructing nets of 3-D shapes, understanding and finding missing angles in geometric problems involving parallel lines, triangles, circle theorems and polygons, finding factors, multiples and prime numbers, effective use of their calculator, using standard form, completing and shading a Venn diagram, simplifying and factorising expressions, solving linear and simultaneous equations, decimals and percentages, rounding, finding the HCF of two numbers, transformations, plotting and interpreting a reciprocal graph, and sequences. Although this does not cover all areas examined on this paper, these are the areas that successful candidates gained marks on.

Candidates find ‘show that’ questions challenging and often use the fact that they are trying to show in their calculations.

Candidates should be encouraged to process calculations fully and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

The standard of presentation was generally good. There was evidence that most candidates were using rulers to draw diagrams and straight line graphs and using a pencil to draw the reciprocal graph.

Comments on specific questions

Question 1

(a) The majority of candidates correctly converted the cost given in yuan to dollars. The most common error was \$7680, from multiplying by the exchange rate instead of dividing. Several candidates used the correct method and found the cost in dollars as \$187.50 but then rounded this exact value to \$188. Candidates should be reminded that exact answers should be written fully and not rounded to 3 significant figures.

(b) (i) Candidates showed good understanding of negative numbers and most candidates found the correct difference. The most common error seen was 11°C from 15 – 4, not considering that the minimum temperature was –4 not 4.

(ii) Candidates did equally well in this part with most finding the correct temperature. Common incorrect answers were 7°C and –7°C from –5 – 2 and 5 + 2.

(iii) This part proved to be one of the most challenging questions on the paper. Only the most able candidates found the minimum temperature on Sunday as –8°C. The most common incorrect answer was 18; candidates used –5 as the minimum temperature for the week and therefore –5 + 23 = 18. The question states the minimum temperature for Sunday and as 4 was the maximum temperature for Sunday then an answer of 18 is impossible. Other common errors were 23 – 15 = 8 instead of 15 – 23 = –8; 19 from 23 – 4 and –19 from 4 – 23. Many less able candidates did not attempt this question.

(c) Finding the smallest number of guards needed each week proved to be one of the most challenging questions on the paper and the correct answer of 7 guards from correct working was seen only from the most able candidates. Working out the number of hours the museum was open for in a week was challenging to many candidates, with 8 + 6 = 14 seen as a common incorrect answer, not realising that these hours applied to all five weekdays and each of Saturday and Sunday. Other errors included 9 hours for each of Monday to Friday, and 7 hours for each of Saturday and Sunday by including the start hour. Some candidates multiplied by 7 instead of 5 and 2 to find the total number of hours open. Some candidates worked out 8 weekday hours and 6 weekend hours but then multiplied these by the number of guards. Most candidates who found the correct number of hours as 52 usually could not convert this into man-hours and $(52 \times 4) \div 30$ was rarely seen. A few candidates used the fully correct method but truncated their answer of 6.93 to 6 guards instead of 7. The most common incorrect answer which followed the correct number of hours open was 2 guards which was found by dividing 52 by 30. A large proportion of candidates did not attempt this question.

(d) Calculating the increased entry price was well answered by most candidates. A variety of methods were used with the most common correct method being to find 28% of \$18 and then adding to find the increased price of \$23.04. Some candidates then went on to round this exact value to the nearest whole dollar. A common error was just finding the increase and giving the answer of \$5.04. Many less able candidates divided 18 by 28 and multiplied by 100 giving the common incorrect answer of \$64.29.

Question 2

(a) (i) This part was well answered. Some candidates converted to a decimal or percentage, often truncating (66.6% or 0.666) but were not penalised if they had shown the correct fraction first. $\frac{4}{20}$ or $\frac{12}{20}$ were common incorrect answers as the candidates added the values on the spinner.

(ii) Most candidates found the correct probability. 6 was the most common incorrect answer. Ratio answers of 6:6 or 6 out of 6 were seen but rarely. A small number of candidates gave the answer as $\frac{6}{20}$ or $\frac{20}{20}$, following the same error as in **part (i)**.

(iii) Most candidates gave the correct answer of 0 or $\frac{0}{6}$ or 0%.

(b) (i) Most candidates could complete the table correctly. Some candidates did not read the question fully and did not add the scores on the spinners. These candidates often looked for patterns in the table.

(ii)(a) Many candidates found interpreting the table and extracting information from it challenging. A common error had candidates misinterpreting the table and using 24 possibilities instead of 16. Many less able candidates counted the correct number of 5's in the table but did not express their answer as a fraction.

(ii)(b) A similar number of candidates were able to find this probability as in the previous part. The common error was to include 5 when counting the number of values 'more than 5', giving the common incorrect answer of $\frac{14}{16}$.

(c) (i) Most candidates found the mode correctly as 1. Other candidates understood that they were looking for the highest frequency but gave the answer of 15 (the highest frequency) instead of the number on the spinner. Another common incorrect answer was 2, possibly being confused with the median; the mean was seen rarely here. Most candidates who chose to list all 50 outcomes got this question correct.

(ii) The most common incorrect answers were 3.5 (the middle value of 1 to 6), 8 (the middle value of the ordered frequencies) or 7 (the middle value of the unordered frequencies).

(iii) Finding the mean was challenging to many candidates. Candidates should be encouraged to make a common-sense check after finding their answer; any answer greater than 6 should lead candidates to check their working. However, $\frac{50}{6}$ = 8.33.. was the most common incorrect answer. The correct answer of 2.76 was seen often following full and correct working out. Candidates who found the correct total of 138 often divided by 6 or 21 (= 1 + 2 + 3 + 4 + 5 + 6) and not 50.

Question 3

(a) (i) Nearly all candidates showed understanding of factors and correctly identified 18. A common incorrect value given was 8.

(ii) Nearly as many candidates showed understanding of multiples and correctly identified 57. The common incorrect answer was 39.

(iii) Fewer candidates showed understanding of prime numbers. Common incorrect answers were 39, 51, 57 or prime numbers not in the list (e.g. 2, 3).

(b) Finding the reciprocal of 64 was challenging for many candidates. The correct fraction was the most common answer although the correct decimal was seen from some candidates. The most common errors were to square root or halve 64. Other incorrect answers seen were $\frac{64}{1}$, –64 and $\frac{-1}{64}$.

(c) (i) Some candidates found using standard form challenging. Common incorrect answers were 4800 and 0.0481.

(ii) Most of the candidates were able to write 75 000 in standard form. The most common incorrect answer seen was 75×10^3.

(iii) Candidates were generally more successful in this calculation as most were able to gain partial credit for an answer which contained a 9, e.g. 9×10^5, 9×10^{-2}, 90×10^3, 0.9×10^3, 90 000, 0.09, –0.09. Fewer candidates were able to change the correct value 90 000 to standard form.

(d) (i) Completing the Venn diagram challenged many candidates. More able candidates could place all 6 values in the correct positions in the Venn diagram with the most common errors involving the 2 and 32 which were often placed inside the circles or not included in the diagram. Another common error involved the number 64, writing it in both circles instead of the intersection. Some candidates included all square numbers to 100 and cube numbers to 125.

(ii) Only a minority of candidates correctly shaded the Venn diagram. The most common error was shading the intersection.

Question 4

(a) This part was attempted by all candidates with the majority gaining full or partial credit. Sign errors leading to 4*a* and $\pm$ 1*b* were seen frequently. Candidates were more likely to gain partial credit for 8*a* than –7*b*. A few did not simplify 8*a* + –7*b* or attempted to simplify the correct answer to 1*ab*.

(b) The vast majority of candidates gained full credit. Occasional errors were seen, usually with $5 \times (-3)$. A small number of candidates changed their expansion into an equation and solved it, reaching *x* = 3.

(c) (i) Most candidates correctly solved the equation. The most common error was 6 from $\frac{18}{3}$ or, less often, $\frac{1}{6}$ from $\frac{3}{18}$, or 15 from 18 – 3.

(ii) This part was equally well answered as **part (i)**. Common errors in rearranging resulted in answers of 2 from $\frac{(18-8)}{5}$. Most candidates attempted to rearrange the equation by moving terms across the = sign although some solved the equation by substituting values until they found the value that satisfied the equation. Few gave an answer without any working.

(iii) Solving the more complex linear equation was more challenging, although many candidates were able to rearrange and solve correctly. The most common error was to add 4*x* to 12*x* instead of subtracting and so 16*x* = 24 was a common incorrect rearranged equation.

(d) Many candidates were able to give the correct value of x. 8 was a common incorrect answer. Some candidates saw 6^2 on the right hand side and gave 36 as their answer. $x = 6^{-8}$ could not gain credit. Less able candidates divided 10 and 2, or wrote 10x = 2.

(e) Solving the worded problem was the most challenging part of this question. Candidates who were able to use simultaneous equations to model this problem were more successful in finding the price of the tickets. For the candidates who knew what to do after they had set up their equations, elimination was the favoured method. This was not always done in the most efficient way however, so this made the numbers on the right hand side large, which sometimes led to errors. Candidates tended to keep the equations in the order that they were given in the question, so that when they subtracted, they ended up with both sides of their equation with one variable having negative terms, which often led to errors. Substitution was seen less frequently after equations had been written down but was usually successfully. Most candidates who did not recognise this as a simultaneous equations question were unable to solve the problem. However, many who attempted a trial and error method often gained partial credit by finding solutions that fitted one equation or family criteria, commonly making adult and child tickets the same price. Other candidates treated the two families separately and tried to solve them individually. Trial and improvement were evident but rarely resulted in fully correct answers. Another common error was to treat both variables as *a* in the first equation giving 8*a* = 124, *a* = 15.5 and both variables in the second as *c* giving 8*c* = 100, *c* =12.5.

Question 5

(a) Many candidates found writing the number in figures challenging, although a majority of candidates gave the correct answer. Several candidates made errors in the position and number of zeros, e.g 12 020, 1 002 020 or 120 000.

(b) Nearly all candidates demonstrated good use of their calculators to reach the correct answer. Occasional errors tended to be caused by misreading their calculator display.

(c) (i) Nearly all candidates were able to write the fraction of the rectangle that was shaded. Few incorrect answers were seen but these included $\frac{3}{8}$, $\frac{3}{5}$ or the correct fraction written as a percentage.

(ii) Not as many candidates found the percentage of the rectangle that is not shaded. Common errors were to find the percentage shaded or write the correct answer but as a fraction not a percentage.

(d) Candidates that converted all numbers into decimals were more successful. Most candidates gained at least partial credit by having 3 numbers in the correct order or converting 3 numbers to decimals. The most common error was in converting either $\frac{5}{17}$ or $\frac{7}{29}$ into decimals.

(e) Most candidates rounded correctly. Common incorrect answers included 0.3, 3.7, 372.8 or 3.728.

(f) Most candidates were able to use their calculator or knew that any number to the power of zero is equal to 1. The common incorrect answers given were 0 and 19.

(g) Most candidates were able to gain at least partial credit for one correct value (often 127.5) or correct values but reversed. Some candidates misunderstood the degree of accuracy required and wrote 127.95, 128.05 or 127,129. 128.4 was seen occasionally instead of 128.5.

(h) Successful solutions often included factor trees or tables to identify the prime factors. Candidates were able to gain partial credit for a correct pair of factor trees or tables although combining the correct prime factors to find the HCF was more challenging. Often candidates found the LCM. A significant number, following correct factor trees or tables, gave a common factor (2,3,6 or 9) but not the highest common factor.

(i) Finding an irrational number with a value between 6 and 7 proved to be challenging. Very few irrational numbers were seen and many of them were not between 6 and 7 (e.g. π). The only correct answers seen were the square root of a number between 36 and 49 or 2π. The vast majority of candidates who attempted this question gave a decimal value between 6 and 7.

Question 6

(a) Providing the candidates with one face of the net meant that very few candidates drew a 3-D drawing of the triangular prism. Most candidates showed they understood that the net needed two more rectangular faces and two triangular faces although getting the correct dimensions was challenging to many candidates. Many drew the remaining two rectangles as both 4 cm by 6 cm. Few worked out the length of the hypotenuse, but got it correct on the drawing of the triangular faces as they usually drew the other two sides as 3 cm and 4 cm. Several triangles were seen with a base and height of 4 cm. Several candidates did not attempt it at all, possibly not knowing what is meant by net.

(b) Working out the surface area of the prism was more challenging than the previous part with few fully correct solutions seen. The most successful solutions were organised with words or diagrams and calculations to clearly show the area of each face added together. Many calculations were clearly volume calculations whilst others found the surface area of a cuboid with similar dimensions to the given prism. Finding the width of the sloping edge was not obvious to many. Of the candidates who did not gain full credit, many managed to score at least partial credit by finding a correct rectangle area or a correct triangle.

(c) Working out the volume of the prism proved to be challenging also. The best solutions included the use of a formula. The most common error was to work out $3 \times 4 \times 6$ and not divide by 2. A significant number of less able candidates did not attempt this question.

Question 7

(a) Successful candidates used the angle properties of an isosceles triangle and angles on a straight line to correctly find the size of the angle. Good solutions showed each step of the calculations. Many candidates gave partial solutions by subtracting and giving an answer of 62 but did not then go on to complete the solution. Several candidates started correctly finding 62 but then divided this by 2 and marked the bottom two angles of the isosceles triangle as 31. Less able candidates often started with subtracting from 360° or using 360 as the total of the angles in a triangle.

(b) Many candidates gained partial credit for correctly finding the value of x as 31 using alternate angles. However, few candidates were then able to find the value of y to be 121. The most common incorrect answers were 149 (= 180 – 31) or 59 (= 90 – 31).

(c) Good solutions to this circle problems question recognised that the angle in a semi-circle is 90°. Candidates who knew this often went on to gain full credit. Most errors came from not knowing that the angle at *B* was 90°, e.g. treating the triangle as isosceles (180 – 53 – 53 = 74 or *a* = 53) or ignoring the angle at *B* (180 – 53 = 127).

(d) Candidates found this 'show that' question challenging. A large proportion of candidates used the fact that the three angles added up to 360° to calculate the interior angle of the octagon i.e. 360 – 90 = 270 and 270 ÷ 2 = 135 to then show that the 3 angles added up to 360°, therefore giving a circular argument. Calculating the size of an interior angle of a regular octagon proved to be the most challenging part of this question. Successful solutions showed each step of the calculations. A common error was not knowing how many sides an octagon has (6 and 10 the common incorrect number of sides used). Equally common was 360 ÷ 8 = 45 only. A significant number of candidates did not attempt this question

Question 8

(a) (i) Good answers contained all three parts to describe a rotation, including degrees and direction and centre of rotation. The most common error was to omit the centre of rotation. When the centre of rotation was attempted it was often correct although several candidates wrote it as a vector instead of a co-ordinate. Few candidates described two transformations; a rotation followed by a translation which could gain no credit.

(ii) The description of the translation was found the most challenging of all the transformations in this part. Common errors were writing the vector as a co-ordinate or reversing the signs.

(iii) Most candidates understood that it was an enlargement, but the centre of enlargement was often not given. However candidates who drew lines connecting vertices of the two shapes often were able to give the correct centre of enlargement. The scale factor was more often given than the centre of enlargement.

(b) Many candidates did not attempt this drawing of a reflection. However, of those that did attempt it, most were able to gain full or partial credit. The most common error was to reflect in the line $x = -1.5$. Other errors seen were reflections in the line $y = -2$ or $x = 2$. Candidates who drew a mirror line were more successful at drawing the reflected image.

Question 9

(a) Completing the table was the most successful part of this question and most candidates gained full credit. The few errors seen were generally for omitting minus signs for x = –5, –3 or –2.

(b) Candidates generally drew smooth reciprocal curves. Very few straight lines joining points were seen and even fewer thick or feathered curves drawn. Few candidates joined the points (–1, –15) and (1, 15). Plotting points proved challenging due to the scale on the *y*-axis.

(c) A large proportion of candidates did not attempt this question. The most common error was drawing a diagonal line through (0, 6).

(d) A significant proportion of candidates did not attempt this part. The most common incorrect answers were 90 (15 x 6) or incorrect reading from their graph. The follow through was only available if their line for $y = 6$ had been drawn horizontal.

Question 10

(a) (i) All candidates attempted this question and nearly all candidates were able to write down the next term of the sequence.

(ii) Candidates found writing the term to term rule more challenging. Correct answers had many formats, +7, add 7, increase by 7, etc. Common attempts which did not gain credit were $n + 7$ and 7 without a description of increasing.

(iii) Finding the *n*th term was the most challenging part of this sequences question. The correct answer was seen frequently but often candidates repeated their attempt for the term to term rule or did not attempt the question. Many candidates attempted to use the formula to find the *n*th term and when quoted correctly this often led to the correct answer.

(b) (i) Finding the next term of the quadratic sequence was more challenging than the linear sequence in **part (a)**. However, it was well answered with the majority of candidates finding the correct next term. Often candidates found it useful to write down the first difference and sometimes the second difference.

(ii) Finding the next term of this sequence was not as well answered as the previous part. Despite working out differences many did not find the correct term. The most common incorrect answers were 64 (by adding the latest first difference (16) to 48), 50 by starting the first differences back at 2, and 32 by continuing the sequence of first differences.

(c) A significant number of candidates did not attempt this question. Successful solutions showed clear working out, full substitution of $n = 1$, 2 and 3 in 3 separate sums. Common incorrect answers were 6, 9, 14 (using $n^2 + 5$); 6, 18, 42 (using $(n^2 + 5)n$) and 6, 11, 16 ($1 + 5n$).

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer and the loss of the accuracy mark. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. Candidates should also be reminded to write digits clearly and distinctly. Candidates should use correct time notation for answers involving time or a time interval.

Comments on specific questions

Question 1

(a) (i) This part was well answered with almost all candidates adding six connected squares correctly onto the pictogram. The candidates who did not score had either not connected their six squares, had the incorrect number of squares or had not made a response.

(ii) The majority of candidates gave the correct response for this part.

(iii) The majority of candidates obtained the correct answer. Most candidates correctly worked out the number for each meal and then added these together. The errors seen came from either not having or not including the six salad meals or for arithmetic slips in finding the number of meals of each type.

(b) This part was generally very well answered. A small number of candidates answered the question with no working. Common errors included leaving the answer as $7.25, costing the wrong drinks or amount of drinks bought.

(c) The majority of candidates understood the overall method required but only a minority gained full credit. This was often the result of poor notation for the intervals of time. Acceptable answers for a period of time were 55.5 hr, $55\frac{1}{2}$ hrs, and 55 hrs 30 mins. Common errors included weekday hours of 2, 11 or 14, Saturday hours as 6.5 or 12.5, omitting to multiply the weekday hours by 5, or multiplying by 7, and unacceptable final answers of 55.30, 55.3, or 55 30.

(d) This question was answered well with many candidates gaining full credit. The most common error was candidates finding $\frac{1027}{7}$, $\frac{1027}{4}$ and $\frac{1027}{2}$ rather than first dividing by the total parts (2 + 4 + 7).

(e) This part on percentage increase was generally answered well. Common errors included using 7566 as the original amount and finding a decrease to 96.2% or a reduction of 3.85%, an answer of 2.91% from $\frac{(7566-7275)}{100}$, and final answers left as 104 or 0.04.

(f) This part was not generally answered well as although the majority of candidates understood the basic method to be used and appreciated the need to use a formula, a variety of errors were seen. Common errors included the use of incorrect formulas such as time $\div$ distance and time $\times$ distance, incorrect time conversions to 3.3 hours, and use of 210 minutes.

Question 2

(a) This part was generally well answered although the instruction to give the answer in millimetres caused a few problems. Common errors included 0.48, 480 and 4800.

(b) (i) This part, which involved the measurement of a reflex angle, was generally well answered although a number of common errors were seen including 137° from measuring the obtuse angle only, 53° and 180°.

(ii) Whilst many candidates could give the correct name of the angle, the most common incorrect responses were obtuse, acute and reflect as well as a variety of other mathematical words.

(c) This part proved more challenging with not all candidates appreciating that the two geometric properties of angles in an isosceles triangle and angles on a straight line needed to be used. Although a good number of correct answers were seen, common errors included 180° – 26° = 154°, a final answer of 77° and the use of 360° rather than 180°.

(d) This part also proved challenging with not all candidates appreciating the full and complete formula to be used. Common errors included finding the exterior angle as 22.5, the total interior angles as 2520, and the incorrect use of 16 ×180, 16 × 360, 14 × 360, $\frac{2520}{14}$ and $\frac{180}{16}$.

(e) (i) Few correct answers were seen to this part. Common incorrect answers included radius, diameter, chord, tangent and descriptions such as inside, within, around or on the edge of the circle.

(ii) Only the more able candidates could give the correct reason of ‘the angle in a semicircle is 90’. Common errors included ‘it’s a right-angled triangle’, ‘the triangle is inside the circle’, ‘it is on a tangent’ and a number of non-mathematical descriptions or reasons.

(f) This part was not generally answered well as, although the majority of candidates understood the basic method to be used and appreciated the need to use a formula, a variety of errors were seen. Common errors included the use of incorrect formulas such as πd, $\frac{1}{2}\pi r^2$, using the diameter value of 6 for the radius, inaccuracies resulting from using π as 3.14 or $\frac{22}{7}$ rather than the 3.142 as stated in the rubric or their calculator value. A good number were able to gain credit for giving the correct units but many gave cm or cm^3 or no units at all.

Question 3

(a) (i) The majority of candidates recognised the shape was a trapezium. There were many varied incorrect answers with the most common being parallelogram, rhombus and parallel.

(ii) The majority of candidates recognised the diagram showed a cylinder. Incorrect answers were varied with cuboid, circle and prism the most common.

(b) This part was less well answered. Common errors included $\frac{64}{4}=16$, $\frac{64}{2}=32$, $64^2 = 4096$ and 64 × 4 = 256.

(c) A significant number of candidates found this question challenging and it proved to be a good discriminator. Those candidates who appreciated that an algebraic method could be used were usually successful in reaching the correct answers from the initial equation of $w + w + w + 3 + w + 3 = 26$. Others successfully solved it by good numerical methods, trial and improvement or diagrammatic methods. Incorrect answers were often based on 6.5, from $26 \div 4$, giving $6.5 \pm 3 = 3.5$ and 9.5, or 6.5 and 19.5. Some based their answers on 13 giving 13 and 5, 13 and 10 or $13 \pm 3 = 10$ and 16. Others started from $26 – 6 = 20$ then $20 \div 2 = 10$, usually giving 10 and 3 as the answer.

(d) (i) This part, on drawing the net of a given cuboid, was generally well answered with a variety of correct nets seen which were drawn accurately and precisely. Common errors included, nets consisting of 6 by 3 rectangles placed above and below the given face and 3 by 3 squares drawn on either side, the inclusion of rectangles measuring 6 by 2, the omission of the 6 by 3 side, and occasionally a 3–D sketch of a cuboid or one or two separate rectangles.

(ii) This part was not generally answered well although the most successful candidates were those who had learnt and used the formula $2(lw + lh + wh)$. Common errors included; 18 from 3×6 (the area of the given face), or $3 \times 6 \times 1$ (the volume of the cuboid), and 27.

Question 4

(a) (i) This part was generally very well answered although errors of 07 58, 7, 12, and incorrect notation such as 7 hrs 12 were seen.

(ii) This part was also generally very well answered although errors of 06 54, 07 53, 8, 16, and incorrect notation such as 8 hrs 16 were seen.

(b) (i) This part was generally very well answered with the majority of candidates able to accurately measure the distance between the two points and correctly convert it using the given scale. Common errors included leaving the distance as 9.5, an inaccurate measured distance of 10 cm and incorrect conversion to 950 or 9500 or 0.95.

(ii) This part was generally well answered with a good number of candidates able to plot the correct position of the town on the scale drawing. A significant number plotted the location of the town at the correct distance but not at the correct bearing while fewer candidates plotted the correct bearing but at an incorrect distance. The incorrect bearings were often a result of reading the incorrect scale (80°) on the protractor, or aligning the protractor incorrectly.

Question 5

(a) (i) This part was generally well answered with a good number of candidates able to correctly find the median. Common errors included; using the unordered pair of 95 and 182 to give an answer of 138.5, leaving the ordered list without any further work, using 200 and 238 but obtaining answers of 438 and 319 (from $200 + 238 \div 2$ suggesting incorrect use of the calculator), with a small number finding the mean or range.

(ii) This part was also generally well answered with a good number of candidates able to correctly find the mean. Common errors included; leaving the answer as 3050, arithmetic errors in the addition, omission of one or more values in the addition, with a smaller number finding the median or range.

(iii) This part proved more challenging with very few candidates able to state a valid reason why the mean was not a suitable average because of the one extreme value. Answers were very varied but were often based on the range being too big, the mean not being one of the given values, all the wages of the workers being different, or comments such as ‘it is unfair’.

(b) (i) A minority of candidates were able to state the correct mode, 56, from the stem-and-leaf diagram. Many thought the answer was 6, although it was usually unclear whether this came from ignoring the ‘stem’ of 50 or because there were more 6’s in the ‘leaf’ section of the whole diagram. Another common answer was 5, though again, it was often unclear whether this was because there were more values in the row for the 50’s than in any other row, or from $6 – 1 = 5$ using the stem.

(ii) A minority of candidates were able to calculate the correct range, 52, from the stem-and-leaf diagram. Incorrect answers were very varied although a common error was to add all the numbers in each row and find the range of these, resulting in 29 – 14 = 15. Other errors included using 6 – 1 = 5 from the stems and the answer of 9 from subtracting the units digits 9 – 0.

Question 6

(a) This part was generally answered very well with just a few common errors of six hundred thousand and twenty five and sixty hundred thousand and twenty five.

(b) This part was generally answered very well although common errors of 849.500, 84.95, 849.4, 849 and 849.0 were seen.

(c) (i) The vast majority of candidates understood the meaning of the term factor and many were able to gain full credit. It should be reinforced to candidates that the factors of any number include 1 and the number itself, as it was common to see just the two factors of 3 and 7 stated, sometimes given as a multiplication. Other common errors included 1, 3, 7, 1 × 21 and 3 × 7, 1 × 3 × 7 × 21.

(ii) The majority of candidates recognised the term prime number and were able to give one of the three correct values, with a number giving all three. Common errors included, 45 and 49, either alone or alongside the correct answers, whilst a very small number had not read the question carefully and gave a number outside of the given range.

(d) This part was very well answered with the rare error of 0.25 or 2.5.

(e) (i) This part was also very well answered and candidates understood the notation and how to use their calculator to find the required value. The most common errors were to find the square root or to find the square root and multiply this by 3.

(ii) This part was generally answered very well although the common errors of 0 and 7 were seen.

(f) This question was well attempted and it was clear that the formula for compound interest was well known and understood. Candidates should be reminded that premature rounding leads to inaccurate answers and they should be encouraged to carry out the calculation in one go on their calculator. A significant number of candidates scored only partial credit as they did not follow the instruction 'Give your answer correct to the nearest dollar'. Common errors included; subtracting the initial investment to give just the interest, using simple interest, and using an incorrect compound interest formula. Candidates should be encouraged to check if their answer is plausible for questions in context as many answers seen were either small or very large when the formula was used incorrectly.

Question 7

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

(a) (i) The majority of candidates were able to identify the given transformation as a rotation but the identification of the centre of rotation and angle of rotation proved more challenging. A very small number gave a double transformation, usually rotation and translation, which doesn't gain any credit. Common errors included, angles of 90° anticlockwise and clockwise, centres of (–2, –4) and (2, 2).

(ii) The majority of candidates were able to identify the given transformation as a reflection but the identification of the line of reflection again proved more challenging. Common errors included $y = 0$, x-axis, $x = 2$ and giving a vector or co-ordinates in place of a line of reflection.

(iii) A smaller number of candidates were able to identify the given transformation as a translation, with transition and transformation being common errors. Again the identification of the translation vector proved challenging with the common errors being reversed or inverted vectors, incorrect signs, and the use of co-ordinates.

(b) A significant number of candidates found this question challenging and it proved to be a good discriminator. Those who drew rays connecting the points of the given triangle to the given centre of enlargement were the most successful. The given scale factor of 0.5 proved challenging for many candidates. Common errors included; a triangle with the correct scale factor but incorrect centre (often (0, 0) or (–2,–2)), a triangle with the correct centre but incorrect scale factor (often 2 or 1 or –0.5), with a significant number unable to attempt this part.

Question 8

(a) There were many correct answers seen which referred to there being 2 Ms or there being 12 letters or both. Sometimes a correct statement was spoilt by stating the incorrect probability of $\frac{2}{10}$ or $\frac{1}{12}$. A number of answers just involved stating the correct probability and not giving an explanation referring to numbers of Ms or numbers of letters.

(b) Candidates showed very little working in this part but many gained full credit for the correct answer of 0.39. When working was seen it usually led to the correct answer. Common errors included 0.61, 0.15 and 0.25.

(c) Candidates generally appeared unfamiliar with completing a Venn diagram of this type. A significant number of candidates found this question very challenging and it proved to be a good discriminator. Few candidates appreciated that the figure to start with was the 10 (like football but not cricket) as this could be placed directly onto the Venn diagram. Correct use of the other three pieces of information would then complete the diagram. Many started with the figure of 24 (like football) but incorrectly positioned it usually in the (like football but not cricket) section, often followed by the figure of 19 (like cricket) positioned incorrectly in the (like cricket but not football) section. A small yet significant number placed all the numbers from 1 to 40 onto the diagram. A significant number were unable to attempt this part.

(d) (i) Candidates were clearly unfamiliar with this notation and there were very few correct answers to this part. The most common errors involved listing the numbers either in *A* or $A \cap B'$ or $A \cap B$. Other errors included; all the values added to give answers of 54 or 90, incorrect notation such as 9(*A*) and the answer of 2.

(ii) Candidates were more successful at this part and there were many correct answers seen. Common errors included; a list of 3, 9 and 15, and seen less often, a list of 6, 12 and 18, the omission of one element and the answer of 6.

(iii)(a) This part was generally answered reasonably well although a significant number just gave an answer of 7 or a list of the elements rather than a probability. Other common errors were; incorrect denominators of 18, 20 and 12, and/or incorrect numerators of 3, 13 and 16,

(b) This part was generally answered slightly less well, and again a significant number just gave an answer of 12 or a list of the elements rather than a probability. The common errors listed above were also seen in this part, with $\frac{3}{19}$ often seen possibly due to confusion with the union and intersection notation.

(iv) A significant number of candidates found this question challenging and few correct statements were seen. Although a good number identified the correct region many did not understand the set notation used in the question. Common errors included lists such as 2, 4, 6, 8, 10, 12, 14 16, 18 or 3, 9, 15 or 1, 5, 7, 11, 13, 17, 19, and incorrect statements such as odd numbers, prime numbers, integers less than 20, even number or multiples of 3.

Question 9

(a) This was a well answered question with the majority gaining full credit. One successful strategy often seen was to re-write the question, grouping the *x* values and *y* values together. Common errors included; final answers with 2*x* and/or 5*y*, – 3*y*, 11*y* or –11*y*, 30*xy* or 1*xy*.

(b) Candidates found writing the expression in this part more challenging. Common errors included 60*x* + 29*y* = 89, 89*xy* and simply 89.

(c) Candidates demonstrated very good algebra skills dealing with this equation involving a bracket with the majority gaining full credit. The majority made a correct first step by multiplying out the brackets, although some made a first correct step of dividing by 5. Common errors included incorrect first steps of $10x + 4 = 85$, $2x + 4 = 80$, $5 \times 6x = 85$ and incorrect second steps of $10x = 105$, $30x = 85$, $2x = 21$, $6x = 17$.

(d) (i) Many candidates had a good understanding of the laws of indices and found both correct values in **part (d)**. In **part (i)**, the most common incorrect answer was 2 rather than –2 and workings were sometimes shown as 8 – 6 beside the question. The other common error was to add the powers, giving an answer of 14. A small number calculated –2 correctly but recorded their answer incorrectly as 2^{-2}.

(ii) This part was more successful than **part (i)**, probably because the missing power was with the first number and no negative numbers were involved. The most common incorrect answers were 2, from 6 – 4 and 24, from 6×4. Again, 5^{10} was sometimes given as the answer and candidates should be made aware that this form is incorrect when asked to give the value of an index.

(e) The vast majority of candidates had the mathematical knowledge and tools to gain some credit in this question with many successfully gaining full credit. Candidates had far more success in writing out the equations than the expressions in **Question 9(b)**, perhaps because they are more comfortable when an equal sign is involved. Less able candidates sometimes omitted the letters or signs or re-wrote the given sentences rather than writing them algebraically. The most common and most successful method was to equate one of the coefficients and then subtract one equation from the other, and the majority of candidates showed full and clear working for this. It was less common to see a rearrangement and substitution method which is where more algebraic errors occur.

Question 10

(a) The table was generally completed very well with the majority of candidates giving 2 correct values for full credit. However the point at $x = -2$ was more challenging with a large proportion of candidates dealing with the negative sign incorrectly within the x^2 term and giving $y = 1$ or 7. Candidates should be encouraged to look at the general shapes of different groups of graphs as the majority followed through their error to plotting, not realising that this could not possibly be the correct point for this quadratic graph.

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

(c) This part on using the graph to solve the given equation was well answered. There were many correct answers with candidates reading the values off accurately from their curve. Common errors included; misread of the scale, omission of the negative sign, and incorrect values of ±4 and ±3. A significant number were unable to attempt this part. A small yet significant number of candidates tried to solve the equation algebraically, which was not the required method and is beyond the syllabus for core, and this was rarely successful.

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key messages

To do well in this paper, candidates need to demonstrate that they have a good understanding across the wide scope of the syllabus.

In addition, candidates need to ensure that they read the questions carefully and ensure that they are answering the question asked.

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

General comments

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

In questions that say ‘show that’ such as **Question 1(f)(i)**, candidates should understand that they should arrive at the value they are expected to show rather than using it in their workings.

Candidates should be aware of the stem of a question where it relates to more than one part. For example, in **Question 2(a)**, all five parts required answers from 55 to 85. Some candidates overlooked this requirement after the first couple of parts.

Candidates need to understand the importance of notation. For example, in **Question 6(b)** and **(c)** a significant number of candidates were treating the vectors as fractions.

Working needs to be given to enough accuracy, so that final answers are accurate to at least 3 significant figures unless they are exact answers, in which case the complete answer should be given. In this paper, questions where premature rounding was a particular issue were **Questions 4(d)**, **4(e)** and **8(c).**

Where a question asks for a reason, such as in **Questions 8(a)(ii)**, **(b)(i)** and **(b)(ii)**, it requires a mathematical reason such as ‘angles on a straight line add to 180°’. It does not require a description of what the diagram looks like or a mathematical calculation of the angles.

The standard of presentation and amount of working shown was generally good.

Comments on specific questions

Question 1

(a) (i) A large majority were able to write the number in words correctly. A few added the word ‘hundred’ to their answer, for example ‘two thousand and sixty-seven hundred’. Other errors included writing 2 as a numeral or sixth or sixteen for sixty.

(ii) This was very well answered with a very high proportion of candidates able to round the number correctly to the nearest hundred. A few rounded to the nearest ten or to the nearest thousand or gave the answer as 207.

(b) The majority cancelled the ratio to its simplest form. It was common to see answers that were only partially cancelled.

(c) Nearly all candidates calculated the correct percentage. A few found the percentage of unused cabins.

(d) A significant number of candidates were able to calculate the correct percentage increase, but many others used incorrect methods. The common errors were to divide the increase by the new amount or to divide the original amount by the new amount. Some candidates gave the answer 1.84, from dividing the increase by 100.

(e) Many candidates were able to write the number correctly in standard form. A common incorrect answer was 153×10^6. A few gave the answer as 153 million or other incorrect attempts at standard form, such as 15.3×10^7 or 1.53×10^{-8}.

(f) (i) This 'show that' question was not answered very well by a significant number of candidates. Most candidates recognised the sector occupied a quarter of the circle and that this was 90°. However, it was quite common for candidates to use the value 120 to show the angle for the sector was 90° rather than using the 90˚ to show that there were 120 cabins. Some did not gain any credit as their method was not shown clearly enough.

(ii)(a) A large majority were able to calculate the correct angles for the pie chart. Those with incorrect answers often gave two angles that added to 126°, appreciating that the total needed to sum to 360°.

(b) A large majority of candidates were able to complete the pie chart accurately.

Question 2

(a) (i) A large majority gave the required multiple of 23. A common incorrect answer was 46.

(ii) A large majority gave the required factor of 120. Some candidates gave other factors of 120.

(iii) Most candidates gave the correct common multiple of 8 and 12. Some gave other multiples, usually 24 or 48. A few gave the answer as 4 or 2, possibly getting confused with common factors.

(iv) Candidates found this part more challenging and many were unable to give the correct answer. Some did give a square number as the answer, but usually these were 1, 4, 9 or 64, which were either out of range or not an odd number.

(v) A minority of candidates gave one of the possible correct answers, with 59 being the most common. The most common incorrect answer was 57. Others did recognise the answer should be a prime number but gave a value out of range such as 2 or 3.

(b) Many candidates were able to write 220 as a product of its prime factors. Some gained partial credit for a list of the correct prime factors or for a correct method. Others just gave one or more factors of 220.

Question 3

(a) Many candidates were able to complete the table of values correctly. A common error was to calculate the y-coordinate as –3 when $x = -1$.

(b) Although a number of completely correct and accurate graphs were seen, a large majority of candidates scored only partial credit for drawing the graph. This was often as a result of the previous error in **(a)**. Some candidates plotted a point inaccurately, some had ruled sections and a few plotted the points but did not join them with a curve.

(c) (i) Many candidates were able to draw the line $y = 3$, and most covered the width of the grid, as required. Some omitted this part and a small number drew a vertical line through $x = 3$.

(ii) Those candidates who had drawn the line $y = 3$ in the previous part nearly always gave the correct values of x for the points of intersection of the line with the curve. Some candidates attempted to solve using the quadratic formula but were rarely successful; this is beyond the syllabus and not the required method.

Question 4

(a) Many candidates gained full credit for finding this compound area. Some lost the accuracy of the final answer as a consequence of rounding the partial areas to 3 significant figures before adding them. Most candidates were able to earn partial credit for one correct area or for finding one of the missing lengths on the diagram. A few found the perimeter or just added the numbers from the diagram or multiplied them all.

(b) A minority of candidates gained full credit. Candidates who started with the formula $C = \pi d$ usually found the correct diameter. Those who used the version $C = 2\pi r$ usually found the correct radius but some forgot to double the answer. Having got this far, candidates often did not convert the units from metres to centimetres, whereas for some this was what gained them some partial credit. Some incorrect methods were seen such as $4.25 \times \pi$ as well as some trivial calculations such as 4.25×2.

(c) A minority of candidates gained full credit. A variety of incorrect attempts to use the formula for the volume of a cylinder were seen, the most common being $2\pi rh$. Others included $\pi rh, 2\pi r$ while many, such as 24×15, did not involve the use of π.

(d) Many correct answers were seen. A few lost the accuracy as a result of rounding the scale factor prematurely. Most candidates who did not gain any credit had found the difference between the two given diameters or the pair of lengths for the first pot. They then added or subtracted that value to find the missing height. A few found a scale factor but used it incorrectly.

(e) Many correct answers were seen. Those who compared the cost per litre usually chose the correct bag. Those who compared the number of litres per dollar often did not interpret the result correctly and picked the small bag. Those who had not gained full credit usually gained partial credit on this question for some relevant calculations. Again, a few lost the accuracy as a result of rounding too much.

Question 5

(a) (i) Most candidates found the range correctly. Errors seen included writing the range as '7.1 to 14.9', not selecting the largest and smallest values carefully enough and finding the range of the maximum power.

(ii) Candidates who rewrote the given list of numbers in numerical order were generally successful in selecting the middle two numbers, 77 and 85 and hence the median of 81. It was quite common to see errors or omissions in the ordering of the list or candidates selecting the middle two numbers 44 and 51 from the unordered table. A common error was the calculation of the mean of all ten numbers.

(b) (i) Almost all candidates plotted the two extra points correctly.

(ii) Most candidates correctly stated that the type of correlation was negative. Common incorrect answers included positive, power, linearity, decreasing, descending or comparison.

(iii) Many candidates were able to describe the relationship as the greater the power the less time taken to reach 100 km/h. Some candidates did not describe the overall relationship but gave the numerical values of the actual power and times for the most, or least, powerful car.

(iv) Many candidates drew well placed lines of best fit. Those who drew lines which had the majority of points on one side of the line or the other did not gain credit. Common errors were lines with a positive gradient, unruled lines and a zig zag joining of the points.

(v) Most candidates were able to give a good estimate of the time taken for the given car to reach 100 km/h. It was quite common for candidates to misread the maximum power scale at 66 rather than 63.

(c) This question was answered very well by most candidates. They understood the requirement to subtract the deposit and divided the remaining money by the amount of payments.

(d) This part was answered accurately by many candidates. However some candidates did not read the question carefully and costed either the fuel already in the tank or the cost of $52-\frac{1}{4}=51.75$ litres.

Question 6

(a) (i)(a) Most candidates translated triangle *A* correctly. Some candidates gained partial credit for translating the triangle correctly in one of the two directions. A minority of candidates gained no credit for translating triangle *A* by $\begin{pmatrix}-3\\7\end{pmatrix}$.

(b) Many candidates reflected triangle *A* correctly. However a number of candidates only gained partial credit because they reflected triangle *A* in the incorrect line, usually $x=2$ or $x=2.5$ or $y=3$. In addition, some candidates did not read the question carefully and reflected their triangle from **(a)(i)(a)**, rather than triangle *A*, in the line $x=3$.

(ii) Some candidates were well versed in how to describe the transformation correctly and stated rotation, 90°, (0,0) succinctly. Other candidates clearly recognised the transformation but used inacceptable phrases such as ‘turns’, ‘moved round’ and ‘went left’ or made errors with the centre, size of the angle or direction. A significant number of candidates did not describe a single transformation and gave explanations that involved both rotating and translating and these did not gain credit.

(iii) Some candidates described the transformation concisely as: enlargement, scale factor 3, centre (4,4) to gain full credit. Phrases such as ‘it is bigger’ or ‘it grows’ were not acceptable and the word ‘enlargement’ needed to be written. Other errors were seen with the scale factor and centre. As in **part (a)(ii)**, a single transformation was required and those candidates describing an enlargement with a translation did not gain credit.

(b) (i) Most candidates answered this correctly. The errors seen often included arithmetic and sign slips. A number of candidates treated the vectors as fractions and either included a fraction line in their answer or tried to add or multiply as fractions.

(ii) A good proportion of candidates answered this correctly. The common errors were, as in the previous part, predominately arithmetic or sign errors, but often candidates were able to gain partial credit. However, fractions were again seen with common errors such as $-2\begin{pmatrix}-1\\4\end{pmatrix}=\frac{-2}{4}$ and $\frac{5}{7}+\frac{2}{4}=\frac{34}{28}=\frac{17}{14}$ seen regularly.

(c) Some candidates answered this correctly. However common errors were $(10,-7)$ and $(-10,7)$ found from subtracting rather than adding as well as the transposed answer, $(3,2)$. Some candidates attempted to draw a diagram of the point and vector but these frequently contained errors either with the plotting of the point or the size or direction of the vector.

Question 7

(a) Almost every candidate answered this correctly. The odd errors seen were usually slips in arithmetic and one of the available marks could usually be awarded if working was shown.

(b) This question was answered well with a good proportion of candidates correctly and completely factorising the expression. Those who only partially factorised the expression to, for example, $4(3b+2b^2)$ or $2b(6+4b)$ gained partial credit. Incorrect methods included responses such as $3+2b$, $20b$ and $96b^3$.

(c) Many correct answers were seen. Common errors were seen in the first step with the negative signs, for example, $4m = y - p$. Other errors included writing the final answer as $m = y + p \div 4$ or $m = \frac{y}{4} + p$.

(d) Most candidates understood that the powers were added and gave $x = 9$ as the correct answer. The most common incorrect answer was to multiply the powers and give $x = 4$. Some candidates worked out $5^x = \frac{244140625}{125} = 1953125$ but were unable to find x from here.

(e) (i) It was rare for a candidate to answer this part incorrectly. If an incorrect answer was given it was usually 0 or occasionally 3.

(ii) This part was almost always answered correctly. If an incorrect answer was seen it was usually –25.

(f) The best solutions were those where candidates started with the equation $2[(2x+5)+(3x-1)] = 33$ and proceeded to solve it for x and indeed some clear and accurate solutions were seen. Others made arithmetic or rearranging slips. Some candidates chose to work numerically showing $33 - 8 = 25$ and $25 \div 10 = 2.5$. Other candidates used trial and improvement but not all could find the solution. Other errors seen included using only two sides, multiplying all the lengths together, squaring the lengths or solving $2x + 5 = 0$ or $3x - 1 = 0$. Candidates who stated an incorrect value for x but went on to correctly evaluate $3x - 1$, for their x, were awarded partial credit.

Question 8

(a) (i) While some candidates correctly named the line as a chord, a multitude of incorrect answers were seen including circumference, diameter, tangent, segment, straight line, bisector and sector.

(ii) Only a small proportion of candidates were able to explain why the angle was 90°. Candidates were required to use the words tangent and radius (or diameter) in a short sentence such as 'the angle between the tangent and the radius is 90°'. Most candidates gave long descriptions about the circumference, straight lines, triangles or perpendicular lines which did not gain credit.

(iii) Many candidates answered this question correctly. Others scored partial credit for working out 37° but they were unable to proceed further as they did not realise that triangle *OPQ* was isosceles. Although the diagram clearly said it was not to scale, some candidates measured angle *x* as 120°.

(b) (i) Whilst the majority of candidates were able to give the value of *a* as 48, far less were able to give the correct mathematical reason, 'corresponding angles'. Most gave descriptions about parallel lines and the angle being the same as the other 48 which did not gain credit.

(ii) Most candidates gave the correct value for *b* but, as in **part (b)(i)**, far less gave a correct mathematical reason. Candidates could not gain full credit if they only showed calculations such as $180 - 65 - 48 = 67$ or gave a reason such as 'a straight line is 180°' with no reference to any angles.

(iii) Many candidates answered this correctly and were able to do so without adding anything extra to the diagram or showing any working. Common incorrect answers were 48°, 65° and 132°.

(c) A large proportion of candidates wrote $\tan 34 = \frac{11.8}{x}$. However many then rearranged this incorrectly to $x = 11.8 \times \tan 34$ or incorrectly understood $\frac{1}{\tan 34}$ to be $\tan^{-1} 34$. Other errors included premature approximation using tan34 = 0.67 or choosing sine or cosine in error. Those attempting longer methods were rarely successful.

Question 9

(a) Almost all candidates drew pattern 4 carefully and precisely.

(b) Almost all candidates completed the table correctly. Occasional errors were seen for the number of white counters such as 18, 20 or 21 instead of 25.

(c) (i) Many candidates gave the correct expression or an answer algebraically equivalent to $2n + 2$. Common incorrect answers included $n + 2$ or stating the term to term rule as +2 or giving 14 as the number of black counters in pattern 6.

(ii) Many candidates gave the correct answer. Common errors included linear expressions in *n* or 36, the number of white counters in pattern 6.

(d) Many candidates produced some excellent answers to this question both in terms of their calculations and their written explanation. They usually worked out the number of black and white counters needed as 26 black and 144 white and stated that whilst there were four extra black counters there were four too few white counters. Candidates who stated that there were not enough counters but did not support their answer with any numerical values did not gain credit.

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

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

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

Candidate's work should be clearly and concisely expressed with answers written to an appropriate degree of accuracy. Candidates should work with more than 3 significant figures in their intermediate working. Accuracy marks may be lost if answers are not given correct to at least three significant figures.

Candidates should show full working within their answers to ensure that method marks are considered where final answers are incorrect. Candidates should write down any intermediate step that they may have done with a calculator.

Candidates should avoid writing in pencil and then overwriting in pen as solutions can become illegible.

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

Candidates should ensure that their calculator is set in degrees.

General comments

Many candidates demonstrated their understanding of a wide range of mathematical concepts.

The majority of candidates indicated their methods clearly but some candidates only gave their answers, with no working, and subsequently could not gain partial marks.

Candidates should continue to take care to correctly read numbers and algebraic expressions given in the question paper. Candidates should not reduce the number of significant figures at the start of a question.

If work is replaced it is better for candidates to make a fresh start rather than attempting to overwrite figures and expressions.

Candidates should not expect the Examiner to select the correct method if presented with a choice of methods by the candidate.

In the 'show' questions the best solutions had a step by step style with just one equals symbol per horizontal line. The algebraic question on this paper required careful squaring of a bracket.

Candidates seemed to have sufficient time to access all questions, although some did struggle with the difficulty of the last question.

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

It is important that candidates show the fractions used in a probability product as a final simplified value may not indicate a correct partial method.

The topics that proved to be accessible were: drawing and describing transformations, simple ratio and proportion, percentage reduction, calculation of the mean from grouped data, reading from a cumulative frequency diagram, use of trigonometric formulae, gradient of a tangent, simplification of routine algebra, using the quadratic equation formula.

More challenging topics included: calculation of a time difference with a change of time zone, interpretation of a box-and-whisker plot, given a frequency calculate the height of a histogram, finding the interception points of a line and a quadratic curve algebraically, working with bearings, simplification of the product of three brackets, squaring a bracket with a fraction, factorising a quadratic equation where the coefficient of x^2 is not 1, finding probabilities of two events, finding the equation of a tangent at a point when given an expression for the gradient, working with and sketching the tangent function.

Comments on specific questions

Question 1

Overall, this was a very accessible first question, with most candidates scoring high marks.

(a) Most candidates drew a correct translation. Those who did not score full marks usually scored one mark for one component being correct.

(b) Most candidates scored full marks with a correct reflection. A few reflected in one of the lines, $x = -1$, $y = 1$ or $y = 0$. A small number of candidates reflected the image of part **(a).**

In **parts (c)** and **(d),** almost all candidates gave single transformations but when a combination of transformations was seen the extra transformation was a translation. When the candidate gives an extra transformation no marks can be awarded for the question part.

(c) Almost all candidates correctly stated that the transformation was an enlargement and many gave the correct factor of 3. A few gave a factor of $\frac{1}{3}$. It is also important for candidates to know that ratio forms of the factor are not accepted. The centre of this enlargement proved to be more challenging and many candidates gave incorrect coordinates or omitted this property of the enlargement.

(d) Almost all candidates correctly stated that the transformation was a rotation and most gave the correct angle. A few omitted the fact that it was clockwise. As in **part (c)** the centre proved to be more challenging, again with a number of omissions or the answer (0, 0). The vocabulary of the syllabus is expected so 'turn' is not allowed as an alternative to rotation.

Question 2

(a) Most candidates found this ratio question very accessible. The correct answer was usually stated without any interim working. It is expected that a simplified ratio should contain integer parts. Occasionally candidates did not fully simplify the ratio or gave fractions within their ratio.

(b) (i) The majority of candidates used $\frac{114}{6}$ to achieve the correct answers. The most common error seen was to divide 114 by the total number of parts, 25.

(ii) This percentage reduction question was usually answered correctly. Candidates who calculated 96.90 as a percentage of 114 first sometimes forgot to then subtract from 100 per cent. The majority of candidates used the correct denominator of 114 but some weaker candidates used 96.90.

(c) (i) Many candidates achieved only partial success in this question part. Incorrect answers of 1h 50 m, 3 h 50 m and just 50 m were common indicating that candidates misunderstood or disregarded the time difference.

(ii) Almost all candidates understood that the required calculation was 1802 divided by time. Some candidates made no attempt to convert their time to hours or lost accuracy by prematurely rounding their time to 2.8 or 2.83. Others used 2.5. Candidates that showed their working were able to achieve partial marks for correctly recalling, and substituting values into, the formula *speed* = *distance* ÷ *time*.

Question 3

(a) This proved to be a discriminating question as, in each part, a reason was required to support a decision.

The challenges were to state clearly which property of the box-and-whisker plots were being used and to also to make a comparison and not simply state values.

Median was required for the first statement and either range or inter-quartile range was needed for the second statement. The comparison required more than just statements of values and the use of 'greater than' or 'smaller than' were the most appropriate phrases to use. Phrases such as 'the boys median is 84 *while* the girls is 102' is not sufficient as no comparison of their relative sizes is given. Inclusion of an irrelevant statement even if accompanied by a correct statement is not acceptable. For example, for the first part, 'Disagree because the median for women is greater and the range is bigger' does not demonstrate an understanding that it is the median that allows for a comparison of the amount of time spent exercising, not the range.

(b) (i) This was a well answered question. Candidates seem to be very well prepared in this calculation of a mean, using mid-interval values.

There was the occasional slip, especially with mid-interval values but usually sufficient working was shown to allow for the award of part marks as appropriate. Some candidates used upper boundaries of the intervals. Some candidates used interval widths instead of mid values which scores no marks.

(ii)(a) Almost all candidates correctly found the 60th percentile from the cumulative frequency curve. Incorrect answers usually came from misreading the scale on the horizontal axis.

(b) Most candidates were also able to read from the time axis onto the cumulative frequency axis. A number of these candidates gave the value, 92, on the cumulative frequency axis instead of subtracting it from 100.

(iii) This was a very challenging question and only the stronger candidates were able to deal with the heights of bars on a histogram with unequal intervals. Few candidates were able to recall *frequency density* = *frequency* ÷ *group width* and that height is proportional to the frequency density. Many attempts did not involve frequency density leading to common wrong answers of 3.6 when the ratio of the frequencies and height were used but group widths ignored, and 16.2 when the ratio of group widths and height were used but frequencies ignored. A large number of candidates omitted the question.

Question 4

(a) There were mixed responses to this upper bound question.

The errors seen were adding 0.5 instead of 0.05 to the two given values, finding the area instead of the perimeter and calculating the perimeter using the given values then finding the upper bound of this answer.

(b) (i) This was a straightforward right angled triangle calculation and most candidates succeeded in finding the height of the trapezium. The sine rule and cosine rule were seen and usually correctly applied. Quite a large number of candidates gave this height to only two significant figures, writing 9 sin 80 = 8.9, losing the accuracy mark.

(ii) This explanation question proved to be challenging and many candidates appeared to be unsure of how to show that the triangle was isosceles.

The question required a clear calculation of one of the angles of the triangle or an explanation of how the particular value could be calculated. There was also the requirement to conclude that the triangle was isosceles because two angles were equal.

The more able candidates were able to do this articulately, for example:

Angle CDF = 100 because angles on a straight line add to 180. Angle DCF = 40 because angles in a triangle add to 180. Angle DCF = angle DFC so triangle CDF is isosceles.

The main errors seen were to assume the triangle to be isosceles and state this as the reason for the two angles being equal or to simply state that two angles were equal with no calculation or explanation as to why.

(iii) The area of the trapezium proved to be more challenging than anticipated with many candidates finding the area of trapezium ACDF instead of ABCF. Another quite common error was to use the length of a side of the trapezium instead of the height. The most successful method was to use the formula for the area of a trapezium and the other method seen was the subtraction of the area of a triangle from the area of a parallelogram. Premature rounding of the height 8.86 lead to inaccurate answers.

(c) This was a challenging multi-step question involving angle properties of a circle, right-angled triangle trigonometry and the area of a circle.

Most candidates correctly used angles in the same segment to find angle ACD. Many then recognised the angle in a semicircle to set up the correct trigonometry for a right-angled triangle. The candidates who reached this stage were usually able to divide the calculated diameter by two and then find the area of the circle. There were many final answers out of the accuracy range as a result of using only three significant figures in the working.

One error seen was placing the right angle at *A* instead of *D*. Another was to treat angle *BDC* as 21° and use an incorrect isosceles triangle.

Some candidates successfully used the isosceles triangle *COD* instead of the right-angled triangle.

(d) This was another problem solving question**.** Candidates had to equate the perimeter of a sector to the perimeter of a square and there were many good solutions.

A large number of candidates omitted the two radii from the perimeter of the sector and only earned one mark for the length of an arc.

The other error often seen was to equate areas instead of perimeters.

Question 5

(a) (i) Usually correct with values from 2.7 to 2.8 being given. The notation f(*x*) = 14 appeared to be unfamiliar to some candidates.

(ii) The majority of candidates drew a good tangent but some problems in the calculation for the gradient came from not using the correct scale on the y axis and not being able to read off the negative scale on the x axis. It is pleasing to note that the tangents drawn were invariably clear, in the right location and suitable for reading off values. Candidates are generally choosing convenient values for the purpose of reading values and subsequent calculation.

(iii) The drawing of the line was usually well done. Those who failed to get full marks either drew an inaccurate line, mis-read the scale at the intersection of the line and curve or gave a positive value such as 2.85. It is important that candidates check the accuracy of their line, particularly at the extremes. Using the line to solve the given equation proved to be more difficult with many blank responses.

(b) This question proved to be a challenge. Though many fully correct solutions were seen there were also many left blank. The best solutions began by equating $2x^2 - 2x - 7$ to $3x + 5$, rearranging and then showing a factorisation or application of the quadratic formula to find the values of *x*. Most candidates were then able to find the relevant values of y. Partial marks can only be awarded if clear working is shown and candidates should be warned against doing too much on their calculator without providing evidence of their method. Some candidates began by equating the expressions but then did not recognise how to proceed to solve the resulting quadratic equation in this unfamiliar context. The most common errors were either 'differentiating' the given quadratic and then going on to the find the minimum point or attempting to find the roots of the original quadratic. A minority of candidates did not immediately equate the two expressions but rearranged x in terms of y and then substituted this into the quadratic with little success. Some candidates calculated tables of values of x and y and were occasionally able to find the value at (4, 17) but the expected algebraic approach was the only approach that lead to finding both intersection points.

Question 6

(a) (i) The most successful solutions here began with the explicit form of the cosine rule. Many candidates showed correct substitutions into the formula but did not then appreciate that to *show* that angle CBD rounds to 106.0 it was essential to state the more accurate value of between 106.01 and 106.02. Candidates that jumped from the explicit cosine rule straight to the answer 106.0 were only able to gain the 2 method marks since the accurate value of the cosine was also omitted. Some candidates began with the implicit form of the cosine rule and while some successfully progressed to the correct explicit form others made sign errors when re-arranging or did not apply order of operations correctly and stated instead $287.9^2 = 576 \cos CBD$. Weaker candidates omitted this question part completely or used the value 106 in a calculation involving the sine rule or cosine rule and produced a circular argument. Using a given value that you should be 'showing' earns no credit.

(ii) There was a very mixed response to this bearings question. Common errors included 360 – 38 = 322, 360 – 106 = 254 and 106 – 38 = 068

(iii) This question again demonstrated that many candidates are not confident with bearings. Many good candidates used the sine rule correctly to find angle A = 40.0 and while some went on to find the bearing correctly. Others stopped here or continued to 90 – 40 = 50, 180 + 40 = 220 or 360 – 40 – 50 = 270, indicating a lack of understanding of the concept of bearings. Some candidates assumed that triangle BAD was right-angled at angle D and used SOHCAHTOA to calculate angle A. Weaker candidates made no attempt at trigonometry and instead showed additions and subtractions of various angles, or just gave an answer with no working. Others left this question part blank.

(b) (i) Many correct answers were seen here from candidates using 0.5 × 192 × 168 × sin106. Occasionally candidates made incorrect pairings of sides and angles, for example, 0.5 × 192 × 287.9 × sin 106. Candidates that used Hero's formula sometimes lost accuracy due to premature rounding as did candidates who chose to calculate and use angle DCB or angle CDB instead of 106. Weaker candidates used the area of a right – angled triangle and calculated 0.5 × b × h.

(ii) Many candidates correctly calculated 3.575 × their **bi)** and rounded to the nearest $100 as required. Some candidates did not round their answer at all or rounded incorrectly. Others began by dividing their area by 10,000 but then prematurely rounded this value before multiplying by 35750.

Question 7

(a) The completion of terms in the table for three sequences was almost always correctly carried out. There were a few mistakes with the triangular number sequence and some candidates did not see the last row as the sum of the previous two and instead attempted to use the difference between the terms.

(b) Most candidates recognised the square numbers but a significant number used the method of differences, not always with success. Candidates need to realise that the number of marks awarded for each question is an indication of the amount of work required.

(c) (i) The substitution into a quadratic expression was usually successfully answered.

(ii) This part involved finding the *n*th term, which was a quadratic expression.

The most efficient method was to subtract the answer to **part (b)** from the given formula in **part (c)(i).** This method was rarely seen as most candidates did not see this connection. Instead candidates seemed to be experienced in finding *n*th terms of this type of sequence, with approaches such as looking at n^2, $\frac{n^2}{2}$, $n(n-1)$ or using the method of differences.

(d) This was a very challenging final part to this question with many candidates omitting the whole question and many others not fully understanding the given information. Candidates did not take on board the significance of 'all' in the question being in bold. The very common misunderstanding was to use the total number of dots in the *n*th diagram and not the total number of dots in all of the first *n* diagrams.

The candidates who used the given formula correctly showed good algebra in solving their correct simultaneous equations and gained the full five marks. There were a few more attempts at the method of differences but often with the wrong sequence of values. A large number of candidates attempted to compare the quadratic formula in **part (c)(i)** with the cubic expression in this part. There were also some candidates who found one equation in terms of *a* and *b* and then attempted to rearrange in some way to find the values of *a* and *b* without a second equation. There were also some attempts at rearranging the given formula.

Question 8

(a) A very well answered part with most candidates able to write down the correct factorisation.

(b) Many fully correct inequalities were seen here but it was also common for candidates to just write the numerical answer or to use an equality. Many candidates kept both sides positive by collecting the constants on the left hand side and the *x* terms on the right but candidates who allowed the terms to become negative often ended up with the wrong inequality.

(c) Many candidates coped well with simplifying this expression involving indices. The most common error was in the numerical term with some candidates doing nothing with the 3 or writing 9 for 3^3 instead of 27. When errors were seen in the powers of *x* and *y* it was as a result of candidates adding 3 to the powers instead of multiplying, or occasionally cubing the powers to get x^8y^{64}.

(d) Many correct solutions were seen from candidates who began by cross multiplying. A significant number also correctly reached $4 = 8x$ but then concluded that $x = 2$. Some errors were seen in the expansion of $2(2 - x)$ either to $4 - x$ or to $4 - 4x$. Having reached $4 - 2x = 6x$ some candidates were unable to deal with the negative x term correctly and instead progressed to $4 = 4x$.

(e) This expansion of three linear brackets proved to be a challenge for many candidates. Good candidates understood the process of expanding the brackets, clearly multiplying a pair first and then multiplying by the third, but one or more sign errors or numerical slips in their expansions or in collecting like terms was common. A common error made by weaker candidates was to multiply the first two brackets and then add to the product of the second and third brackets to get a string of terms none of which were cubic.

(f) (i) Many candidates were familiar with compound interest and were able to convert the information in the question to the equation $206.46 = 200(1 + \frac{r}{100})^2$ but the common error was then to solve this equation. Of those that recognised the need to expand the bracket only a minority were able to complete this process correctly. The result was often only two squared terms or failing to square the fraction term correctly. Some candidates began by putting the 200 inside the bracket and then attempting to square.

(ii) Candidates who approached this by using the quadratic formula usually showed their working, had good recall of the formula and gained the first two marks. It was however common to overlook the requirement for an answer to 2 decimal places and r = 1.6 was a common answer that did not gain the final mark. Some candidates chose instead to begin with the equation $206.46 = 200(1 + \frac{r}{100})^2$. It was necessary to show all steps clearly to gain full marks. Candidates that progressed from $\sqrt{\frac{206.46}{200}}$ straight to r = 1.6 without showing intermediate steps were only able to gain one of the three marks available. A significant number of candidates left this question part blank even if they had solved the equation in **part (i).**

Question 9

(a) (i) This was answered well with many candidates scoring 2 marks. Some candidates could not find the value for the intersection but knew that the totals must be 15 and 18 respectively, for example 12, 3, 15 was often seen with 5 also correctly placed. Weaker candidates wrote 15 and 18 with the intersection left blank.

(ii) The majority of candidates correctly used the value of Spanish only out of the total number of candidates. A common error seen was when candidates did not take into account the 5 candidates who studied neither language resulting in a denominator of 27.

(iii) This proved to be more difficult for candidates with the main error of using 32 candidates rather than just the 15 who study German.

(b) This question part was very well answered with the majority of candidates using the concise calculation of $\left(\frac{54}{36}\right)$ x 64 , recognising that 54 represented 36 per cent of the total and that 64 per cent of the total was required. A small proportion of candidates correctly found the total number of marbles as 150 and gave this as their final answer. A common error was to find 36 per cent of 54 which resulted in a non-integer value.

(c) (i) In general with **parts (c)** and **(d)** candidates had some difficulty with combined probability and deciding if the probabilities are replaced or not. It is important that candidates show the fractions used in a probability product as a final simplified value may not indicate a correct partial method. The most common incorrect answers were from $\frac{15}{25}\times\frac{14}{24}$ where candidates ignored the replacement and $\frac{15}{25}+\frac{15}{25}$.

(ii) Most candidates realised they had to subtract the previous answer away from 1 and as such were nearly always successful. Some candidates failed to make the link with **part (i)** and tried working out all the required combinations with much less success.

(d) The majority of correct solutions worked through all the possible options. Some did see the ease of evaluating the probability of 1 – 'no red pencils '. Many candidates following the evaluating outcomes approach missed at least one outcome. The most common incorrect responses were $\frac{3}{5}$ which came as a result of only calculating RR, RY, RG (three of the five combinations forgetting YR and GR); and $\frac{1}{2}$ which was the result of RY,YR,RG,GR – forgetting RR. This question part emphasises the need to show working as simply stating a probability such as $\frac{1}{2}$ is not sufficient evidence for a correct multiplication of two probabilities involving denominators of 25 and 24 with different numerators. Most candidates understood the concept of 'no replacement' but instances of denominators not reducing were seen.

Some weaker candidates did not understand the importance of only picking two pencils and instead worked with triple products. There was minimal evidence of candidates using tree diagrams to help solve this question part.

Question 10

(a) (i) Many good candidates were able to find all three co-ordinates but occasionally muddled the order when writing in the answer space. Candidates must remember to refer to the diagram and also to show working out so that credit for correct method can be given. Weaker candidates often left this question part blank and others attempted to find the minimum point using differentiation.

(ii) Many candidates successfully differentiated the expression. Some spoilt their answer by equating to 0. Some candidates did not understand the word 'differentiate' and instead factorised the expression or left this part blank. This was evidenced by some very good candidates omitting this part but then completing **part (iii)** correctly using the notation $\frac{dy}{dx}$.

(iii) This part was challenging for most candidates as they were not able to link this part to the previous part. Many of those who had successfully differentiated in **part (ii)** were unaware that it would help here. Only the most able candidates were able to find the gradient and then the equation of the tangent successfully. The most common wrong approach was to try to find the gradient by using (2, 6) with another point on the curve or simply using (2, 6) directly to give a gradient of 3. This was typically followed by an attempt to substitute (2, 6) into their incorrect equation. Another error seen was to solve 2x + 3 = 0 showing some confusion over the applications of differentiation.

(b) (i) There were a small minority of excellent sketches showing clear asymptotes and curvature. It is evident that many candidates were familiar with the shape of the sine function but less so the tangent. In some cases otherwise correct diagrams stopped at clearly fixed points, or had large gaps near 180 and 360.

(ii) This was a demanding question part but some candidates clearly had a very detailed understanding of how to solve trigonometric equations between 0 and 360. These candidates understood in which quadrants their solutions must lie and then correctly interpreted their calculator answer. Others managed to get –54.5 as a solution but could not then use it to get two solutions in the required range. This question provided a clear example of candidates who could have gained partial marks by working with values of greater than 3 significant figures in their intermediate working. Truncating –54.46 to –54.4 was common.

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

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

The recall and application of formulae and mathematical facts and the ability to apply them in both familiar and unfamiliar contexts is required, as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Work should be clearly and concisely expressed with answers written to an appropriate degree of accuracy.

Candidates need to be aware that when drawing graphs points should be plotted within 1 mm of the correct position. Curves should be drawn freehand with a sharp pencil.

Candidates should be aware that it is inappropriate to leave an answer as a multiple of π or as a surd in a practical situation unless requested to do so.

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

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

General comments

Candidates scored across the full mark range. Solutions were usually well-structured with clear methods shown in the space provided on the question paper. The vast majority of candidates showed working within the question paper booklet and did not use additional supplementary sheets.

There were a number of very high scoring candidates demonstrating an expertise with the content and showing excellent skills in application to the problem solving questions, scoring in excess of 120 marks on the paper. At the other extreme, a small number of candidates were inappropriately entered at extended tier and did not have the mathematical skills to cope with the demand of this paper.

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

There were a few candidates who did not keep to an appropriate degree of accuracy within their calculations. Some candidates are omitting important steps in their method, for example when finding areas in **Question 9(a)**, they often showed the initial trigonometric equation but then omitted the rearrangement to the explicit form and then gave a value to 2 significant figures. In cases like this, Examiners will not imply the method unless at least 3 significant figures are given.

The topics that proved to be most accessible were currency and percentages including compound interest, standard statistical analysis and calculations, transformations, single event probability, completing a table for an algebraic equation and drawing the corresponding curve, standard procedures with functions and linear sequences.

The most challenging topics were reverse exponential problems, histograms, similarity, problems involving angles in circles, harder function work involving brackets and directed terms, cubic and exponential type sequences.

Comments on specific questions

Question 1

(a) This part was answered well, with most candidates multiplying the average speed by the time in order to find the distance. The few who divided the average speed by the time obtained an answer for the distance that, in the context of the question, should have alerted them to an error. Some candidates did not convert the 10 minutes into hours correctly and multiplied by 11.1, for example. A few candidates multiplied by 670 minutes but did not always divide by 60. Those who obtained a correct value for the distance did not always round it to the nearest 10 km, giving a final answer such as 9078.5, 9079 or 9080.0.

(b) (i) More candidates were successful in this part, finding the time conversion to 15.7 hours easier than that required in **part (a)**. Most candidates also used $\frac{distance}{time}$ correctly. The errors seen included incorrect conversion of the 42 minutes into hours e.g.15.42 or using 942 minutes and obtaining a flight speed of 10.9 km/h. A minority of candidates used $distance \times time$ or $\frac{time}{distance}$.

(ii)(a) Many candidates were able to find the distance travelled per dollar. Errors seen included calculating 470 ÷ 10260 which gave only 46 metres travelled per dollar. A significant number of candidates misread the question and used the wrong distance, either from **part (a)** or adding the distance from **part (a)** to 10260.

(b) Many candidates successfully worked out $\frac{470}{10260 \div 100}$. Other candidates used the previous part and correctly calculated $\frac{100}{21.8}$. Several candidates incorrectly multiplied the previous part by 100. Other errors included answers not given to the nearest cent with 4.6 often seen, sometimes with no complete method step leading to this value.

(c) Almost all candidates answered this part correctly. The answer of 12.97 (or more accurate) was required and those candidates giving the answer 13, with 12.97 or better not seen, did not score.

Question 2

(a) Nearly all candidates recognised this as a translation, but several did not use the correct mathematical term to describe the transformation. Translocation and move, for example, are not acceptable alternatives. Most candidates correctly named the vector or correctly described it in words. A few gave a coordinate which is not acceptable.

(b) (i) There were many correct reflections, a few reflected the triangle in $x = 0$ or occasionally $y = 1$.

(ii) This part was also answered well by most candidates, with the most frequent errors being a rotation through 90° clockwise or a rotation around an incorrect point.

(iii) Fewer candidates answered this part correctly and there were a number who made no attempt here. The most common error was to use a scale factor of $\frac{1}{2}$ or $-\frac{1}{2}$.

Question 3

(a) (i) This part was answer very well with most candidates quoting, and applying, the compound interest formula correctly. Answers were usually given to an appropriate degree of accuracy. Very occasionally the interest was given as the final answer rather than the amount of the investment. A small number calculated the simple interest.

(ii) This was also answered extremely well. By far the most common method was to calculate the increase in value using the answer to the previous part, dividing this by 2000 and converting it to a percentage. A few candidates divided the increase by the answer to **part (a)(i)**, rather than 2000. Some used an alternative method of dividing the answer to **part (a)(i)** by 2000 but not all of those using this method subtracted 100.

(iii) This was quite a difficult question but was answered very well by many candidates. Most were able to write down an initial expression of the form $2000 \times \left(1+\frac{2}{100}\right)^n$. For the next stage many went on to $2000 \times 1.02^n = 2500$, leading to $1.02^n = 1.25$. Some were unable to proceed any further but others used logarithms (beyond syllabus) to find a value for n. Whilst most then rounded this value up to the nearest integer to give the correct answer, some did not do this. A more common method, involving trial and improvement, was also used. This was also carried out well by a number of candidates who often reached $n = 11$, or 12, after a couple of trials.

(b) Candidates found this more challenging than the previous part, although there were quite a number of candidates who earned full marks. Quite a number did not appreciate that the question involved a percentage decrease and so used $\left(1+\frac{4}{100}\right)^{16}$. Another error, made by some, was to use $255 \times \left(1-\frac{4}{100}\right)^{16}$ rather than $P \times \left(1-\frac{4}{100}\right)^{16} = 255$. Most, who set up the correct equation, solved it correctly and gave their answer as an integer. There were a number of candidates who misread 255 as 225 but any candidate using the correct method with this value was awarded 2 marks.

Question 4

(a) (i) This part was nearly always answered correctly, with just the occasional incorrect answer of 60 seen.

(ii) This was also answered very well with most candidates identifying the quartiles and using these to give the interquartile range. A very small number of candidates gave an answer of 60, presumably coming from 90 – 30 and a similar number gave one of the two quartiles as the final answer

(iii) This part was a little more demanding with some giving an answer of 25 by using a value of 60 on the cumulative axis. Others did calculate the correct value to use when working out 60 per cent of 120 but did not use the diagram and gave 72 as the final answer.

(iv) This was answered well with most using the diagram with a height of 40 cm to obtain the corresponding cumulative frequency value. Some candidates gave this as the final answer, although most did subtract it from 120. Occasionally the scale was misread leading to a value of 117 for example.

(b) (i) Most candidates appeared to be very familiar with finding an estimate of the mean from grouped data and so the quality of the work was very high with a large majority scoring full marks. It is also worth reporting that generally the presentation of the work for this part was of a very good standard. A small number of candidates used the class widths, or a half of the widths, rather than the mid-values and a few divided by 4 rather than the total frequency.

(ii) This part was much more challenging. Many candidates did not take any account of the different class widths of the two intervals and so gave an incorrect answer of 15.2. Some earned a method mark for giving the frequency density for one of the two classes even if no further progress was made.

Question 5

(a) The majority of candidates gave a correct solution. Some of these then went on to give the cost of 3 small cakes as the final answer. This did not earn full marks but was credited with 2 marks. There were a few attempts which set up the equation correctly $3x + 2(2x + 1) = 12.36$ but then incorrectly expanded the brackets, giving $3x + 4x + 1 = 12.36$.

(b) This part was also answered very well. As in the previous part some went on the give the cost of the total number of small chocolate cakes. Others set up the correct equation but expanded the brackets incorrectly, giving 14*x* + 1. There were some candidates who incorrectly used the answer from **part (a)** and gave 18*x* = 7(2 ×1.48 + 1), either as the first step or following a correct first step.

(c) Candidates generally found this part rather more difficult as it was not so straight forward to set up the initial equation. Some of those who were successful in obtaining the correct initial equation did so by giving $\frac{4}{x}=\frac{13}{2x+1}$ leading to 4(2*x* + 1) = 13*x*. Most of those attempting to give an equation without fractions, as the first step, often gave the incorrect equation e.g. 4*x* = 13(2*x* + 1). Others wrote down a pair of simultaneous equations such as *nx* = 4 and *n*(2*x* +1) = 13. Many of these candidates who tried to eliminate *x* were unable to give a correct equation in *n*. However, a number of candidates who did set up a correct equation were able to solve it correctly to obtain full marks.

(d) The final part of this question was more challenging. Those candidates who were able to write down the correct fractional equation initially, frequently showed some particularly good algebraic skills in removing the fractions from the equation, reducing it to a 3-term quadratic equation and solving this correctly using either factorisation or the quadratic formula. A few of those who had a correct quadratic equation wrote down the answer of 0.5 without showing the required working. Some who had obtained an incorrect 3-term quadratic equation were given credit for correctly factorising or correctly substituting into the quadratic formula for their equation. Many candidates incorrectly gave 20*x* + 10(2*x* + 1) = 45 as their initial equation. As in **part (c)** there were some who used alternate correct methods starting with a pair of simultaneous equations and although it was difficult to correctly eliminate one of the two variables some were successful and went on to score full marks.

Question 6

There were many good responses to this question. Virtually all candidates gave the answers as fractions with those that did give an answer as a decimal often showing the corresponding fraction as well. There were very few examples of candidates using an incorrect method by giving probabilities as ratios or by using words.

(a) All three parts were answered very well, with errors being rare.

(b) (i) This part was done quite well with the many giving the correct answer. Some of the incorrect answers given were $\frac{2}{6}$, and incorrect methods included $\frac{1}{6}+\frac{1}{5}$, $2\times\left(\frac{2}{6}\times\frac{1}{5}\right)$ and $\frac{2}{6}\times\frac{2}{6}$.

(ii) This part proved to be more difficult than the previous part although many candidates scored full marks. Similar types of errors to those in **part (b)(i)** were noted. These included just giving one component or multiplying a component by a constant, for example, $\frac{2}{6}\times\frac{1}{5}+2\left(\frac{3}{6}\times\frac{2}{5}\right)$.

(c) Most candidates appreciated that when the discs are picked with replacement the denominators on all the fractions used will be 6. However, few candidates realised that replacing the discs allowed the possibility of choosing two reds which was not the case in the previous part. So, it was quite common to see an answer coming from $\frac{2}{6}\times\frac{2}{6}+\frac{3}{6}\times\frac{3}{6}$, the probability of picking two yellow discs and two blue discs.

Question 7

(a) This was well answered by all candidates.

(b) Candidate's plotting was accurate and most drew an acceptable curve. There were a few very thick curves drawn, and a smaller number used their rulers to join the points.

(c) (i) Most candidates drew a line at $y=-2$ to solve the equation and many correctly read the intersection with the curve. A significant number wrote 0.45 without the negative sign.

(ii) Many gave a correct answer from drawing the line $y = 1 - x$ and then finding the intersection with the curve. There were a few candidates who did not recognise the method to adapt the given equation in relation to the graph, attempting to solve the equation or to draw a new curve. Those who rearranged the terms often obtained $y = 1 - x$ but then either did not draw a line, or drew $y = x - 1$ or $y = 1 + x$.

(d) There were many correct answers. Some candidates did not appear to recognise the meaning of the word 'integer', with decimal answers often seen. Answers such as $x > 2$ were also wrong as this inequality would also include decimal values.

Question 8

(a) There were many correct answers and most candidates showed no working apart from annotations on the diagram. Among the errors were those that arose from wrong assumptions, such as that there was a right angle at the intersection of *AD* with either *EB* or *EC* (or sometimes both).

(b) This question proved very challenging for most candidates. Most did not appreciate that $11x$ was the reflex angle *KOL* and therefore started incorrectly by considering $11x = 2 \times 2x$. Other candidates, who did appreciate that $11x$ was the reflex angle, then indicated that the obtuse angle *KOL* was $180 - 11x$ rather than $360 - 11x$.

(c) (i) Full marks were rarely awarded. Candidates often identified that angle *DXA* = angle *CXB* but did not give a reason. Fewer candidates identified that angle *ADB* = angle *ACB* and that angle *DAC* = angle *DBC* and only a small proportion of those that did identify these equalities then gave a correct geometric reason for this as angles in the same segment or angles on the same arc. Many candidates appeared unfamiliar with what was required to show similarity.

Key advice for preparing candidates for such questions would be to emphasise that the correct geometric reasons (stated on the syllabus) for relationships between angles must be given and that a good approach is to use the answer lines provided to give each separate statement with a reason. Finally, a statement should be given in conclusion to say that all three angles are the same and therefore the triangles are similar to secure the final mark.

(ii)(a) This was answered correctly by around half of the candidates, most incorrect responses were from candidates mixing up the corresponding sides and calculating $\frac{10}{8} \times 5$ rather than $\frac{10}{8} \times 7$.

(b) This was answered correctly by most candidates who recognised the need to use the cosine rule. Some stated the cosine rule in the form $8^2 = 7^2 + 5^2 - 2 \times 7 \times 5 \times \cos BXC$ but then made errors when rearranging this to find the angle.

Question 9

(a) Most candidates were able to access this question at least in part and the full range of scores were regularly awarded. Those with a good understanding of trigonometry often gained full marks. A premature rounding of intermediate values to 2 significant figures sometimes led to an accuracy error with the final answer. The areas of the top and base were usually correct and the common error with the trapezium area was use of an incorrect height due to incorrect trigonometry. The area of the slant side faces was the biggest problem for many. Often the slant height used was incorrect, or the vertical height was used, while some thought these rectangles had the same dimensions as the top. A few misunderstood the question and calculated the volume, although they often gained credit for the trapezium area.

(b) (i) Most candidates answered this correctly but there were also a number who did not attempt it. The usual methods were $5 + \left(\frac{8-5}{2}\right)$ or $8 - 1.5$ or $5 + 1.5$. However, a few used Pythagoras' theorem to calculate $XF = 1.5$ even though they had used this value in **part (a)**.

(ii) Answers were mixed. Sometimes $AF = \sqrt{8^2 + 12^2}$ was incorrectly found. A significant number did not attempt this and a few attempted to use the cosine rule.

(iii) Candidates found this part very challenging. Many had difficulty visualising the required angle and often angle *GAF* was found or the question was not attempted. Those who chose the correct triangle, *GAX*, usually gained both marks.

Question 10

(a) (i) This was nearly always answered correctly.

(ii) Almost all candidates answered this part correctly.

(b) There were many correct answers for the inverse function. Those candidates not earning full marks frequently made a correct start, but often made a sign error in the next step when dividing by – 2, for example.

(c) A large number of candidates were correct here although a few could not find *x* after writing $\frac{1}{x} = 2$.

(d) This part discriminated well between candidates of varying ability. A good proportion of candidates wrote down the correct expressions in terms of *x* and simplified them to obtain the answer. Many other candidates omitted any brackets when writing − gg(x) in terms of the function and then made errors when subtracting gg(x) from g(x)g(x). Most could expand $(1-2x)(1-2x)$ correctly.

(e) Although many candidates were able to write down an expression in *x*, a significant number did not write it in the simplest form.

(f) This was nearly always correct.

(g) This was nearly always correct although answers of $\frac{1}{25}$ or 32 were seen.

(h) There were many correct answers to this part, and candidates who did not gain full marks often scored 1 mark for reaching the value $\frac{1}{25}$.

Question 11

(a) Many candidates found the 5th term of each sequence correctly, with sequence B being the least successful of the three.

The *n*th term of the sequences proved more difficult. Sequence A, the linear sequence was more frequently correct than the other two sequences. Sequence B was the least well done, with candidates often attempting difference methods. In sequence C, the numerator was often correct, and when a correct denominator was found, it was expressed in any one of the equivalent forms to 2^{n+2} such as $8 \times 2^{n-1}$ or 4×2^n and each of these equivalent forms was acceptable.

(b) There were many correct answers here, although a number of candidates tried to use their answers to **part (a)**. Simple examination of the of the first five numerical values given was the method to use here.

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key messages

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

The recall and application of formulae and mathematical facts and the ability to apply them in both familiar and unfamiliar contexts is required, as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Work should be clearly and concisely expressed with answers written to an appropriate degree of accuracy.

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

General comments

The standard of performance was generally good with most candidates attempting all questions. Some candidates showed their working with clear steps that could be easily followed whereas others omitted steps. For some candidates, improving presentation would help, as there were instances where candidates miscopied their own figures.

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

Some candidates lost marks by approximating values prior to the final answer. This was apparent, for example, in **Question 1(c)(i)**.

The topics that proved to be accessible were standard form, ratio, percentages, transformations, box-and-whisker plots, speed, 3D geometry and simple functions.

More challenging topics included reverse exponential increases, conditional probability, proving triangles are similar, differentiation, magnitude of a column vector, position vectors, solving simultaneous quadratic and linear equations.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to write the surface area correctly in standard form. Common errors included 5101×10^5 or 510.1×10^6. A small number rounded the surface area to 3 figures or less.

(ii) Many correct answers were seen. Errors usually arose from writing 70.8 per cent in decimal form as 0.078.

(b) (i) This was almost always correct with the occasional incorrect answer resulting from miscopying the data from the table.

(ii) Many correct answers were seen. Errors usually arose from miscopying the figures from the table, using a country other than The Maldives or from multiplying the two areas.

(iii) Most candidates understood the method required and often obtained the correct percentage. Rounding to fewer than three significant figures or truncating to three figures produced a significant number of incorrect final answers. Other errors included performing the division in the wrong order, finding the difference in areas as a decimal and forgetting to convert to a percentage.

(iv) With population density defined in the question almost all candidates obtained the correct answer.

(c) (i) Candidates found this more challenging and only a small majority obtained the correct percentage. Several began by finding the increase while others expressed the population in 2017 as a percentage of the population in 2000. This latter group tended to be less successful, often rounding the initial percentage to three figures before subtracting 100 and giving a final answer with too few figures. A common error involved finding the increase in the population as a percentage of the population in 2017.

(ii) This proved challenging and fewer correct responses were seen. Some showed the correct calculations but incorrect processing on the calculator led to incorrect final answers. A small number simply divided the previous answer by 17 and some divided the populations by 17.

Question 2

(a) (i) Many correct rotations were seen. The most common error was a rotation clockwise about the given centre. The occasional wrong centre was used and sometimes the wrong angle of rotation, usually 180°.

(ii) Many correct translations were seen with some candidates earning partial credit for a translation with a correct displacement in one direction. Some candidates treated the translation as $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$.

(b) Many correct descriptions were seen. The most common error usually involved an incorrect centre or the omission of the centre. Only a few responses suggested two transformations with a translation almost always the second transformation.

Question 3

(a) (i) Many correct answers were seen with 58 as the most common error.

(ii) This was almost always correct.

(iii) Although many correct answers were seen, candidates were generally less successful in this part. Some gave the overall range but most differences were due to slips with the numeracy.

(b) Candidates demonstrated a good understanding of speed and most obtained the correct answer. Some did not realise that conversion of units was required and answers of 22.2 were seen.

Question 4

(a) (i) This was almost always correct.

(ii) Many correct answers were seen. Three common errors were seen which included giving the probability of picking a B and a Y in any order, adding the two probabilities and evaluating the probabilities with replacement.

(iii) Finding the probability of two letters being the same proved more challenging and fewer correct answers were seen. Some calculated the probability of both letters being S, others the probability that both letters were I. Some weaker candidates started from the five letters that were S or I and mistakenly gave a probability of $\frac{5}{11} \times \frac{4}{10}$. Only a few worked with replacement.

(b) (i) The majority of answers given were correct. Common errors included $\frac{1}{11}\times\frac{1}{10}\times\frac{1}{9}$ and from weaker candidates $\frac{5}{11}\times\frac{4}{10}\times\frac{3}{9}$.

(ii) Only the more able candidates could make much progress with this question. Successful responses were characterised by a methodical approach to the various outcomes. A few attempted a tree diagram while some others attempted to list the possible outcomes. In both cases, it was common to find that some of the possible outcomes were missing, especially when outcomes were listed as SSP, SSO, SSI, etc. rather than SSx, etc. Errors were often made when considering the probabilities of the different orders, e.g. P(I, I, x) correctly calculated as $\frac{3}{11}\times\frac{2}{10}\times\frac{8}{9}$ but P(x, I, I) given as $\frac{11}{11}\times\frac{3}{10}\times\frac{2}{9}$.

(iii) Candidates who realised the three events in **part (b)** were mutually exclusive earned some credit for a correct method and almost always earned both marks if the previous two parts were correct. Most candidates did not spot this connection and a variety of incorrect methods such as lists, partial tree diagrams, etc were seen. A common error was to assume that the probabilities of all three letters being the same and all three being different were mutually exclusive.

Question 5

(a) (i) A majority of candidates gave a correct value for angle *x*, although not all were able to give the correct reason. Some had a vague idea of the reason but had the angle at the circumference as twice the angle at the centre. Not all candidates used the correct terminology and the use of middle for centre and circle or edge for circumference were common errors.

(ii) Fewer correct angles were seen and, as in the previous part, not all gave a correct reason. Few candidates gave the reason as the alternate segment theorem, preferring instead to use less efficient methods of finding *y*. In many of these cases candidates were more likely to omit a reason for one of the steps used. Some attempted to use the isosceles triangle and tangent properties but gave inadequate reasons such as the tangent is perpendicular to the centre.

(iii) This proved more challenging and only a small number of fully correct answers were seen. As in the previous part, some reasons were omitted or were incomplete. Incorrect terminology was also seen, sometimes 'quadrilateral in a circle' was used for cyclic quadrilateral or cyclic was omitted. A higher proportion of candidates made no attempt at a response.

(b) (i) Candidates found this question very challenging and only a minority earned all three marks. In many cases some or all of the equal angles were identified but, more often than not, reasons were not given or were incorrect. Many attempts involved a mention of the parallel lines, a shared angle or point and therefore the triangles were similar.

(ii)(a) Although candidates fared a little better on this part only a minority obtained the correct ratio. A common incorrect answer was 4 : 3.

(ii)(a) Few candidates were able to calculate the correct area of the quadrilateral or triangle *PQR*. Most incorrect answers involved the use of the linear scale factor leading to the common answer of 15cm^2. Some of those using the correct area factor stopped after finding the area of triangle *PQR*.

Question 6

(a) Almost all candidates obtained the correct volume.

(b) Most candidates demonstrated a good understanding of three-dimensional Pythagoras and were able to calculate the length of the internal diagonal *AG* and give an adequate conclusion. A significant number were able to demonstrate that the pencil would fit by calculating the face diagonal *AF*.

(c) (i) Many correct answers were seen. Most candidates opted to use the tangent ratio with some opting to use a different ratio by calculating the diagonal *AC*.

(ii) In this part, most candidates opted to use the tangent or sine ratio. Overall, candidates were less successful, largely due to using rounded values for previously calculated lengths.

Question 7

(a) (i) Some candidates coped well with a quadratic with a negative square term. Others changed all the signs in the quadratic, obtained the factors $(x + 3)(x – 8)$ but then forgot to allow for the original change of signs.

(ii) This question produced a full range of marks with the majority of candidates earning all three marks. A few reversed the values of *a* and *b*. Not all candidates understood the link with the previous part and attempts to solve the quadratic using the formula were seen.

(iii) Many candidates did not realise that differentiation was required and correct solutions were in the minority. Those that differentiated usually obtained the correct gradient and any errors usually involved the loss of the minus sign and substituting $x = 1.5$ or equating the gradient to the x coordinate to get $5 – 2x = –1.5$. Many of the incorrect methods involved finding the gradient between two points on the curve or finding the *y*-coordinate at $x = –1.5$ and dividing it by –1.5 .

(b) (i) A wide variety of shapes of curves were seen with only a minority recognising that the graph needed to be a positive cubic function. When a positive cubic curve was drawn candidates usually gained credit for the *y*-intercept and the negative *x*-intercept but not all the cubic graphs sketched had a turning point at $x = 3$. A number of negative cubic graphs were also seen. The most common incorrect sketch involved quadratic curves allowing candidates to earn some credit for correct intercepts.

(ii) Most candidates understood what was required but not all reached their final answer without an error. Many started with the expansion of $(x + 1)(x – 3)$ and most were successful but, for some, errors with signs resulted in incorrect expansions. Those that started with $(x – 3)^2$ were more prone to errors and $x^2 – 9$ and $x^2 + 9$ were frequently seen. A small number expanded all three brackets correctly but slipped up in collecting like terms.

Question 8

(a) (i) A majority of candidates dealt with the vectors correctly and obtained the correct answer. Common errors included $\overrightarrow{BC} - \overrightarrow{AB}$, multiplying the components of the vectors as well as numerical slips such as $–1 + 5 = –4$.

(ii) Candidates were less successful on this part with the most common error involving $\overrightarrow{BC} + \overrightarrow{DC}$.

(iii) Candidates were generally less successful in this part and only a minority obtained the correct magnitude. A significant number gave the answer as a vector involving 2 and 5 and with different combinations of signs. Some of those that did use Pythagoras slipped up by evaluating $5^2 – 2^2$. A higher proportion of candidates made no attempt at a response.

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

(ii) Candidates were less successful in this part. Some with an incorrect answer were able to earn part marks for a correct method. Candidates would be well advised to be methodical and their first step should be to identify a correct route for the required vector.

(iii) Candidates found this part extremely challenging and fully correct answers were rare. As in the previous part, a methodical approach to the question was needed but, in most cases, was not seen. Finding $\overrightarrow{CD}$ or $\overrightarrow{BD}$ was crucial and proved too difficult for many candidates. Some did have a correct expression for at least one of the vectors but rarely provided evidence of their method. There was a significant increase in the number of candidates making no attempt at this part.

Question 9

(a) A majority of the responses showed some understanding of inequalities and a majority listed the relevant integers. Common errors usually involved giving just the largest and/or the smallest integer whilst some rearranged the inequality to $1 < x \leqslant 5$ and went no further.

(b) (i) Many correct answers were seen. A few earned partial credit for a partially factorised expression, usually for taking y as the only factor.

(ii) Although candidates were less successful in this part, a small majority obtained the correct answer. The most common error was $(y - 3x)^2$.

(c) This part produced a wide variety of responses covering the whole range of marks. Errors in working usually involved incorrect working with the negative terms. Stronger candidates had no difficulties providing well laid out solutions. Some came up with the correct numerator and denominator but then made errors when expanding and simplifying them.

(d) Fully correct solutions were in the minority of responses seen. Those that equated the linear and quadratic expressions were often successful in rearranging to get the required quadratic equation with only the occasional error being seen. Applying the quadratic formula was usually successful, whether it was on the correct equation or following on from a slip in previous working. Only a few used completing the square to solve the equation. Occasionally, a candidate would try to substitute to obtain a quadratic in y but this was rarely successful. Weaker candidates often applied the quadratic formula to $2x^2 + 7x - 11$.

Question 10

(a) Many correct answers were seen although some candidates multiplied the functions together to get an answer of –18.

(b) A majority of answers seen were correct. Some candidates started correctly but made errors in manipulating the algebra, usually involving a negative sign. Some left their answers in terms of f(x) or y and a few answers of $\frac{1}{4-3x}$ were seen.

(c) (i) Many candidates understood the process involved but errors with a negative sign resulted in an incorrect final answer, often $1 - 6x$. Another common error in the manipulation was to treat $4 - 3(1 - 2x)$ as if it was $(4 - 3)(1 - 2x)$.

(ii) This part proved more challenging as a lot of manipulation was required. Only a minority of candidates were able to obtain the correct answer of $20 - 36x$. Some started by writing $(4 - 3x)^2 + x - 9(x^2 + x)$, incorrectly writing x instead of $4 - 3x$. Other common errors included incorrect expansion of $(4 - 3x)^2$ and $-9(x^2 + x)$, usually involving a negative sign or giving $16 - 9x^2$ as the expansion of the first of these.

(d) This proved even more challenging and correct solutions were in the minority of those seen. In most cases if candidates understood manipulation of indices they went on to earn both marks. Occasionally 3^{2kx} was seen and earned partial credit. Common incorrect solutions included $\frac{1}{2}$ and ± 2.

Question 11

Many fully correct responses or nearly correct responses were seen. For the linear sequence, both the fifth term and the nth term were almost always correct. For the cubic sequence, the fifth term was almost always correct but the nth term proved more challenging. Some attempted the method of differences but not always successfully. For the power sequence, the fifth term was almost always correct. For the nth term, those that spotted the common ratio of 4 usually earned some credit but the majority had no strategy other than the method of differences.