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MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed with 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 accurate, are in the correct form and make sense in the context.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. There were a number of questions that were standard processes and these questions proved to be generally well understood. Others, for example the problem-solving aspect of questions such as **Questions 19**, **22** and **23** were found more challenging. Most candidates showed some working with many candidates setting their work out clearly and neatly.

Candidates must note the form in which answers are asked for, e.g. **Question 11** asks for the answer correct to 4 significant figures and **Question 14** needs the fraction in its simplest form.

Comments on specific questions

Question 1

(a) Most candidates answered with bars accurately drawn using a ruler.

(b) Most candidates gave climbing as the most popular activity.

Question 2

Candidates could draw their line anywhere along the length of line *L*. Most lines were drawn with a ruler. Some answered with a line that was nowhere near perpendicular; often their line was parallel or made a X shape with line *L*.

Question 3

(a) A correct line had to run from one side of the circle to the other and it was acceptable to draw a diameter as this is a special case of a chord. Some drew a radius or a tangent.

(b) This question did not require any use of π, just to halve the given diameter. Some mistook 28 cm as the circumference of the circle.

Question 4

(a) Candidates answered this part well, measuring the distance from *A* to *B* and applying the scale correctly. Candidates were more likely to measure incorrectly than misapply the scale. Some did not appear to have rulers as they roughly marked centimetres along the distance.

(b) Candidates found this one of the more challenging questions with many writing a distance rather than a bearing. Not many candidates annotated the diagram to show they knew where this bearing was.

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Question 5

Most candidates knew that this conversion should have the same figures with the decimal point in a different place. There were some answers using totally different figures.

Question 6

This was quite well answered with a few opportunities for candidates to gain partial credit for either converting all the values so they could be compared or only making one error in the ordering.

Question 7

Many candidates were more likely to find the value of *y* correctly than *x*. There are various methods to find the values, but the most straightforward approach is to find *x* using angles on a straight line and *y* by alternate angles and these can be done in either order.

Question 8

Candidates had to work through the information to find the five numbers larger than 37 in this problem-solving question. Many candidates worked though this, sometimes with crossings out, and found three or more of the numbers.

Question 9

A common incorrect answer was 1^1 or -1^1 as candidates did not calculate the value of each and then subtract which showed a general misunderstanding of how to handle indices.

Question 10

For this question about time, there were various incorrect answers such as 3h 3 min (the 3 mins should have been subtracted) or 3h 57 min. The most successful candidates showed working such as 55 min + 2 hours + 2 min.

Question 11

Most candidates used their calculator correctly using the correct order of operations. Often there was an error in the accuracy of the answer as 4.2857… was seen frequently or rounded incorrectly to too few figures.

Question 12

The common misunderstanding was for candidates to multiply 380.8 by 1.19 instead of dividing. Some candidates did not use all the figures in the question so rounded before they started. Candidates must use the full numbers given in the question to do their calculations.

Question 13

A frequent incorrect answer was 0.45 from adding the first two probabilities. Some candidates knew what to do but made slips in their adding or subtraction.

Question 14

This was one of the simpler fraction questions as it only needed one fraction to be converted before the subtraction could be done. The simplest way is to use a common denomination of 21 but it was perfectly acceptable to do this using a denominator of 42. After subtracting, the fraction had to be given in its simplest form.

Question 15

This proved to be a challenging question for many candidates. Some worked out the angle at *C*, others who knew this involved trigonometry, used the wrong ratio, mostly cosine. Those that used the correct ratio sometimes calculated *BC* = 15 ÷ sin 38. Others who finished the method correctly gave their answers to 2 significant figures instead of 3.

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Question 16

(a) This was a well answered question.

(b) Some candidates started well with a correct first step but as this gave $v - 3 = -5t$, often the minus sign was lost. Some candidates started with their previous answer and worked backwards to give 4 instead of the rearrangement of the formula.

Question 17

(a) Some candidates did not fully understand the term relative frequency. This could be expressed as a fraction, decimal or percentage as the question did not specify the form of the answer. Many left their answer as 8.

(b) Although some candidates answered this correctly and it is a standard question, many candidates found finding the mean from a frequency table challenging.

Question 18

Many candidates found the correct two factors to gain full credit. Some partially factorised the expression by writing either 7 or y outside the bracket. Some correctly factorised then went on to do further work. A few combined the unlike terms into $-35xy$ which came from $14 - 7^2$ followed by xy.

Question 19

Although there were some clear, well set out workings and correct answers to this question, this proved to be a challenging question for many candidates. There was a wide variety of incorrect answers implying that this problem-solving question was not fully understood. Some used the compound interest formula. This is the reverse of questions which gives the interest rate, number of years and the amount of money to be invested and asks for the interest to be calculated. Candidates often were awarded partial credit for a correct first step. For many, candidates seemed to be uncertain of where to start or once they had worked out the total interest, where to go next as workings were often scattered across the entire working space.

Question 20

(a) Many candidates answered this well and found the correct next term in the sequence.

(b) Candidates found this part more challenging, finding the nth term. Some gave –5 as their answer, which is the common difference, and did not know how to use the information to work out the nth term; others gave $n - 5$. A few candidates seemed to think the nth term meant the ninth term as –18 was sometimes seen.

Question 21

The concept of irrational numbers was challenging to many as most answers were integers, often prime, or a decimal number between 10 and 20. 15 was seen many times, maybe as it is midway between 10 and 20. A well known example of an irrational number is π and any multiple of π to make it within the range specified is acceptable. Those that understood what was required were more likely to choose numbers such as $\sqrt{175}$ rather than multiples of π. Some candidates who gave a square root sometimes choose one that was an integer, for example $\sqrt{324}$ (= 18). Some incorrectly gave recurring number such as $10.\dot{3}$. Answers such as 12.64784… do not denote irrational numbers by using three dots.

Question 22

(a) This was a well answered question. Answers could be left in any format. Many candidates converted to normal numbers, subtracted them and some converted back. Some subtracted 2.06 from 9.73 and then subtracted 7 from 8 for the exponent. Some added the values or divided them.

(b) Many good responses were seen in this question with candidates having to choose the correct values to work with and use the given formula. All workings had to be shown.

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Question 23

Although the question stated that the shape was a trapezium, very few chose to use the formula, and instead calculated the area of the rectangle and the triangle separately. To find the area of the triangle or the trapezium, Pythagoras' theorem had to be applied to find the height of the triangle or when added to 72, gave the other side of the trapezium. Some assumed the right-hand side of the trapezium was 2 × 72 or that the area of the triangle was (180 × 204) ÷ 2. A few candidates added all three lengths together. Those that used the trapezium formula often gave $\frac{(204+180)}{2} \times 72$.

Question 24

This question involving similar triangles was found challenging. Many wrote 8 – 6 = 2 and 6 – 2 = 4. Some who found a scale factor of $\frac{4}{3}$ from the first triangle then multiplied 6 by this, instead of dividing, so wrote the answer 8. It is important to consider the entire problem and to realise the missing side will be smaller than 6 so if calculations give a larger value, then everything should be checked to find the errors.

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MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

When reasons and explanations are required in questions more details, rather than vague statements, are needed.
The four rules, when applied to directed numbers, need strong emphasis in preparing candidates for the examination.

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 presentation of work was generally good and most candidates showed clear working where required. Premature rounding in calculations was sometimes seen.

Comments on specific questions

Question 1

Most candidates were able to find the correct order and combination of digits but there were a number of common errors. The digits 0 and 7 reversed and 0 omitted were the most common. A small number gave the answer as three separate numbers, 600,7 000,532.

Question 2

Parts (a), **(b)** and **(c)** of this question were well answered. In **part (a)** 65 was occasionally seen for a square number while incorrect choices for multiples of 13 and factors of 186 were most often from mixing up 62 and 65. **Part (d)** was not so well answered with many candidates just giving one prime number and a small number quoting three or more numbers as primes or even all the odd numbers.

Question 3

The drawing of a congruent triangle was well done with only a small proportion of candidates drawing an enlarged triangle. Good, clear ruled triangles were generally seen with few making errors on accuracy. Rotations and reflections, although not needed, were usually still well drawn. Only a few candidates did not use the grid lines.

Question 4

(a) Stem-and-leaf diagrams were understood by many candidates. The answer 2 was seen at times from those who just considered the 30 line.

(b) Generally those who gained credit in **part (a)** also found the mode correctly. Some attempts at both mean and median were seen. A common incorrect answer was 9, which showed recognition of the most common but lacked interpreting the diagram correctly.

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Question 5

Candidates who followed the instructions of the question to repeat the example with the new values usually gained full credit. Missing out a step or not doubling both numbers was seen. Some did not follow the defined method and simply finding the result of the calculation did not earn credit.

Question 6

There were many responses that focused on the two required reasons and gave enough description to earn credit. It was the width, or an equivalent word, of the bars that was required and not 'coffee was larger'. Specifying the actual widths, 2 and 3 also made that reason clear. Simply stating that the scale was wrong was not enough; it needed some detail about the scale not having equal intervals. Some chose to specify missing items such as a title or not enough candidates or drinks surveyed.

Question 7

(a) The placing of the brackets in this part was correct for the vast majority of candidates.

(b) This part was far more challenging, but a significant number of candidates did work out correctly that it was just a single number to be bracketed. A few included the index in the bracket. Otherwise, there were many attempts at different positions of the brackets.

Question 8

This question was answered correctly by very nearly all candidates. The most common incorrect answers were 5 or −5 although occasionally 12 was seen.

Question 9

(a) While there was a good response to the sector angle, a significant number followed the fraction by nothing or multiplying by 100 which led to a percentage rather than an angle. Some tried to calculate the area of a circle. A small number, realising an angle was required, multiplied the fraction by 180 instead of 360.

(b) It was rare for an answer of 'yes' followed by an explanation, however simple, not to gain credit. Very occasionally, an explanation seemed to contradict that the sector angle for red had changed. Some felt that no cars leaving the car park meant the angles for them did not change, even though there were more cars present. Just a calculation of the new angle for red cars without a worded reason did not gain credit.

Question 10

(a) The vast majority of candidates understood the method for subtracting vectors and usually this part was correctly answered. The main error seen was not on vector operation, but in working out 2 – (−1) which was often given as 1.

(b) More correct responses were seen than in **part (a)** since negative numbers were not involved and the multiplications were basic. A few added fraction lines in the answer and some regarded the answer as if it was a fraction and so reduced to its simplest form.

Question 11

Although many candidates understood how to find the surface area, with considerable success, many confused volume and surface area, resulting in the often seen 8 × 6 × 3. A number of responses had the addition of the three distinct areas but without doubling the result. Drawing a sketch was a help for many correct solutions. Common errors were to find four of one area with two of another or a square cross-sectional area.

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Question 12

(a) While there were quite a number of correct expressions for the cost of one bag, many could not take the step from a numerical question to the same process with letters. Multiplication of the letters and division the wrong way round was often seen. The difference between an expression and an equation caused a lot of candidates to not gain credit.

(b) Most candidates realised that the expressions *rx* and *ay* were part of the solution, and usually they added them. Most errors then occurred in the expression for the change from $20. Subtracting $20 instead of subtracting from $20 was seen at times but the major error was from no brackets around the whole expression for the cost, or without brackets adding, rather than subtracting, *ya*. Some had expressions which did not include all the letters, often $20 - x - y$ which showed weakness in translating a numerical question to an algebraic expression. Again, an equation was often seen, usually $20 = rx + ay$.

Question 13

(a) This question was well answered with most performing a single calculator operation leading directly to the whole number. The errors came when answers were found, and usually written down, for the square roots separately. Rounding then produced an inaccurate answer.

(b) This question testing understanding of using the calculator to find cube roots generally resulted in partial credit. However, a significant number of candidates thought the index meant division by 3. Others just ignored the index and tried to apply 2 decimal places to the figures 6789. Many candidates didn't round to 2 decimal places or gave an incorrect rounding, often truncating to 18.93.

Question 14

The first stage in this ratio question was to change the numbers in standard form to ordinary numbers and most candidates did this correctly. Once past this stage there were many correct ratios but most were not in the simplest form.

Question 15

(a) The terms of the sequence were found correctly by most candidates, and a partially correct answer was rarely seen. Some assumed the first term was for $n = 0$ instead of $n = 1$. More usually errors came from incorrectly working out the expression or simply writing algebraic expressions for the terms such as n, $n + 1$, $n + 2$.

(b) Showing 5196 was a term in the sequence was quite well done. Most candidates either worked through the equation to find $n = 72$ or showed that $72^2 + 12$ did equal 5196. Worded descriptions were common but did not always gain full credit. Incorrect methods seen were square rooting or squaring 5196 as well as adding 12 or dividing by 12. Some stated the number was too big to be in the sequence.

Question 16

The question stated that there were two irrational numbers and so both were required to gain credit. While some did correctly identify the two numbers, it was clear that many did not understand irrational numbers. Most found one correctly, either π or $\sqrt{3}$.

Question 17

The rules of indices were well understood and credit was gained by the majority of candidates. A small number of candidates thought the indices had to multiply to give 12, rather than add. Only a few candidates made the error of giving the answer as 9^{10}.

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Question 18

Most candidates understood what was required in this question but many responses included trailing zeros. For example, 2.0 instead of just 2 and 0.050 instead of 0.05 were common. Otherwise, the rounding error of 850 instead of 800 was particularly common. Quite a number simply worked out a calculator answer for the sum as it stood.

Question 19

This limits question was not well answered. The error of adjusting by 0.5 rather than 0.05, leading to 30.2 and 31.2 was very common. Some candidates reversed otherwise correct limits. Further misunderstanding of the inequality signs saw quite a number of upper limits of 30.74.

Question 20

(a) Most candidates gained at least partial credit simplifying the algebraic expression. Most could expand the brackets correctly but some worked out $-3b - b$ as $-2b$. Other incorrect combinations of letters and numbers occurred in simplifying.

(b) Apart from those with no understanding of factorising, this was answered very well. With only one factor, an algebraic one, most were successful in finding a correct expression in the brackets.

Question 21

There were many fully correct answers but a few candidates were unsure of the difference between lowest common multiple and highest common factor. Working with tables or factor trees was generally good although some did not realise the factors had to be primes. Lists of multiples were often successful but errors did occur. Some gained credit by giving a multiple of the LCM.

Question 22

Candidates found this reverse bearings question challenging. Very few knew that they had to add 180 and the diagram did not seem to help. 180 – 59 was a common incorrect calculation which indicated no realisation of the angle (clearly reflex) that was required. The other main error was to subtract 59 from 360, sometimes by incorrectly writing 59 for the obtuse angle at *B*.

Question 23

By far the majority of candidates understood a method for subtraction of mixed numbers. Most converted them to improper fractions and then to a common denominator. Some of those who dealt with the whole numbers and fractions separately did get rather mixed up and could not reach the final answer correctly. Working was seen quite clearly in most cases but occasionally decimals were seen in the working or answer. Many left the answer as an improper fraction rather than a mixed number.

Question 24

The majority of candidates realised that the required side could only be found after the vertical common side of the two triangles was calculated. The main challenge was in finding this length but provided some value was indicated for it, a method mark for correct Pythagoras' theorem in the second part could be gained. Some used incorrect ratios for the trigonometry. With 4 marks for the question, candidates needed to realise that length *BC* could not be found from a single calculation.

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MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

It is vital to cover the whole syllabus in the preparation of candidates for the examination.

Premature rounding in calculations should be avoided.

Answers need to be given to 3 significant figures or the required accuracy stated in the question.

General comments

While many candidates did show clear working in multi-step questions, improvement is needed in setting out logical progression. There was some evidence of a lack of working resulting in the loss of possible method marks when answers are incorrect.

Some candidates did not show any, or clear, use of rulers and protractors where necessary. The need to use a pencil for diagrams should be emphasised.

Handwriting needs attention for a significant number of candidates, particularly with clear figures to distinguish between, for example 1 and 7 or 4 and 9.

Comments on specific questions

Question 1

Many correct answers were seen in this question. Of those who did not write the correct number, various permutations of the digits were seen with 1 003 806 being the most common.

Question 2

(a) Most candidates answered this question correctly. Common incorrect answers were 8.6, 860 and 8600.

(b) Most candidates answered this question correctly.

(c) Many candidates answered this correctly, demonstrating an understanding of the term perpendicular. A small number used compasses although a construction wasn't required. Others used a ruler but not a protractor as lines were drawn at various angles. A small number had confused the terms perpendicular and parallel.

Question 3

Most candidates answered this question correctly. Common incorrect answers were $8x$, $3x$ and $-6x$.

Question 4

This was well answered with the majority of candidates gaining full credit. The perimeter rather than the area was found by a small number of candidates.

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Question 5

Those who understood probability were able to find the correct answer. Common incorrect answers were 0.5, 5% and 99.95.

Question 6

Some candidates were able to give the correct answer. The common incorrect answer was 38 to 42 from reading the wrong protractor scale. Others thought bearing was length and the answer 7 was often seen.

Question 7

Many were able to give the correct answer, although this question on substitution was found challenging by several candidates. Some rounded $\sqrt{3}$ to 1.73 or 1.7 and gave an inaccurate answer of 793.1 or 807. Others calculated $(4 \times 7)^3$ while some correctly wrote down 4×7^3 but incorrectly calculated 28^3.

Question 8

Most candidates were able to give the correct answer and gained full credit. A common error was $8.5 \times 6 \times h = 357$, followed by 357 – 51. A small number calculated just 8.5×6.

Question 9

Many candidates worked out the correct answer. Others gained partial credit for 83. A small number appeared not to understand the angle notation *PST*.

Question 10

(a) Many candidates were able to correctly complete the stem-and-leaf diagram. Some had not ordered the values while others omitted a number.

(b) This part proved more challenging than **part (a)**. Common incorrect answers were 1 or 1.2. Others found the mean of 1.225. A few had written the correct value of 1.15 but then rounded it to 1.2 on the answer line.

Question 11

(a) Most candidates answered this question correctly and were able to gain full credit.

(b) Several candidates demonstrated an understanding of vectors and were able to plot the correct point. Others did not understand the vector or did not read the question carefully as many plotted the point (3, −2) or (−2, 3).

(c) The majority of candidates who gave the correct answer in **part (b)** gained credit in this part.

(d) Several candidates answered this correctly; common incorrect answers were *RP* and *PQR*. Some gave answers using numbers rather than letters.

Question 12

(a) Many candidates were able to give the correct answer; common incorrect answers were y^2, y^8, y^{15} and $y^{0.6}$.

(b) Many correct answers were seen; common incorrect answers were $7x$, 1 and 0.

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Question 13

(a) Most candidates answered this question correctly.

(b) The majority of candidates were able to correctly plot the point. Candidates should use a sharp pencil to plot points.

(c) Most candidates gained credit for a suitable line. Some did not rule the line and others drew the line through the origin. A small number just joined up all the points.

(d) The majority of candidates gained credit in this part.

Question 14

(a) Although candidates recognised the need to use Pythagoras' theorem, several did not halve the base and used the value 4 rather than 2. Others added rather than subtracted the squared values. A common error was to give the answer 4.6 without showing a more accurate value; answers should be given to 3 significant figures.

(b) Several correct nets were seen. A significant number had drawn nets with triangles of height 5 cm even if they had the correct answer in **part (a)**. A small number appeared not to be familiar with the term net.

Question 15

Those who were familiar with the term factorise often gained full credit. Others scored partial credit for a partial factorisation, usually $3p(6x - 9)$.

Question 16

Many candidates gave the correct answer and gained full credit. The special case mark was rarely awarded.

Question 17

(a) Incorrect terms such as 'the same', 'identical' and 'equal' were often seen.

(b) Candidates who recognised the need to use trigonometry usually chose the cosine ratio and gained full credit.

Question 18

Several candidates gained full credit in this question. The main error was to leave the answer as $2^3 \times 4 \times 5$ or to leave the 4 in their factor tree. A small number gave the answer 8 which was the highest common factor.

Question 19

A few candidates did not understand the word 'treble' which led to many answers of just $n - 5 = 22$. Others assumed treble meant to the power of 3 and wrote $n^3 - 5 = 22$. Some had the correct answer of 9 but no equation and others left the 9 embedded in the equation with $9 \times 3 - 5 = 22$ seen.

Question 20

Many candidates just counted squares for the gradient not realising the scales were different, resulting in answers of 1 or –1. Others correctly picked out two coordinate points but made arithmetic errors trying to calculate the value. Many answers of (–2, 2) or (–2, –1) were seen.

Question 21

Many candidates gave the correct answer. The main error was premature rounding of $\frac{7}{30}$ as 0.23 which meant the answer was not accurate.

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Question 22

Many candidates gave the correct answer and all the required working to gain full credit. Several had not read the instruction to give the answer as a mixed number and left their answer as $\frac{55}{24}$. A small number had used a calculator and could not gain any credit.

Question 23

Many candidates had some idea of how to solve simultaneous equations and several gained full credit. Other candidates correctly opted to multiply the first equation by 2 to equate the *y* coefficients, although some then subtracted the two equations. Several who equated the *x* coefficients correctly tried to subtract the two equations but made arithmetic errors. A significant number of candidates gained the special case mark for 2 values satisfying one of the original equations.

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MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key messages

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

General comments

This examination appeared to give the candidates plenty of opportunity to display their skills. There were many good scripts with a significant number of candidates demonstrating an expertise with areas of the subject content and proficient mathematical skills. Almost all candidates managed the demands of this paper. There was a larger number of questions than some previous papers but there was no evidence that candidates had time issues reaching the end. Some candidates omitted questions or parts of questions, but this appeared to be a consequence of a lack of knowledge or familiarity with a topic rather than any timing issue.

Candidates were particularly successful in the basic skills assessed in **Questions 1**, **2**, **3**, **5**, **7**, **8a** and **10a**. The more challenging problems were **Questions 11b**, **13**, **14**, **16**, **26** and **27**. Candidates were very good at showing their working, especially where the question required it, and this made it easier to award method marks when answers were not correct or were inaccurate. Some candidate lost marks due to misreading or not following the demands of a question, particularly in **Questions 16, 17** and **24**.

Greater clarity in the writing of numbers and letters would have been helpful as often these were difficult to distinguish, in particular figures 1 and 7, and letters *a* and *q*. Marks were sometimes missed by candidates not being careful with accuracy in their solutions. In some questions, many did not make it clear what they were trying to do; an example being **Question 26** where terms in **a** and **b** were stated without showing which vectors (e.g. $\overrightarrow{AK}$ or $\overrightarrow{OL}$ etc.) they were intended to represent.

Comments on specific questions

Question 1

This offered candidates a comfortable start to the paper with most managing to offer one of the two answers (31 or 37), some giving both. There was a small number with answers out of range or a non-prime in range (e.g. 33, 35 or 39).

Question 2

As calculators were allowed it was rare for candidates to not reach the correct answer, commonly with the two separate parts evaluated before subtraction. In a very few cases an incorrect answer of –1 was seen.

Question 3

This was generally found to be a familiar topic and the question done well, although a few used 1 hour = 100 minutes. Another common error was being 1 hour out. A variety of methods was seen (e.g. approximating to 3 hours then adjusting by 3 minutes incorrectly, or lining up 13:02 – 10:05 but subtracting each smaller value from the larger one) leading to the answer 3 hours 3 minutes. A small number offered 3 hr 7 minutes.

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Question 4

Most correctly evaluated the expression with their calculators. Many candidates ignored or misunderstood the rounding demand, instead rounding or truncating to 4 decimal places. Some applied standard rounding to give 4.29; more care should be taken to read the question fully.

Question 5

Most were correct here, but some candidates did not appreciate the correct way round to convert between the currencies. So whilst many correctly divided 380.80 by 1.19, sometimes a multiplication was attempted.

Question 6

Most candidates successfully tackled this question, usually giving the prime factors as a product as required. There was a variety of approach, most commonly using factor trees, but sometimes with incomplete decomposition. A small number of responses did not seem to understand the demand, either listing <u>any</u> factors or simply giving a calculation resulting in 180.

Question 7

A few candidates gave the correct answer with no working which was not acceptable, as the question specified that the method should be shown. Not all opted for the easy conversion of $\frac{3}{7}$ to $\frac{9}{21}$, as use of any other suitable denominator required extra work (a common denominator of 147 was not uncommon to see), but equivalent alternative methods were acceptable. Some did not convert their final answer to the simplest form as the question demanded (e.g. leaving it as $\frac{7}{21}$), and consequently did not score the final mark.

Question 8

Part (a) was straightforward for most candidates. A few went wrong with order of operation errors such as finding $(at)^2$. Responses were less successful with **part (b)**. Many took correct steps to rearrange the formula, but left answers with incomplete steps such as $\sqrt{\frac{s \div a}{0.5}}$ or $\sqrt{\frac{s}{\frac{1}{2}a}}$. Unsuccessful candidates usually took wrong first steps such as subtracting $\frac{1}{2}$ or had incorrect attempts to square root too early. Some took an unhelpful first step of dividing by t^2. A minority did not understand the demand, producing numerical answers (sometimes 'undoing' their work in **part (a)** ending back at $t = 4$).

Question 9

There were two factors to be extracted, 7 and y. A small minority took out only one common factor to give $7(2xy - y^2)$ or $y(14x - 7y)$, scoring 1 mark, but others attempted to 'solve' the expression as an equation, or managed to introduce x^2 into the situation. A further common error was to see an incorrect $7y(7x - y)$.

Question 10

Part (a) gave candidates a comfortable start to the question with most spotting the pattern and obtaining the correct next term. Working with linear sequences seems to be familiar to the majority, with the correct answer to **part (b)** being the most common response. Nearly all candidates recognised the term difference of –5 with most then correctly using it as $-5n$ in their answer. Commonly these also correctly found the constant term 27, with only a small number incorrectly giving $22 - 5n$. Other examples of incorrect answers seen included $n - 5$ and $27(n - 5)$. Candidates should be encouraged to use correct notation and avoid answers starting with $n = \ldots$, or with poor notation such as $27 - n \bullet 5$.

Question 11

Similar triangles appeared to be a less familiar topic for many with a fairly even split in **part (a)** between correct answers using a scale factor, and those erroneously subtracting 2. Correct answers in **(b)** did not

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usually follow an incorrect **part (a)**. For those with a scale factor approach this was often used as a linear factor in **(b)** when attempting the new volume, with the common wrong answer of 240. Those without a scale factor sometimes approached **part (b)** attempting calculations of cross-sectional area, but without success.

Question 12

Many candidates were aware they needed to divide the angle sum by 30 although most did not find the correct angle sum for a pentagon of 540°.. Most gained credit for knowing a multiple of 180° was needed for the division but this was very commonly 360°, leading to an incorrect answer of (12 × 9 =) 108°. Those with calculations finding the interior angle of a regular pentagon of 108° (by first finding 360 ÷ 5 for the exterior angle) did not score as this did not help to answer the question. Other common incorrect attempts found 30 but then divided by 5.

Question 13

It was not possible to evaluate this standard form question with a calculator and few candidates tackled it correctly. Most were not able to convert the two numbers to a common form to allow subtraction leading to a valid '198' in their answer. Some responses started well but left the answer as 198×10^{98}. Common errors included subtraction of powers with an answer of e.g. 2×10^{2}, or adding powers giving an answer including 10^{198}.

Question 14

Candidates found this question very challenging with many unsure of how to start. Only a small number managed a fully correct solution. Often they were able to gain some credit, either for correctly converting the speed to 30 m/s, or for an attempt to multiply the speed by time 7 (either before or after attempts at conversion). It was not uncommon to see unsuccessful attempts at the conversion, either using a factor of 60 just once, multiplying instead of dividing, or sometimes using a factor of 100 rather than 1000 for kilometres. A minority reached 210 metres for the distance travelled in 7 seconds but this was often then seen as the final answer, or in some cases had 120 metres added rather than subtracted. Common incorrect calculations included speed 108 divided by time 7.

Question 15

Whilst many candidates seemed to know that $\frac{1}{64}$ was equal to 4^{-3} not all of these offered –3 as their answer. As *x* was asked for, –3 was the only acceptable answer. Common incorrect answers were +3 or $\frac{1}{3}$.

Question 16

Fully correct descriptions here were rare. In order, the most common aspects to score marks were for 'enlargement', then the correct centre, with the scale factor being least commonly correct (often instead given as $\frac{1}{2}$, 2 or –2). Despite the clearly emphasised instruction to give a <u>single</u> transformation it was very common to see an attempt at a succession of transformations (which scored no marks), commonly involving rotation and translation. Candidates should be familiar with the vocabulary of transformations expected by the specification (instead using e.g. 'shrink', 'magnify', 'turn', 'slide').

Question 17

A large number of responses missed the fact that the question was about a <u>hemi</u>sphere, not a sphere. If they were able to solve their equation for a full sphere they were able to gain some credit. Some that noticed they were working with a hemisphere but thought they should simply halve their value for *r* found for a sphere. It was evident that some candidates were using square root for their final step rather than the needed cube root.

Question 18

Only a minority of candidates recognised that *x* was the same as the given 38°, using the alternate segment theorem. The sum of opposite angles in a cyclic quadrilateral, or alternate angles in parallel lines, were better

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known however with many picking up at least a method mark for writing in 120° for angle CBA on the diagram, or angle ACB with x. Not many found both x and y correctly.

Question 19

The most successful part here, with a mark gained by nearly all candidates, was identifying that PX = XB. Many candidates were also able to identify the two correct angles (PQX and PXQ), but correct reasons were less common. Many without correct reasons simply referred to parallel lines or stated that the triangles were congruent. More were able to identify the opposite angles than the alternate angles.

Question 20

The successful deduction of deceleration using the gradient of the graph was achieved by many candidates in **part (a)**. Strictly, as deceleration was asked for rather than acceleration, this should have been a positive value although –1.5 was condoned. For those not understanding how to deduce deceleration common errors were either attempting the area of the triangle or attempting the length of the sloping line using Pythagoras.

In **part (b)** most were aware they should be finding the area under the graph, although some simply did an incorrect calculation of 12 × 24. The most common way candidates scored 1 mark was for the area of the rectangle up to time 16 (= 192), with many of these then forgetting the $\frac{1}{2}$ for the triangle area. Use of the area formula for a trapezium was not much in evidence.

Question 21

This problem proved challenging, with few scoring full marks. Some were unaware that brackets were needed at all, whilst those not quite earning 1 mark did not have two brackets the same, a key first step, (e.g. instead reaching an unhelpful $1-q+a(q-1)$). It was also not unusual to see errors dealing with the signs for the second bracket (i.e. having the incorrect $1 - q - a(1 + q)$). Of those that did correctly reach $1 - q - a(1 - q)$ not all then treated the first two terms as $1(1 - q)$ which leads to the final step.

Question 22

Whilst only a minority were able to get a fully correct answer many were able to either obtain the correct coefficient 36 or the correct power 144. Some candidates had both of these as 36 or both as 144.

Question 23

In **part (a)**, a minority of candidates knew the quick way to identify the value of a (halving the coefficient of x in the expression), and then finding b. A larger number attempted to expand $(x + p)^2$, sometimes correctly to score 1 mark but, commonly not then proceeding to the correct answers. A fair number of candidates choosing this route were unable to square the bracket correctly. Often p and q were 'found' by a rearrangement of the question with p and q offered in terms of x and q or x and p, which did not address the problem.

Whilst **part (b)** was much more successful for candidates than **part (a)**, with many correct answers seen, it was extremely rare to see any use their answer to **part (a)**. Instead most chose to rearrange the equation and use the quadratic formula or in some cases factorise. Some of these ignored the RHS and worked with $x^2 + 8x + 10$ only, which was not acceptable. Some clearly could not spot either approach to the question and merely tested a few possibilities, but unless they found both $x = 2$ and $x = –10$ they earned no marks as they had no clear method.

Question 24

Whilst some candidates worked through to find the correct answer many simply found the length of a diagonal of one face. (Candidates need to know that a diagonal in a solid shape joins vertices that do not share a face.) Some correctly applied Pythagoras' theorem in 3D in a single calculation, whilst those working in stages were more likely to introduce rounding errors. Attempts that did not score any marks often involved finding the volume of the cuboid, or finding the average of the three given lengths.

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Question 25

Many candidates were able to score marks for at least one of the two relationships stated as an equation, quite often for both, but much less common was being able to combine these two into a correct final answer. Poor use of notation meant than many used k to stand for two different constants of proportionality, often both found correctly, which then usually caused confusion. A minority of candidates were able to combine the two relationships, with a correct answer often given as $2\sqrt{\frac{64}{x}}$. The least successful responses missed out the step of writing as equations using a constant of proportionality..

Question 26

Candidates commonly find vectors challenging and this was no exception, with many responses left blank. Clear labelling of intermediate vectors they are trying to find would most likely lead to more marks being earned in many cases. If unlabelled, the Examiner does not know the candidate's intention. Common errors observed included for example finding vector $\overrightarrow{BA}$ but thinking it is $\overrightarrow{AB}$, and answers that were not vectors, e.g. with fractions added. Although its absence was not penalised, candidates should be encouraged to use correct notation for vectors with underlining of single lower-case letters or an arrow above a pair of upper-case letters.

Question 27

This was a good question for some who knew immediately to equate the two equations for y to find the required intersections. Some gained credit for attempting the solution of their resulting quadratic if incorrectly rearranged. Weak responses worked with $y = x^2 - 3x - 11$ which did not provide any useful results.

Some candidates attempted a non-algebraic approach trying pairs of coordinates, sometimes 'plotting' (without graph paper) or sketching graphs. Where this latter approach was tried, a few spotted suitable points from their tables of values and whilst this was able to gain credit, most did not extend to finding more than one point and so could not score better than a single mark.

A few candidates appeared to be attempting differentiation which did not help with this question.

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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 many high scoring scripts with a significant number of candidates demonstrating an expertise with the content and showing adept mathematical skills. Premature, excessive or inaccurate rounding did cost candidates marks. This was particularly evident in **Questions 7**, **12b**, **14**, **17b** and **23**. Some candidates do not draw certain digits clearly leaving doubt as to which number they are trying to write: 1, 4 and 9 in particular cause problems. There were quite a few cases where candidates appear to have misread their own handwriting, changing values between consecutive steps. Candidates were strong in the basic skills assessed in the earlier questions on the paper. Where candidates scored highly but did not get full marks, it was frequently **Questions 7**, **18b** and **23** that were the cause. There was no evidence that candidates were short of time, as almost all attempted the last few questions omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time. Few candidates were unable to cope with the demand of this paper.

Comments on specific questions

Question 1

The majority of candidates were able to answer this question correctly. Most gave 13 but –13 was also a common correct answer. Many needed no working but others wrote 4–(–9). Some showed an incorrect calculation e.g. 4 – 9 = –5 or 9 – 4 = 5. Using a number line may have helped understanding. +/– 14 was also seen, sometimes accompanied by the sequence 4,3,2,…,–8,–9. This suggests that candidates included both ends of the number line that they drew. Others gave the answer +/– 12.

Question 2

Most candidates understood how to find the angle for a sector of a pie chart and gained both marks. A common method was to find the fraction $\frac{3}{20}$ and then multiply this by 360, although some candidates stopped at $\frac{3}{20}$ or multiplied by 100 giving the percentage 15 per cent rather than the angle. Some of these candidates thought it was 15°. Some candidates confused the question with the area of a sector and involved π, with $\frac{3}{20}\pi$, $\frac{3}{20}\pi r^2$ or $\frac{\theta}{360}\pi r^2$ often quoted. Many candidates could not score as they were using the incorrect colour of car and so more care should be advised when reading values from a table. Weaker responses often divided either 20 or 360 by 3. $\frac{3}{360}$ was also occasionally seen.

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Question 3

This question had a strong response with many candidates gaining full marks. The vast majority of candidates knew how to start and hence scored at least 1 mark. The most common strategy was to use division with either 500 ÷ 43 or 5 ÷ 0.43 but some chose to use repeated subtraction or addition to reach an answer. Use of trial and improvement was also seen. A common incorrect answer came from those who thought that the answer to the division was dollars and cents and 11.63 frequently became 11 figs. and 63 cents change. There were also quite a few who were unsure how to deal with the units and who gave the answer 11 figs. and 0.27 cents. Occasionally candidates rounded 11.6 up to 12 rather than down to 11. A small number of candidates scored 0, sometimes using 43 ÷ 5 or by not knowing the conversion from cents to dollars, with $5 being seen as variously 50, 5000 or 250 cents.

Question 4

Most candidates correctly found the exact value of 102. A small number of candidates lost accuracy by rounding each of the roots before multiplying them and giving an inexact answer that rounded to 102.

Question 5

This was reasonably successful for many candidates with the majority scoring at least 1 mark. The most common successful method seen was doubling each face area then summing. Only a small number gained 2 marks by finding all three face areas but forgetting to double the sum. A very common error was thinking there were four of one face area and two of another. Most common among those not scoring was multiplying all three sides to find volume (sometimes then doubling their answer). A small number of candidates found the sum of all the edge lengths.

Question 6

Most candidates answered this question correctly scoring 2 marks realising that all three probabilities added to one. It was very rare to see any working such as $1-(0.2+0.32)$ resulting in incorrect answers scoring 0 marks. One error was adding 0.2 to 0.32 to reach 0.34 but this was very rare as most candidates are likely to have used their calculators. The most common error was to forget to subtract from 1, leading to 0.52.

Question 7

This question was very well answered. Many candidates were able to calculate the reduced price correctly, usually by finding 82 per cent of $126, although some found 18 per cent of $126 and then subtracted the discount from the original price. The answer of $132.32 is exact so should not be rounded, however it was very common to see the correct answer rounded to either $103.3 or $103 which was not accepted for 2 marks. A small number of candidates gave the answer $22.68, the discount rather than the reduced price. Some candidates interpreted the question wrongly and used incorrect methods including 126 × 1.18, 126 ÷ 1.18, 126 ÷ 0.82 and 126 – 0.18.

Question 8

A high proportion of the candidates answered this question correctly. Common errors were to give algebraic expressions as answers such as $n^2 + 1$, $n^2 + 2$ and $n^2 + 3$, or not evaluating and giving answers such as $1^2 + 12$ and so on or using n = 0 or n = 2 to find the first term. It was also common to see the first three terms of the sequence n × 2 + 12 rather than $n^2 + 12$.

Question 9

This proved to be a difficult question for many. The best answers used a diagram with the North line drawn in at B. Of those who gave the correct answer, many used the diagram and the method 180 + 59 = 239 with the diagram split up to show the North line, 180 and 59 or found 121 using co-interior angles between the parallel North lines then 360 – 121. Some tackled this without using the diagram and only wrote 180 + 59 to get the correct answer. The required angle on the diagram was not usually drawn in this case. Weaker responses did not show understanding of the concept of bearings, and split the diagram up incorrectly, often using 90°. Many found the wrong angle on the diagram. 360 – 59 = 301 or 180 – 59 = 121 were common wrong methods and answers.

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Question 10

The vast majority of candidates understood the notation involved in **part (a)** and correctly found both vectors. There were very few using fraction lines in this session. The most common error in **part (a)(i)** was to make an arithmetic error with the negative, resulting in the answer $\begin{pmatrix}1\\4\end{pmatrix}$. In **part (a)(ii)** some candidates correctly found $\begin{pmatrix}12\\48\end{pmatrix}$ but then 'cancelled' this to give an answer of $\begin{pmatrix}1\\4\end{pmatrix}$.

It was apparent that the notation in **part (b)** was not widely understood with a very high rate of non-response and many giving the answer $\begin{pmatrix}3\\4\end{pmatrix}$ again. Of those who did recognise the need to use Pythagoras, there was a large proportion using the vectors incorrectly, often dealing with the modulus of **p** and **q** separately. There were many combinations of adding and subtracting the values from the vectors involving squaring and square rooting. Among the correct answers, were those who used $\sqrt{(2--1)^2+(8-4)^2}$ rather than using their answer to **(a)(i)**.

Question 11

This question was generally done well. The most common incorrect answer was 7 from the misconception that the indices should be multiplied instead of added and most candidates who gave this answer also showed the calculation 28 ÷ 4. A few instances were seen with an answer of 6^{24}. This gained no marks as the question asked for the value of p.

Question 12

In **part (a)** those who understood that the gradient of each line segment on the distance-time graph represented the speed of each part of the journey usually scored some marks here. A common error for the first part of the journey was to draw a line segment from the origin to the point (1.5, 20) instead of (1.5, 30). In many cases, candidates correctly drew a horizontal line on their graph representing the 30-minute stop following on from their initial diagonal line. Many drew the first two parts of the journey correctly but had trouble with the third part. The most difficult part of the question was to draw an appropriate line with a gradient of 16 for the final part of the journey. Some candidates drew a line with the correct gradient but did not realise that the graph needed to end at a distance of 70. It was quite common to see lines extended all the way to 5 hours.

Those making no progress tended to draw horizontal or vertical lines at various points and in some cases more than three parts to their journeys or simply left this part of the question blank.

Many candidates demonstrated some knowledge of $\text{speed} = \dfrac{\text{distance}}{\text{time}}$ in **part (b)**. The most common errors with the time included using 4 hours (neglecting to include the 30-minute stop) or using 5 hours (usually following through the final time shown on their graph, which was sometimes a 30-minute horizontal line at the end of a correct graph). Weaker responses assumed that the average speed could be found by averaging the speed of each part of the journey, giving the common incorrect response of $\dfrac{16+20}{2}=18$. Some incorrectly found the area under the distance-time graph. Despite being told in the question that the total distance for the journey was 70 km, there were a number of candidates who did not use 70 km in their calculation of average speed. Quite often the answer was truncated from $15.\dot{5}$ to 15.5 instead of accurately rounded to 3 significant figures.

Question 13

Most candidates were able to score well on this question with little evidence of reliance on calculators. Most attempted the route of changing to improper fractions, usually with success, but many then missed the simpler common denominator of 24, instead choosing to use 48. Cancelling the result was usually successful although a noticeable number missed the demand to give their answer as a mixed number in its simplest

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form, instead commonly giving the answer $\frac{31}{24}$ or less frequently $1\frac{14}{48}$. Those scoring only 1 mark typically had an arithmetic error when changing to improper fractions. In the minority of candidates who chose to work with mixed numbers, an error sometimes seen was in the subtraction of a larger fraction from a smaller to leave a positive answer, resulting in an answer of either $1\frac{17}{24}$ or $2\frac{17}{24}$. Although directed not to use a calculator, those with an incorrect answer may have realised they had made a mistake and possibly located their error had they checked their answer with a calculator.

Question 14

This question proved a challenge for most candidates. The most common error was to take the interest \$1328.54 to be the final amount rather than the interest earned. Those who started correctly and got as far as $\left(1+\frac{r}{100}\right)^{10} = \frac{5868.54}{4540}$ sometimes proceeded to spoil their answer by incorrectly writing $1+\left(\frac{r}{100}\right)^{10} = \frac{5868.54}{4540}$ instead of $1+\frac{r}{100} = \sqrt[10]{\frac{5868.54}{4540}}$. Another common error was to round their result too soon, writing $\left(\frac{5868.54}{4540}\right)^{0.1}$ as 1.03 rather than 1.026, giving an inaccurate final answer of 3 per cent rather than 2.6 per cent. A small number of candidates worked with simple interest rather than compound interest. A small number of candidates used a trial and improvement method with less success.

Question 15

This proved quite challenging with quite a few offering no response. Many candidates were able to find the correct highest common factor. Some unsimplified answers were seen such as 2^2a^2b or $2ab \times 2a$. Candidates who understood HCF usually gave an answer involving 4. They did not always appear to know how to deal with the algebraic parts of the expressions, so answers of 4, $4ab$ and $4a^2b^2$ were common. Some responses showed a confusion between highest common factor and lowest common multiple so the answer $60a^3b^2$ was also often seen. Some also picked out 2 as a common numerical factor and used that in place of the 4. Others identified correct factors but then wrote them with addition or subtraction instead of a product. Some candidates attempted to use factor trees or factor ladders but were not always able to deal with the algebraic terms. A method that often led to the correct answer was to write each expression as a product of individual terms, for example, and then identify the common terms in the two products to give the HCF. A common incorrect answer was $4a^2\,b(3a + 5b)$.

Question 16

Approximately a third of candidates answered **part (a)** correctly. Successful answers realised the need for brackets to establish priority. In weaker responses P' often appeared with no union or intersection sign. Incorrect responses most commonly seen were $(M \cup G)P'$, $M \cup G \cap P'$, $(M \cup G) \cup P'$, $n((M \cup G) \cap P')$ and $(M \cap G) \cup P'$. Quite a few candidates gave a numerical response to this question with 22 often being seen.

Only the strongest scripts reached the correct answer of 22 in **part (b)**; this was one of the most difficult questions on the paper for the candidates. In future, candidates need to make sure they are familiar with set notation. The most common incorrect response seen was 3, followed by 13. A few listed the values in the correct region but did not give the total.

Part (c) was answered correctly by about half of the candidates. Of those not gaining 2 marks it was common to award a mark for the correct numerator, usually $\frac{8}{40}$ or $\frac{8}{14}$, or the correct denominator, usually $\frac{14}{23}$. Many others also scored a mark for the working $\frac{3}{n} + \frac{5}{n}$. The most common incorrect working and answer was $\frac{3}{23} \times \frac{5}{23} = \frac{15}{529}$.

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Question 17

A significant number of candidates drew perfectly symmetrical graphs in **part (a)** with the angles marked on the *x*-axis, passing through the necessary points and with correct amplitude, although many of the diagrams contained straight lines while others lacked rotational symmetry. Not starting at zero was quite common, often starting at (0,1) and drawing a cosine curve, or starting at (0,–1) instead. Weaker responses used the wrong wavelength e.g. drew graphs of y = sin2*x* or y = sin $\frac{x}{2}$. There were quite a few non-responses or straight lines drawn.

A few candidates got both answers correct in **part (b)** to gain 3 marks, but accuracy was sometimes a problem. The majority of candidates scoring marks gave one correct angle to gain 2 marks. This was often given with –19.5 as the other answer. Accuracy with the angles was a problem with truncation to –19.4 often seen. If candidates struggled with the angles, they often managed to gain 1 mark usually for $\sin x = -\frac{1}{3}$ or for two angles adding to 180. Some candidates did not proceed beyond the answer their calculator gave of –19.5. Some could be seen using their answer to **part (a)** to help them find other angles but this was not very common, perhaps because –19.5 did not fit on their graph and they did not know how to extend their graphs to include it. 160.5 was often seen as an answer linked to 19.5 from using sin $x = \frac{1}{3}$. Some candidates did not rearrange the equation to find sin x. Candidates are advised that if answer space provides for two solutions, then giving a third solution or only giving one solution should indicate that a mistake has been made.

Question 18

Successful candidates in **part (a)** set up the correct relationship as $y = k \times \sqrt[3]{x+1}$ and found the multiplier which was then substituted correctly and there was a good proportion of fully correct answers. There were some errors rearranging the equation $1 = k \times \sqrt[3]{7+1}$ to find the constant of proportionality. Some candidates set up the correct equation to find the constant but then did not use the same relationship when substituting the values to find y. Those who did not score marks were generally setting up incorrect relationships which mostly stemmed from not reading the question carefully or misinterpreting the information given. Many omitted the cube root, used the cube, square or square root or used inverse proportion. A common incorrect answer from weaker responses was 5, from simply evaluating $\sqrt[3]{124+1}$.

Hardly any candidates correctly answered **part (b)**, with this being the most challenging question on the paper. The most common answer by far was that F will double. Many said that F increases but did not give a factor. Many demonstrated a lack of understanding of inverse proportionality by saying that it would also halve or that it would stay the same. Some candidates set up a correct relationship and substituted values, often leading to a correct answer. A few did not gain the mark because they said 'it increases by 4' which suggests an addition.

Question 19

In **part (a)** the most successful candidates began with their first step as interchanging the variables i.e. changing $y = 7x - 8$ to $x = 7y - 8$. Those who began with this as their first step always scored the first mark regardless as to whether or not there were sign errors in the rearranging, which was very common. Many were then able to rearrange successfully to make *x* the subject and gain full marks. Some lost a mark as they did not swap the variables leaving a final answer of $\frac{y+8}{7}$. The most frequent error was a sign error in the working and with $\frac{x-8}{7}$ being the most common incorrect answer. Some candidates were unsuccessful as they seemed to confuse the f^{-1} notation with that of a reciprocal and hence gave the answer $\frac{1}{7x-8}$. Some of the weaker responses gave numerical answers.

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Many candidates were able to attempt **part (b)** with most able to substitute the $\frac{1}{3}$ into the expression correctly gaining at least 1 mark. Some converted $\frac{1}{3}$ to rounded decimals such as 0.3 and 0.33 and lost accuracy due to this. Some who correctly evaluated $g\left(\frac{1}{3}\right) = 17$ were then unable to solve the equation $2^x + 1 = 17$ successfully as they added the 1 to the 17 instead of subtracting it, or were unable to solve $2^x = 16$. Candidates should be able to spot that the power is 4, or were expected to try various powers if they could not. Some candidates over complicated the work by attempting to use logarithms, not always correctly. A further incorrect answer that was sometimes seen was 131073 arising from $2^{17} + 1$.

Question 20

There was a generally good attempt made in **part (a)** with about two thirds of candidates successfully factorising the given expression. Of those making a correct first step, such as $2m(1-4k)+3p(1-4k)$, some went on to cancel the $(1-4k)$ leaving them with an incorrect answer of $2m+3p$. A few made sign errors when factorising and $(1+4k)$ was sometimes seen in the final answer. Some lost the 1 from $(1-4k)$, leading to an answer of $(-4k)(2m+3p)$. Candidates are advised to ensure both parts contain the same signs, it was not uncommon to see the expression $2m+3p-4k(2m-3p)$.

Part (b) was found to be more challenging than **part (a)**, although about a third of the candidates had fully correct solutions. The most common answer seen was the incomplete factorisation of $5(x^2-4y^2)$. Some candidates appeared to recognise that they were dealing with the difference of two squares but gave incorrect final answers such as $5(x+4y)(x-4y)$. Some candidates divided throughout by 5 at the start and gave a final answer of $(x+2y)(x-2y)$.

Question 21

About a third of candidates worked through to a correct solution, often with rather disorganised working. A sizeable minority of candidates were attempting, with mixed success, to use standard results for a quadratic sequence, i.e. 1st term $a+b+c$ and 1st difference $3a+b$. Greater care needs to be exercised in reading and understanding the question, a very common error was with candidates not substituting 1 and 2 for *n*, but rather substituting for *n* the *values* of the first and second terms (–3 and 2). Some candidates substituted into the given expression but equated to zero. A further error for some was to see for example $a\times1^2$ simplified to a^2 in their equations (sometimes going on to make use of the quadratic formula). Many candidates were able to go on to gain credit for a correct attempt to solve their simultaneous equations, although some made processing errors, being inconsistent with their addition/subtraction at this step. A large number only obtained one equation, often 3a + b = 5 using the first difference and not knowing how to substitute 1 and 2 into the nth term to obtain a second equation.

Question 22

There was a very large variety of answers for this question. A large proportion of scripts gave no response at all, others wrote down just the correct answer and others just an incorrect answer, with no working shown. The most common incorrect answer given was 3:4. Those who attempted to show some working generally found the vectors $\overrightarrow{AD}$ and $\overrightarrow{DB}$ but sign slips meant that they frequently did not arrive at the correct values of $\frac{4}{7}(-x+y)$ and $\frac{3}{7}(-x+y)$ respectively. It was not uncommon to see $\overrightarrow{AD}$ left unsimplified as $-x+\frac{3}{7}x+\frac{4}{7}y$.

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Question 23

Candidates work for this question was generally well presented with the relevant steps well set out and the correct answer 18.4 was seen quite often. The majority of candidates scored at least 1 mark by substituting numbers into the given formulae. A common error was not halving the hemisphere. Premature rounding was common, leading to a loss of accuracy in subsequent calculations, which in turn lead to a final answer that fell outside the required accuracy. Another common error was including the area of the circle from the hemisphere, many went straight to a hemisphere formula of $3\pi r^2$ rather than adapting the given sphere formula to the situation. Some candidates started with a correct equation $2\times\pi\times6.2^2+\pi\times6.2\times l=600$ but then struggled to manipulate the algebra and rearrange the equation correctly to find l. It was common to see $l=600\div\left(2\times\pi\times6.2^2+\pi\times6.2\right)$ or $l=600-\left(2\times\pi\times6.2^2+\pi\times6.2\right)$ evaluated. Also common was the radius to be used as 6.2 for the sphere but 6.5 for the cone or vice versa.

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MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

Candidates are asked to give answers correct to 3 significant figures if the answer is not exact or to 1 decimal place if it is an angle. Therefore in arithmetic working, they should work to a greater degree of accuracy, at least 4 significant figures, and, when using calculators, they should try to keep to the maximum accuracy of the calculator.

General comments

Candidates should be familiar with terms and rules. The criteria 'RHS' for congruent triangles was not well known. In set theory many did not seem to understand the notation for the intersection of two sets, and few understood the complement (NOT) of a set. In circle angle theory most did not show understanding of where the right-angle is in relation to the diameter of the circle. In number and algebra there was a knowledge gap in manipulating indices. Most struggled to subtract two indices correctly, particularly when at least one of them was negative. A good general understanding was shown for algebra and statistics and the quality of number work remains high.

Comments on specific questions

Question 1

This question was answered very well, with the common error being an answer of 0.05 or 5 per cent.

Question 2

The most common errors were to substitute into the formula incorrectly or to write the answer as 792.0.

Question 3

This question was answered very well with some responses working out angle *PSR* as 83° and leaving that as their answer.

Question 4

(a) A common error was not to order the numbers in the rows, whilst a few did not show the repeated numbers as such. A few other weaker responses missed out one or two numbers.

(b) Common incorrect answers were 1.1 or 1.2. Some used the original numbers instead of the diagram in **(a)**.

Question 5

Many gave the correct answers. Common errors included starting with $n = 0$ giving the answers of –1, 0 and 3. Some calculated one of the three terms incorrectly, usually the second or third term.

Question 6

(a) This was generally well answered with y^2 as the usual incorrect answer.

(b) This was generally well answered with the usual incorrect answers seen including 1, 0, x and 7x.

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Question 7

(a) This part was answered well with the majority of candidates reading the vertical axis and noting it was in thousands. So we usually saw 27 000 but sometimes just 27, and there were the very occasional 270 and 2700. Some gave other figures such as 29 000 or 30 000.

(b) This was usually plotted correctly.

(c) This was usually answered well. A number of candidates began at (150, 0), resulting in a steeper line. Occasionally the line was actually a series of lines or even a series of curves meandering through the points.

(d) This part was usually well answered.

Question 8

The two most common methods used were $\frac{2}{9}\times\frac{6}{5}$ or $\frac{4}{18}\div\frac{15}{18}$ with the second one sometimes having a common denominator of 54. A few candidates wrote down the correct answer with no working. Some used decimals or gave their fractional answer as a decimal.

Question 9

Successful responses generally worked in 2 steps. Initially either dividing by 1000, and then multiplying by 60, or vice versa. The most common errors were an answer of 0.005 from dividing by both the 1000 and 60 or multiplying by 1000 and then dividing by 60 leading to an answer of 5000.

Question 10

The most common incorrect answer was 3 which was the number in the intersection. Some gave the three numbers 25, 12 and 3 without adding them up.

Question 11

This question proved challenging. The most successful candidates worked out the missing angles in the triangles; however, even when this was done the answer *DF* was still often selected as this was 90 degrees for the angle *DFE*. This suggests a misconception that the 90 degree angle was formed by the diameter and a chord, rather than it being subtended at the circumference of the circle by the diameter.

Question 12

The most common errors included $\frac{14}{50\times1}, \frac{7}{5\times1}, \frac{14}{50\times3}, \frac{14}{5\times2}$ and $\frac{28}{10\times1}$. The most usual common factors of 14 and 28 given were 7 or 28, the usual common multiples of 10 and 25 were 5 or 10 and 1 was often given as a prime number. Many gave correct factors or multiples but they did not choose the right ones to give the largest possible value of the quotient.

Question 13

(a) This was usually well answered. Some correctly obtained the partial factorisation $3p(6x – 9)$, others gave an incorrect factorisation such as $9p(2x – 3p)$.

(b) This was answered quite well but not as well as **part (a)**. The problem was when the 1 is not clearly shown such as the partial factorisation $t(m + n) – m – n$. Another common error was to start to factorise with $m(t – 1) – n(t – 1)$.

Question 14

Many responses showed the second difference of +6 but less knew what to do with this information. Many gave a linear expression. Those who knew what to do found the correct expression quite easily.

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Question 15

This was answered very well. The most common error was to reach $12x + 4x \geqslant 13 + 3$, leading to $x \geqslant 1$.

Question 16

The common error in the first part was to give A instead of D. In the second part they either divided 30 by 10 to give 3 or they truncated the decimal to 0.3 or 0.33. In the third part to find the distance travelled they would often do 30 × 10 = 300.

Question 17

Most candidates completed the first line correctly, a few gave two lines instead of the two angles. Most completed the second line correctly with usually *DA*. However in the third line most gave the criteria SAS. Few knew the correct criteria of RHS.

Question 18

Only the strongest candidates knew how to use the ratio to find the answer. The most common answer was 280º from $\frac{360}{2+7} \times 7$. Although they were able to use ratio, they made a mistake in assuming $x + y = 360°$. Some responses made a similar error when they made the assumption that $x + y = 180°$ and they obtained the answer 140^0. The most efficient way of solving was realising that $y - x$ was 180 degrees and also 5 parts so 1 part was $\frac{180}{5}$ = 36 degrees and y was 7 parts hence $y = 36 \times 7$.

Question 19

(a) The most common error was to start with $(-5k)^2 = 675$ which lead to answer of $\sqrt{27}$.

(b) Many left the answer in the unfinished form of $\frac{1}{\frac{7x-2}{5}}$.

(c) For $h^{-1}(x)$ many used either $\frac{5}{7x-2}$ or $\frac{7x-2}{5}$ in place of the correct expression. Those who did use the correct expression for $h^{-1}(x)$ usually went on to find the correct answer.

Question 20

The most common mistake was involving the expansion of $\left(\frac{k}{2}\right)^2$ or not using brackets or using $\frac{k^2}{2}$.

Another common mistake is that they did not take $k^2 - A_{sec\,tor}$ or they did this but did not divide the difference by k^2 to find the percentage.

Question 21

The most common error in this question was not realising that there were different units of centimetres and millimetres. Many responses incorrectly used a mixture of these units within their working. Most candidates correctly found upper and lower bounds for 22 and 23, and stated or used them within their working to gain some credit. Another common error was stating an incorrect upper bound such as 23.4 and 8.74.

Question 22

This question was well answered. Weaker answers that did not attempt to factorise could not simplify the expression as they usually attempted to cancel the x's straightaway. Of those who did factorise the most common mistake made was $\frac{x(5-x)}{(x-5)(x+5)}$.

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Question 23

Most scripts gained credit in this question for showing sin x =− $\frac{2}{3}$ and the angle − 41.81...Less successful scripts then gave the answers as − 41.81... or + 41.81... with 138.19, not appreciating when the value of sine is negative.

Question 24

This question was answered well. The most common errors were confusing the term inversely proportional with direct proportionality. Some candidates did not show an understanding of the term cube, so they would use e.g. cube root or square. Examples of common errors were the formulas $y = k(x-1)^3$ or $y = \frac{k}{(x-1)^2}$.

Question 25

Many responses did not show an understanding of how to solve this equation. Those that did often made a valid attempt to combine the two terms in m so they would have $m^{-\frac{1}{4}} \div m^{-1}$ but worked this out as $m^{-1\frac{1}{4}}$. Some correctly had this as $m^{\frac{3}{4}}$ whilst others realised the answer was a power of 3 and reached the correct answer.

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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 and gained method marks. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed.

Candidates found 'show that' questions challenging and often did not show all the steps needed. Candidates should also be reminded that to gain marks on these types of questions they must not use the fact they are trying to show.

Candidates should also be encouraged to process calculations fully and to read questions again once they have reached a solution so that they have provided the answer to the question set. Candidates should also be encouraged to think whether their answer makes sense in relation to the question set.

The standard of presentation was generally good; however, candidates should be reminded to write their digits clearly and to make clear differences in certain figures. Many candidates write the digits 4 and 9 identically and similarly 0 and 6 and 1, 2 and 7. Similarly, many candidates overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite. There was evidence that most candidates were using rulers to draw the net, lines of symmetry, line of best fit and transformations and using a pencil to draw the reciprocal graph.

Comments on specific questions

Question 1

(a) Most candidates demonstrated their understanding of place value and placeholders well on this question. Unsuccessful candidates often missed out a zero or added an extra zero. Some candidates were unable to deal with the half million, giving answers such as $6\frac{1}{2}000000$.

(b) The majority of the candidates correctly wrote 6538 to the nearest ten. The most common errors were 6530 or rounding to the nearest hundred, 6500, or thousand, 7000.

(c) Using correct BIDMAS (order of operations) led most candidates to the correct answer of 34. The most common error was to work from left to right and not take into consideration the order of operations, which led to the most common incorrect answer of 14.

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(d) (i) The majority of candidates were able to identify the correct factor of 48 from the list given. The most common error was mixing up factors and multiples with 96 given as the most common incorrect answer, a multiple of 48 rather than a factor of 48. Other common incorrect answers were factors of 48 but not given in the list e.g. 2, 3, 4 ……

(ii) Candidates were less successful at identifying the cube number from the list, although many gave 64 as the correct answer. Square numbers were often mixed up with cube numbers with 9 given as the most common incorrect answer.

(iii) Finding a prime number from the list proved challenging to some. Common incorrect answers were prime numbers not in the list (2, 3, 5, ….) or 57 and 87. However many candidates correctly identified 29 as the prime number.

(e) Finding the square root was one of the best answered questions on the whole paper. The correct answer of 0.035 or the fraction equivalent $\frac{7}{200}$ was given by the vast majority of candidates. Few incorrect answers were seen; however some candidates rounded their calculator answer to 0.04 without showing the exact answer of 0.035 in the working.

(f) Finding the reciprocal of 8 proved to be one of the most challenging parts of this question with less than half the candidates giving the correct answer of $\frac{1}{8}$ or 0.125. Many less able candidates did not attempt the question or did not know the meaning of the word 'reciprocal' and gave common incorrect answers of $\frac{8}{1}$, –8 or 64 (8^2).

(g) Most candidates were able to use their calculator or knew that any number to the power zero equals one. The common incorrect answers given were 8 or 0.

(h) (i) Writing 180 as the product of its prime factors proved to be challenging for many less able candidates who often did not attempt the question. The most common form of the answer was 2 × 2 × 3 × 3 × 5 although many candidates did give the answer in index form. The most common method used were factor trees or tables.

(ii) Candidates were more successful in finding the lowest common multiple of 160 and 180, as they did not have to use the product of prime factors to find this. The most common method used was to list the multiples of 160 and 180 until 1440 was found in both lists. Candidates who used the product of prime factors of 160 and 180 often went wrong when trying to identify the LCM and gave the lowest common factor of 2 as their answer.

(i) Finding the upper and lower bounds was the most challenging part of this question. The most common incorrect answers given were 472 and 474 or 470 and 475.

Question 2

(a) The majority of candidates knew that a hexagon had 6 sides, with the most common incorrect answer given as 8.

(b) (i) The majority of candidates gave the correct type of triangle as isosceles (poor spelling was condoned). The common incorrect answers were equilateral, right angle, scalene or obtuse angled triangle.

(ii) Less than half of the candidates were able to use a protractor accurately to measure the angle *CAB*. Many less able candidates did not attempt the question or gave a length rather than an angle answer. Common incorrect answers were 56° (reading the incorrect scale on the protractor) or 28° (measuring angle *ACB* or *ABC* instead).

(iii) The majority of candidates were able to name the angle *CAB* as obtuse. However, a large number did not attempt this question or gave the common incorrect answer of acute.

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(c) Showing that the interior angle of a regular pentagon is 108° was a challenging question, with many candidates not attempting this question. To gain full credit candidates had to either find the exterior angle $\left(\frac{360}{5}\right)$ and then subtract from 180 or find the total of the interior angles of a pentagon ((5 – 2) × 180) and then divide by 5. In both cases full working had to be shown as it was a 'show that..' question and many candidates did not gain full credit as they did not show all steps of their working. In particular, 3 × 180 to find the total of the interior angles was not enough as the 3 needed to be justified. Some candidates used the 108 given in the question. Candidates should be reminded that in any 'show that' question they must not use the fact they are being asked to show.

(d) Many candidates were able to correctly find angle *DCB* as 68°. This was done in a variety of manners, the most common finding the obtuse angle *ADC* as 112 and then using the total of all angles in a parallelogram as 360 and subtracting and dividing by 2. Several candidates did not understand the notation of angle *DCB* and gave all 3 angles at *D*, *C* and *B*. The most common incorrect answer was 112 (360 – 248) which gained partial credit if shown in the correct place on the diagram or was accompanied by working out.

(e) Finding the size of the largest angle in the triangle proved to be challenging to all but the most able candidates. Many candidates did not attempt this question. Successful solutions used the total of the ratio, divided 180 by this value, and finally multiplied this answer by 7. Candidates who used the correct method but used 360 instead of 180 were still able to gain partial credit. The most common incorrect answer given was 7, which just identified the largest number in the ratio rather than calculating the largest angle.

Question 3

(a) The vast majority of candidates were able to work out the total cost of the tickets. Any errors were generally arithmetic slips, but candidates were still able to gain partial credit if full working was shown.

(b) Most candidates were able to calculate 18% of $110, with most then adding the increase to $110 to find the correct total cost of the meal. Most candidates attempted this in two stages as described above. However many more able candidates did it successfully in one step by multiplying 110 by 1.18. Incorrect answers included 19.8(0), finding the service charge only and not adding, 1.98 or adding 18 or 0.18 or 1.18 to 110.

(c) The majority of candidates correctly worked out the temperature at midnight to be –7 °C. The most common incorrect answer given was 7 °C.

(d) The majority of candidates were able to correctly calculate that $288 was spent on presents. Mistakes were made in finding the fraction of $768, either by dividing and multiplying by the incorrect values or finding the amount NOT spent on presents instead.

(e) (i) Most candidates understood that to solve this problem they needed to divide the total number of passengers (604) by how many passengers each coach can carry (46) and then round up. The most common incorrect answer was 13. These candidates could do the arithmetic but did not relate their answer to the real-life problem.

(ii) Many candidates showed understanding of percentages and used a correct method. Some, who used the correct method, incorrectly rounded. So answers of 44% or 44.3% didn't gain credit if a more accurate answer was not shown in the working.

(f) Only the most able candidates could find the correct answer of 2h 20 min, with candidates finding this time calculation a challenge. The most common error was changing between decimal time and hours and minutes. Many candidates were able to use the correct formula to calculate time and gained partial credit for an answer of 2.33…. hours. However, some candidates used 100 minutes in an hour instead of 60 minutes to convert their decimal time to hours and minutes. Therefore, the most common incorrect answer seen was 2h 33 mins.

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Question 4

(a) (i) Some excellent correct nets were seen with candidates generally drawing the two triangles first, connected to the rectangle given, and then measuring (or calculating using Pythagoras' theorem) the missing side of 5 cm, to draw the remaining two rectangles. Most candidates did attempt a net rather than a 3-D drawing of the prism. The most common errors were to draw 3 rectangles the same size (3 × 7), or two rectangles (4 × 7). Many candidates were able to gain partial credit for drawing two correct triangles in the correct positions.

(ii) Fewer candidates were able to find the correct volume of the prism with many less able candidates not attempting this part. The correct answer of 42 cm^3 was rarely seen with the most common incorrect answer of 84 cm^3 found by multiplying the length, width and height but not dividing by 2.

(b) (i) This 'show that' question was well answered by most candidates. There were a variety of correct methods given to show that the length of the rectangle was 48 cm. The most common were accompanied by markings on the diagram, 6 × 8 (six radii), or 8 × 2 × 3 (three diameters) or variations of these.

(ii) Less than half of the candidates were able to find the correct area of the rectangle despite correctly showing in **part (b)(i)** that the length of the rectangle was 48 cm. Fully correct solutions had workings out to show that the width of the rectangle was 32 cm (4 × 8 or 2 × 16) and that the area was 32 × 48 = 1536 cm^2.

(iii) Calculating the percentage of the rectangle that was shaded proved to be one of the most challenging questions on the whole paper with a significant number of candidates not attempting this part. Around one quarter of candidates were able to gain some credit on this question. Successful solutions were done in stages. The most common method was to subtract the area of the circles from the area of the rectangle calculated in **part (b)(ii)**, and then divide by the area of the rectangle (and multiply by 100). Although this was the most common method all other variations of finding the percentage were seen. A common incorrect answer was 78.5 per cent, which was the percentage not shaded.

Question 5

(a) (i) Most candidates gave the correct coordinate for point *A*. The most common incorrect answer was (1, 3).

(ii) Most candidates were able to plot the point *B* on the grid. The common incorrect answer was to plot *B* at (3, –1) or (–1, –3).

(iii) Fewer candidates were able to plot *C* so that *ABC* forms an isosceles triangle. Successful candidates plotted *C*, drew lines to form *ABC* and then checked by measuring or calculation that two sides were equal. There were many possible correct positions for *C*.

(b) (i) Candidates found writing down the order of rotational symmetry for the rhombus very challenging, with many not attempting this part. Only a minority of candidates correctly identified the order to be 2, with the most common incorrect answer given as 4.

(ii) Candidates were more successful in drawing the lines of symmetry on the rhombus. The most common incorrect answer was drawing 4 lines of symmetry or 2 correct lines and one extra.

(c) (i) Good solutions in this part contained the correct transformation, enlargement, and the correct scale factor (2) and centre (2, 1). The most common error was to omit the centre of enlargement or give the incorrect scale factor. Some candidates attempted to describe the enlargement as double the size. Candidates should be reminded that this is not accurate as the size of the enlarged triangle is actually 4 times the size of the original triangle. It is the sides that have been doubled not the size. Few double transformations were given.

(ii) Good answers contained all three parts to describe a rotation, including degrees and centre of rotation. The most common error was to omit the centre of rotation. Less able candidates correctly identified the transformation as rotation but often did not give the centre or angle or direction. More double transformations were given in this part, the most common being a rotation and translation. The most common incorrect answer given was a reflection instead of a rotation.

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(iii) (a) Many candidates translated the shape correctly. Some candidates did not attempt this part or translated in the incorrect direction, often five down and three right.

(b) Many candidates were able to correctly reflect the shape in the line $y = -2$. Common errors were to reflect in the x-axis or the y-axis. Candidates who reflected in the line $x = -2$ found the image was off the grid. Some candidates reflected the image from **part (iii)(a)** instead of shape A.

Question 6

(a) Many candidates correctly gave an expression for the total number of points scored by the team. Some however did not know the difference between an expression and an equation. A significant number of candidates gave the correct expression but made it equal to a number or letter, thus forming an equation.

(b) This very challenging equation problem was well attempted by the most able candidates however many less able candidates did not attempt it. The best solutions were found by forming a correct equation in x and equating to 121, solving to find x and then using this value to find the correct points score for each team. This method was seen often and when the correct equation was formed candidates generally gained full credit. Candidates who did not use this method often attempted a trial and improvement method to try and find 3 values which satisfied the given criteria. The most common error in forming the equation was the expression for United, which was often given as $2(x + 12) – 3$, three points fewer than double Rovers point score, rather than $2x – 3$, three points fewer than double Athletics' point score.

(c) (i) Simplifying the given expression was the most successfully answered part of this algebra question. Most candidates gained at least partial credit by finding $9a$ or $3b$ in their final answer. The most common incorrect answer was $9a – 3b$ instead of $9a + 3b$.

(ii) Just over half of the candidates were able to gain credit by simplifying the given expression. Most candidates were able to gain partial credit for expanding the first bracket to $12x + 6$ or having $7x$ in their final answer. Most errors occurred when expanding $–5(x – 2)$ or when collecting like terms to form their final answer.

(d) Solving the simultaneous equations proved to be the most challenging part of this question. Many less able candidates did not attempt the question. A variety of methods were used successfully by more able candidates; elimination methods, substitution methods and matrix methods were all seen. Of the candidates who did not gain full credit, many were able to gain partial credit for correctly multiplying to equate coefficients, or correct rearrangement of one (or both) equations. The most common error following this was in the elimination method where candidates did not consistently subtract or add. Candidates were more successful when substituting their rearranged equation when using the substitution method.

Question 7

(a) (i) The majority of candidates were able to accurately plot the two missing points on the scatter diagram.

(ii) Just over half of the candidates correctly identified the type of correlation to be positive. There was a significant number of candidates who did not attempt this question, with the most common incorrect answer given as negative.

(iii) Just over half of the lines of best fit drawn by candidates were judged to be accurate. It should be noted that many candidates do not take into consideration the positions of the crosses and simply draw a line from corner to corner on the grid. A significant number of candidates joined up all the crosses (thus forming a line graph).

(iv) Candidates were more successful in using their line of best fit to estimate the student's score on paper 2. Many candidates were able to still gain credit by making an estimate based on the crosses, if they did not draw a line of best fit or an incorrect line of best fit. The best candidates showed on the scatter diagram a line from 24 on paper 1 up to their line of best fit and then across to the score on paper 2.

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(b) (i) Completing the Venn diagram challenged most candidates. Only the most able candidates correctly found the number of candidates in each section of the Venn diagram. When done correctly this was often accompanied by working out or solving an equation. The most common error was to place the values given in the question in circle *B* and *C* and leave the intersection blank. Nearly all candidates were able to place the 2 in the correct position.

(ii) Finding the probability that the candidate chooses biology and chemistry was similarly challenging for all but the most able candidates. A large proportion did not attempt this part. Those that did often gave the incorrect denominator following an incorrect Venn diagram in **part (b)(i)**, a total of 179 (122 + 55 + 2) instead of 140. Few candidates scored a follow through mark.

Question 8

(a) Few candidates were able to find the correct equation of the line *L*. The gradient caused the most challenges with the correct gradient of $-\frac{1}{2}$ or –0.5 rarely seen. The most common incorrect answers given were $\frac{1}{2}$ or 0.5 (giving a positive gradient rather than a negative) and 2 and –2 (finding the change in *x*/change in *y*). However, candidates were more successful in identifying the *y*-intercept and therefore were able to gain partial credit for an equation of the form $y = kx + 2$. Many candidates did not attempt this question or did not give the correct form for a straight line. A large number of answers were seen with the correct gradient or *y*-intercept (or both) but the equation was without an *x*. A common incorrect answer was $y = 4$ (using the *x*-intercept instead).

(b) (i) The majority of candidates correctly completed the table, although many candidates did not attempt the question. The most common incorrect answers were –11 or 11.

(ii) Many candidates correctly drew the graph of $y = 2x + 5$. A large proportion of candidates did not attempt the question, most having not completed the table in **part (b)(i)**. Some incorrect attempts were to draw lines parallel to line *L* or lines passing through (–4, 4) or (0, 5) and (2, 0).

(c) Fewer candidates were able to write down the coordinates of the point which lies on both line *L* and the graph of $y = 2x + 5$. Those that had drawn a line in **part (b)(ii)** could still gain a follow through mark; however many candidates struggled to read the scale on the axes. The most common error was to read each small square as 0.1 rather than 0.2. A large number of candidates who had drawn the correct line in **part (b)(ii)** gave the incorrect answer of (–1.1, 2.3) in this part. Often candidates missed the minus sign for the *x*-coordinate.

(d) This equation question proved to be one of the most challenging questions of the whole paper. Many candidates missed one (or more) of the three parts needed, i.e. must start with $y = \ldots$, gradient multiplied by *x* (2*x*), and the *y*-intercept (+18).

Question 9

(a) Completing the table of values was the most successfully answered part of this question. Most candidates gained full credit with some partial credit given, often for missing negative signs on some of the values.

(b) Many candidates who gained full credit in **part (a)** also achieved full credit in **part (b)**. Candidates who made errors in their table generally correctly followed through their points. There was a significant number of candidates who did not attempt the drawing of the graph despite gaining full marks in **part (a)**. Candidates generally drew accurate curves with very few candidates joining their points with straight lines. However, some candidates plotted the points correctly but did not join them with a curve. Candidates should be reminded to use a pencil when drawing graphs as mistakes are very hard to remove when drawn in pen.

(c) Around a third of candidates correctly drew the line $y = 5$. It is important to remind candidates that the line should be the full width of the grid and drawn with a pencil and a ruler. There were a variety of incorrect responses including drawing $x = 5$ or $x = -5$ or $y = -5$, drawing $y = x$ or $y = -x$ or a diagonal line through the point (0, 5).

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(d) Solving the equation was more successfully answered than the previous part. Many candidates did not use the instruction in the question to 'use their graph to solve…' and solved the equation by division. The most common incorrect answers were 60 (12 × 5) and $\frac{5}{12}$ or 0.41666.

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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. Candidates should realise that in a multi-step problem-solving question the working needs to be clearly and comprehensively set out particularly when done in stages. Centres should also 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. 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 be prepared to use an algebraic approach for a problem-solving question. Candidates should use correct time notation for answers involving time or a time interval.

Comments on specific questions

Question 1

(a) (i) The majority of candidates answered this question correctly. Common errors included miscounting the number of 'gates' giving an answer of 43 or 53, ignoring the incomplete gate and stating 45, or only considering the vertical tallies in each 'gate' so giving 39 from 4 × 9 + 3.

(ii) The majority of candidates answered this question correctly. Common errors included the unsimplified $\frac{15}{48}$ or calculating 48 ÷ 15.

(iii) This part on using a given ratio was generally reasonably well answered. The common error was to incorrectly use the value of 28 as the total number of tubs of ice cream, leading to the incorrect method of $\frac{28}{18} \times 7$.

(b) (i) This part on working out the range was generally very well answered. Common errors included answers of 45 – 165, 165 – 45, and using 156 as the largest value. A small yet significant number of candidates confused range, median and mean throughout **part (b)**.

(ii) This part on working out the median was generally very well answered. The common error was to give the middle value of 45 from the unordered list, with occasional miscounting of the number of values in the list and using a middle pair.

(iii) The majority of candidates answered this question correctly. Common errors included the incorrect answers of 636 and 628.6, due to incorrect use of the calculator (lack of brackets), arithmetic errors in the addition, and leaving the answer as 770.

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(c) (i) Whilst a good number of candidates answered this question correctly it was evident that many did not appreciate the full method to be used. Common errors of this type included 4.20 – 2.50 = 1.70, $\frac{1.7}{2.5} = 0.68$ as an answer and $\frac{4.2}{2.5} \times 100 = 168$. Common errors using incorrect methods included $\frac{1.7}{4.2}$ leading to 40.5, and $\frac{2.5}{4.2}$ leading to 59.5.

(ii) This part on calculating a volume using a given formula was generally very well answered, with the correct units also given. Common errors included incorrect substitution and the use of 15^2, with the units sometimes given as cm or cm^2 or omitted.

(d) This was very well answered by the large majority. The most common and successful methods were to compare ml per $ or $ per ml, with working clearly shown with numbers rounded to enough accuracy to make comparisons. It was however quite common for candidates to make an error in comparing the correct figures, often leading to an answer of *C*. Candidates not gaining credit either looked at what needed to be added to each bottle, in terms of $ or ml, to get the next bottle, or simply multiplied $ by ml for each bottle.

Question 2

(a) (i) The table was generally completed very well with the majority of candidates giving 4 correct values. The occasional sign or arithmetic error was made.

(ii) Many reciprocal curves were really well drawn with very little feathering, double lines or straight lines seen. A few but noticeable number of candidates with correctly plotted points did not attempt to join them in a curve.

(iii) This part on rotational symmetry was generally very well answered. Common incorrect answers seen were 4, 1, clockwise, reflection and positive.

(iv) This question was found challenging by many candidates and few correct equations for the two lines of symmetry were seen. A lot of numerical answers were offered as well as various coordinates and inequalities.

(v) This part was generally very well answered, although common errors included inaccuracies in plotting and drawing $y = -2.5$ or $x = 2.5$.

(vi) This part on using the graph to solve the given equation was well answered with candidates reading the values off accurately from their curve. A small yet significant number of candidates tried to solve the equation algebraically which was not the required method and was rarely successful.

(b) This question testing understanding of perpendicular was found challenging by some candidates. Some lines passing through *P* crossed at a wide variety of angles, were parallel, vertical or horizontal, or outside the allowed tolerance.

(c) Candidates found this part challenging. Some gave a numeric answer, most commonly 8 from substituting a value of $x = 1$. Some who attempted the correct form interpreted the requirement of the question incorrectly using the given values leading to equations $y = 1x + 7$. Those that recognised that a parallel line had the same gradient gave an equation that started with $y = 3x$ but finding the intercept was the most challenging.

Question 3

(a) (i) Many candidates gave the correct answer. A range of different spellings were given, some of which were ambiguous. The most common incorrect answer was acute. Other incorrect answers came from not reading the question carefully and naming the shape as 'triangle' or giving the name of the triangle such as scalene, isosceles or equilateral.

(ii) The majority of candidates measured the angle correctly. Some candidates misread the protractor scale, giving 67° as their answer.

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(b) (i) Many candidates were able to sketch a rhombus. Although not required, some candidates carefully showed the lines of symmetry and equal length signs on their shapes. Although most made a good attempt at sketching the shape, some were ambiguous, with the shape having more resemblance to a square. Common incorrect answers included sketches of a parallelogram, kite, rectangle or a square.

(ii) Many candidates gave the correct name of the shape. Incorrect answers included square, parallelogram, kite, rectangle, trapezium, diamond, polygon and triangle. Frequently the word chosen did not match the sketch in the previous part.

(iii) Few candidates gained full credit in this part. Some candidates achieved partial credit for finding 110° but did not go on to give the correct answer. Common errors included: giving all angles as 70°, giving 70°, 20°, 20° from using sum of angles in a quadrilateral is 180° or giving 96.7°, 96.7°, 96.7°, from $\frac{(360-70)}{3}$.

(c) (i) A good proportion of candidates gave a clear geometrical statement that 'the angles in a triangle add to 180°'. Candidates needed to be precise in their response, with inaccurate statements, such as, 'a triangle is 180°' not gaining credit. Some candidates gave descriptions about the properties of an isosceles triangle.

(ii) Most candidates gave the correct equation. Common errors included omitting the = 180 or writing the equation $x + 6y = 360$ or $2x + 6y = 180$. A few added the two equations to give $3x + 8y = 360$.

(iii) The majority of candidates had the mathematical knowledge and skills to gain some credit in this question on simultaneous equations with many successfully gaining full credit. The most common and most successful method was to equate one set of coefficients and then use the elimination method, 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 occured. Common errors included a range of numerical errors, incorrect addition/subtraction when eliminating, lack of working, and the use of a trial and improvement method which was largely ineffective. A small number of candidates were unable to attempt this part.

Question 4

(a) (i) Most candidates answered this part correctly. A few gained partial credit for correctly labelling the sides of rectangle *A*. Other errors included finding the perimeter of rectangle *A* or assuming that the length and width of rectangle *A* were either both 5 or both 7.8. Some confused it with the area of a triangle and calculated half of the area.

(ii) A minority of candidates were able to find the dimensions of the cuboid correctly. A common incorrect answer came from adding the two given dimensions to create the third dimension 5 + 7.8 = 12.8. A significant number did not always use the two given dimensions and restarted. Common incorrect answers included finding $\sqrt[3]{468} = 7.76$ and hence the dimensions of a cube, calculating $\frac{468}{3} = 156$ for all three measurements, or a random set of three dimensions with a product of 468.

(b) Whilst many candidates were able to correctly use the formula for the volume of the cylinder, only a minority of these went on to give their answer in terms of π, with the majority giving a decimal answer. A variety of incorrect formulae for the volume of a cylinder were used; $2\pi r$, $\pi \times 8 \times 12$, $2\pi r^2 h$, $2\pi rh$ or finding combinations of surfaces and volumes. A few omitted π from the working, just stating $8^2 \times 12$ and some wrote the correct working but missed π out of the answer, leaving it as 768.

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(c) This question was found challenging by many candidates and proved to be a good discriminator, although few correct and complete answers were seen. Candidates should realise that in a multi-step problem-solving question such as this the working needs to be clearly and comprehensively set out. Partial credit was often gained for finding the correct area for either the circle or the parallelogram. Many candidates used 12 × 12 as the area of the parallelogram (not recognising the height of the parallelogram was the same as the diameter of the circle). Many used the diameter 7 for the radius of the circle. Others used an incorrect formula for the area of a circle such as $2\pi r$, and sometimes $\frac{1}{2} \times 12 \times 7$ for the parallelogram.

Question 5

(a) The scatter diagram was generally completed very well with the majority of candidates correctly plotting the 4 values. The occasional scale or accuracy error was made.

(b) The majority of candidates answered this question correctly. Common errors included negative, ascending, flight and variable.

(c) This question was found challenging by many candidates and few correct points were identified. Common errors included (500, 380), (600, 340) and (70, 60).

(d) The line of best fit was generally completed very well with the majority of candidates correctly drawing an acceptable line. Very few non-ruled straight lines were seen.

(e) This question was found challenging by many candidates although a number of fully correct answers were seen. This multi-stage problem involved an accurate measurement, a correct conversion and correct use of the candidate's line of best fit. There were many well written and comprehensive answers showing these three values, although few candidates indicated with straight lines drawn on their scatter diagram to show how the line of best fit was being used.

Question 6

(a) (i) The majority of candidates answered this question correctly. Common errors included 0.9 and 8.

(ii) The majority of candidates answered this question correctly, with a variety of acceptable equivalences to 'stationary' seen. Common errors included constant speed, constant time, and no acceleration.

(iii) The majority of candidates answered the first part of this question correctly but found the second part more challenging to explain using mathematical language. A variety of acceptable equivalences to 'gradient is steepest' were seen. Common errors included 'it is faster', 'he is accelerating', together with a variety of non-mathematical reasons.

(iv) This part on working out the average speed was generally very well answered with most candidates able to identify the correct formula to be used. Common errors included incorrect distances read off from the graph, using 0724 as the time taken, and incorrect evaluation or conversion of minutes to hours.

(b) This part on working out the total amount was generally very well answered, although not all candidates appreciated that as the answer was an exact amount of money the only acceptable answer was \$32.72. Common errors included miscalculations for the 1 dollar coin, converting 1 cent and 5 cents to \$0.1 and \$0.5, simply finding the number of coins, and dividing their total amount by 92 (the number of coins) possibly trying to find the mean rather than the total.

(c) The majority of candidates answered this question correctly. Common errors included 774.34 and giving a rounded answer of 633.

(d) This part was generally very well answered, although not all candidates appreciated that simple interest was to be used and that the total interest only was required. Common errors included 9092.91 (from using compound interest), 9078 (from finding the total amount), 57800 (from using 8500 × 1.7 × 4), and a variety of incorrect formulas using the values of 8500, 4 and 1.7 or $\frac{1.7}{100}$.

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Question 7

(a) The majority of candidates answered this question correctly. Common errors included 4, 9, 12, 16 and 18 squares shaded.

(b) (i) The majority of candidates answered this question correctly. The most common errors were not shading the triangle or shading both shapes but generally the shapes were correct.

(ii) This question was found challenging by many candidates. Only the more able candidates focused on the position number as stated in the question, with many answers referring to position, shape or size. The most common errors were factors of 4, 4th position, 4 sides, or just 4, it's before the circle, and it's shaded.

(iii) This question was found challenging by many candidates and proved to be a good discriminator. Most candidates related the 99th term to being 3 × 33 or 9 ×11 and so it must be the same shape. Many just referred to the pattern of shapes with the required shape always being the 3rd in the sequence and therefore in position 99 without further explanation. Only a minority used *n*th term or mentioned the 100th term.

(c) (i)(a) This part on completing the Venn diagram was generally very well answered The more able candidates answered well but many others added extra shapes, put them in the wrong place or even repeated shapes. Common errors included the black circles being entered in $B \cap C'$ and the white circles placed outside $B \cup C$.

(b) This part was generally answered well. However the union was often interpreted as the intersection, and many did not realise that a number was required and a list of drawn shapes was often seen.

(ii) This question was found challenging by many candidates and proved to be a good discriminator. The majority of candidates had the mathematical knowledge and skills to gain some credit in this question on Venn diagrams with many successfully gaining full credit. A number of candidates did not appreciate that the required labels were *L* and *B*. Common errors included labelling the circles *W* and *B*, or *LW* and *SB*, incorrectly positioning one or more of the shapes, in particular the small white circle and rectangle, and omitting one or more of the shapes.

Question 8

(a) (i) Many candidates answered this question well using $\frac{360}{8}$ as their method. Some attempted to find the total of the interior angles leading to one interior angle and finally to the exterior angle. Some drew a portion of an octagon and labelled the angles without showing any calculations. A relatively high number of candidates made no attempt at a response.

(ii) A good proportion of candidates were able to gain credit although most started from scratch and did not use the angle from the first part of the question.

(b) (i) Many did not pick up on work already done in the previous parts. Most candidates opted to measure the bearing and answers of 140, or a value close to it were common errors. Occasionally a candidate would give the bearing of *A* from *B*.

(ii) This part proved challenging and some correct answers of *H* from *G* were seen. Some identified the parallel direction but then gave the opposite direction of *G* from *H*. Only a few candidates opted for *B* from *E* or for *A* from *F*. Most incorrect answers involved *F* from *E*.

(iii)(a) Candidates were often successful in this part and isosceles was often seen. Common incorrect answers included scalene, equilateral, right-angled along with generic names such as triangle and quadrilateral.

(b) This part proved challenging and correct solutions were in the minority. Those that recognised the connection with the work done in **part (a)(ii)** were usually successful in finding the correct angle or were able to demonstrate a correct method following on from a previous incorrect answer. A significant proportion of candidates made no attempt at a response.

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(c) More able candidates calculated the correct time, showing all appropriate working. Others were able to gain partial credit for using distance/time. Often their method was spoilt by doing additional incorrect work, while others seemed to be unaware of the correct relationship between time, distance and speed.

(d) Only a few candidates were able to gain full credit in this question with 'No it's too small/big' being the most common answer. Few candidates wrote units in their working and so could not compare relative sizes.

Question 9

(a) (i) This part was generally answered well with the majority of candidates able to identify the given transformation as a translation, although not all were able to correctly state the required translation vector to complete the full description. Common errors here included using coordinates, fractions, and sign or arithmetic errors within the vector.

(ii) The majority of candidates were able to identify the given transformation as an enlargement but not all were able to correctly state the three required components. The identification of the centre of enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (2, 2) and (0, –1) being common errors. The scale factor also proved challenging with 3, $\frac{1}{2}$, and –2 being the common errors. A significant number gave a double transformation, usually enlargement and translation, which results in no credit. Less able candidates often attempted to use non-mathematical descriptions.

(b) This part was generally answered well with the majority of candidates able to draw the given rotation. Common errors included 90° anticlockwise, 180°, incorrect centres of (0, 0), (2, 2), and (6, –2). A variety of reflections were also seen.

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MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key messages

To succeed in this paper candidates need to have knowledge of the complete syllabus, 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. Candidates should realise that in a multi-step problem solving question the working needs to be clearly and comprehensively set out at each stage. Centres should also 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. 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 and be familiar with the notation used in sets and Venn diagrams.

Comments on specific questions

Question 1

(a) The majority of candidates named the shape correctly. Incorrect answers were usually rhombus or diamond.

(b) More able candidates usually gave the correct area. A wide variety of incorrect areas were offered by less able candidates, some unrealistically large. A common error was 2 × 4 = 8.

(c) (i) Most candidates recognised the transformation was an enlargement. Many also gave the correct scale factor. Less able candidates could not find the centre of enlargement and this property was often omitted and sometimes written as a vector.

(ii) Most candidates gained partial credit for recognising the transformation as a translation or a reflection. Candidates who described the reflection often gave the correct line of reflection. A common error was $x = -1$. Those who described the translation often gave an incorrect vector such as $\begin{pmatrix} 0 \\ 10 \end{pmatrix}$ or $\begin{pmatrix} \pm 10 \\ 0 \end{pmatrix}$ or wrote coordinates.

(d) (i) A minority of candidates gained full credit in this part. Many candidates gained partial credit for drawing a shape with the correct orientation, most often from using one of the vertices of the given shape as the centre of rotation.

(ii) Candidates were more successful in this part. More able candidates often gained full credit and many others gained partial credit for a reflection in a vertical line, usually the y-axis.

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Question 2

(a) Many correct answers were seen in this part. A common incorrect answer was $A \cap B$.

(b) (i) The minority of candidates gained full credit although many were able to list some of the relevant square numbers. The number 1 was most often omitted from the list. Even numbers were listed quite often.

(ii) Many more able candidates were awarded full credit and a large majority were able to list some of the relevant prime numbers. It was common to see the numbers 2 or 13 replaced by 1, 9 or 15.

(iii)(a) A minority of candidates were credited full marks. Many candidates were able to complete two of the four regions correctly while fewer completed three correct regions. The region $(A \cup B)'$ was often left blank and it was common for candidates to omit this part of the question completely.

(b) Correct answers were frequently seen in this part. Incorrect answers usually listed extra even integers from the region $(A \cup B)'$.

(c) In this part a small minority of candidates gave the correct answer. Candidates often listed the elements in the region $A \cap B$ rather than write down the number of elements.

(d) In this part a small minority of candidates gave the correct answer. Because many had not completed the Venn diagram in **(b)(iii)(a)** there were many different denominators offered in the probability fraction here. The incorrect answer $\frac{1}{8}$ was very common from those who had not completed the diagram, as was $\frac{1}{16}$. There were also many varied integer answers, showing no recognition that this is not possible for a probability.

Question 3

(a) This question was answered very well. Candidates showed clear working and the majority gained full credit. Some of those who knew how to find the total cost did not show the complete method, which was essential in this question. A common error was made by those who subtracted the cost for two adults from the given total and divided the remainder by 3. A few did not show the exact total \$2441.25; only partial credit was gained when the cents were omitted.

(b) (i) Most candidates made an attempt at this more challenging question. Fully correct responses were seen at times with these candidates showing a clear method. Others managed several correct steps but were short of the final answer. Some candidates used a time line diagram which often helped with their understanding of the question although inaccurate time intervals were common. Candidates often subtracted times as if they were decimal numbers. For example, a common error was 10 10 from those who dealt with the stopping time and the time difference correctly but when finding the interval from 22 35 to 12 25 the following day subtracted 2235 – 1225 = 1010. Similarly, candidates finding the interval of time from 20 05 to 17 25 the following day often subtracted 2005 – 1725 or added these numbers.

(ii) A minority of candidates gave a correct follow through answer. Many wrote their answers to less than the required 3 decimal places, including those who gave rounded integer answers.

(iii) A large majority of candidates gave the correct answer. Incorrect answers were usually the result of the distances being subtracted.

(iv) This part was answered very well with many correct answers for a speed that followed through from their previous answers for distance and time. Some incorrect time notation was evident; for example, 13h 50 was written as 13.5 or 1350. A few converted their time to minutes which was not necessary and usually resulted in an incorrect speed as × 60 was then omitted from the calculation.

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(c) Many candidates answered this part well with full and clear working. A common error was to use 5700 ÷ 19 to find the multiplier 300 rather than 2400 ÷ 8. Candidates must not use the answer they are required to show as part of the working.

Question 4

(a) (i) The majority of candidates identified the polygon as an octagon.

(ii) Most candidates who gained full credit in this part used the interior angles formula, clearly showing their method. Others used the sum of the exterior angles and subtracted their answer from 180. Candidates who started by using the 135 given in the question could not be awarded any credit. There were a significant number of candidates that made no attempt at a response.

(b) (i) This part was answered correctly by a large majority of candidates.

(ii) Many candidates were able to describe the term to term rule correctly. A common incorrect answer was $n + 7$. Some wrote the formula for the nth term of the sequence or just 7.

(iii) The majority of candidates gave the correct answer in this part.

(iv) A significant number of candidates were awarded full credit for the correct simplified expression. Some wrote it in an unsimplified form such as $8n – (n – 1)$ and were also awarded full credit. A few gained partial credit for an expression with $7n$. A common incorrect response was $n + 7$ and there were several candidates who made no attempt at this question.

(v) This part was answered well by most candidates. Many showed a clear and efficient method by setting up an equation and solving it. Others used a counting on method and were usually successful. Candidates should not be dividing 113 by 7, an incorrect method that was seen regularly.

Question 5

(a) This part was nearly always correctly answered.

(b) More able candidates gave the correct answer but the majority took the word 'difference' to mean subtract without considering the context of the question. Hence, the incorrect answer of 8694 was most commonly seen.

(c) A large variety of pairs of integers were offered in this part but only a minority were the correct pair. Most pairs did not satisfy either of the conditions required.

(d) (i) This part was answered very well by all candidates.

(ii) This part was answered very well by all candidates. A small number of candidates placed the decimal point in an incorrect position or gave the rounded answer, 38.

(e) Many candidates gave the correct reciprocal value. Common errors were converting $\frac{1}{9}$ to a decimal, $\frac{1}{0.111...}$, or giving the equivalent fraction $\frac{2}{18}$.

(f) (i) Candidates nearly always gave the correct answer for this part.

(ii) This part was answered very well by all candidates. A few interpreted the cube root notation as $3\times\sqrt{512}$.

(g) (i) The majority of candidates showed good knowledge of standard form notation. Common errors included 587×10^3 and 5.87×10^3.

(ii) This part was also answered very well by most candidates, showing good use of the relevant calculator keys.

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(h) More able candidates usually gave the correct interval values. Some gained partial credit for writing the correct values in centimetres. Most candidates found this question challenging and errors were frequent. Common incorrect answers were 2.42 and 2.44 or those resulting from the evaluation of 2.43 ± 0.05 or 2.43 ± 0.5.

Question 6

(a) (i) Many candidates gave the correct value for the mode but it was very common for candidates to give the incorrect answer of 9, which was the highest frequency.

(ii) This part was not answered well. Most gave the incorrect answer of 7 from subtracting the largest and smallest frequency numbers.

(iii) Many of the more able candidates calculated the correct mean. The most common errors were dividing the correct total by 6 (the number of bars) or dividing 30 (the number of tables) by 6. Some divided the correct total by 21 (using 1 + 2 + 3 + 4 + 5 + 6).

(b) This part was not answered well. There were a few candidates who wrote two different types of accurate comparisons and, where used, the figures were correct. Some were able to give one correct comparison. Many gave two statements of the same type. The context of the question was sometimes misunderstood with candidates writing about table numbers not the number of customers at the table. In particular, there was some confusion about no tables having 5 or 6 customers at 1 pm.

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

(ii) This part was also answered well by the majority of candidates. Those unable to complete the table in the previous part were unable to earn full credit here but some did draw the given angle accurately. A minority did not draw accurate angles or may not have had access to a protractor.

Question 7

(a) A large majority of candidates completed the table correctly.

(b) Many fully correct curves were drawn. A few points were plotted incorrectly by some candidates, mainly those at (–2, –7.5), (2, 7.5) and (10, 1.5). A few candidates joined their points with straight lines or joined the point (–1, –15) to the point (1, 15).

(c) A minority of candidates gave the correct order of rotational symmetry. Many different incorrect answers were given. Some common ones include 1, 4 and 180°. A significant number of candidates did not attempt this part.

(d) (i) A minority of candidates were able to draw both lines of symmetry or just one line. There were a few that were slightly inaccurate. Many incorrect lines were seen and a significant number of candidates did not attempt this part.

(ii) There were few correct answers given in this part. Many candidates just gave an integer value.

(e) Many correct answers were seen in this part. Less able candidates gave the answer as 90 or –90 from multiplying the numbers 15 and –6 in the equation while others gave the answer as 9 from adding them.

Question 8

(a) (i) The majority of candidates recognised the triangle was isosceles. Common incorrect answers included ‘equilateral’ or just ‘triangle’.

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(ii) This part was answered well by many candidates. Some found angle *PRQ* = 66 then calculated (180 – 66) ÷ 2. Others divided 66 by 2 or left the answer as 66. There was some confusion with the notation 'angle *QPR*'. Some candidates having correctly found the three angles in the triangle gave the answer as 180, adding them as a result of thinking *QPR* meant the total *Q* + *P* + *R*. A few listed all three angles on the answer line.

(b) (i) Many candidates found the correct angle but very few gave the correct reason.

(ii) While some candidates found the correct angle, few gave the correct reason. Imprecise statements such as 'tangent is 90°' are insufficient. A significant number gave no response.

(iii) Many candidates found the correct angle but very few gave either of the correct reasons. A significant number gave no response.

(c) Many candidates found this part challenging. Those who used the correct formula for the length of an arc usually went on to achieve full credit. A few lost the accuracy of the final answer by rounding to only 2 significant figures. Many candidates used an incorrect formula, often for the area of a circle or $2\pi r$ without the division by 6.

Question 9

(a) (i) Many candidates demonstrated they could calculate a percentage of an amount. Those who read the question carefully usually gave the correct answer. Many misread the question and found 3% of 56 000 and some added this to 56 000 or 320 600. Others found 3% of 320 600 and stopped and a few added this to 320 600.

(ii) More able candidates who clearly displayed the correct method often achieved full credit. Some were able to give a partial method. Many used an incorrect figure for the denominator, often 347 851. A significant minority gave no response to this part.

(b) Many candidates gave the correct simplest ratio or a simpler form of the given ratio. A common error was to divide each of the three earnings into the total earnings.

(c) A very large majority of candidates knew they needed to divide the cost by the exchange rate. Many did not round their answer to the nearest dollar as required by the question.

(d) More able candidates gave the correct answer in this part but it was more common to see the total value $9261, rather than the interest only. Some candidates used the method for simple interest.

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MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

Candidates sitting this paper need to ensure that they have a good understanding and knowledge of all the topics on the extended syllabus. A number of scripts did not offer any responses to whole questions, the most common being **Questions 4**, functions, and **Question 7**, trigonometry.

Candidates generally showed a good level of working but there were a significant number of scripts with incorrect answers written on the answer line with no method or working. Had some of these answers had working it may have been possible to award method marks to the candidate.

When working through the longer questions, candidates should retain the accuracy of their calculations through the stages. Candidates are prematurely rounding, with some rounding to 2 significant figures within the working, and as a consequence their final answers are frequently not within the required range. Unless directed otherwise, candidates should give answers to at least 3 significant figure accuracy.

General comments

There were some excellent scores on this paper with a good number of candidates demonstrating that they had a clear understanding across the wide range of topics examined.

Candidates should make sure they read the detail of the questions carefully. For example, in **Question 2(a)**, Chris received 12 strawberries but some candidates had Alex receiving the 12 strawberries. In 8**(b)(i)** the word **not** was sometimes overlooked.

Candidates should be aware of when questions connect to the next part. In **Question 3**, **(a)(ii)** used the answer to **(a)(i)**, **part (b)(ii)** was much easier if **(b)(i)** was used as was **(c)(ii)** if **(c)(i)** was used.

Questions that ask candidates to 'show' results require candidates to start with the given information and arrive at the value or result that is asked to be shown. Reverse methods do not usually score. For example, in **Question 5(a)(i)(a)**, candidates should not start with the 67.5° but start with either $\frac{360}{8}$ or $(8-2)\times 180$ and show all the steps needed to reach the 67.5° In **Question 7**, the length of *BC* needed to be arrived at, not started with. In 9**(b)(i)** candidates needed to arrive at the quadratic equation rather than try and solve the equation. The next **part 9(b)(ii)** was where the solving needed to be completed.

In probability questions, if the question is given with fractions then it is usually best to stay working in fractions rather than working in decimals which will not necessarily be exact. For example, **Question 8(b)** and **(c)**.

Logarithms are not part of the extended syllabus. Some candidates used logarithms in both 2**(d)(ii)** and 3**(b)(ii)** but this was not the expected way to solve these questions. In 2**(d)(ii)** candidates were expected to complete trials and in **3(b)(ii)** candidates were expected to recognise that $2^{-y}=8$ gives $y=3$.

Questions with algebra in the stem will normally be expected to be solved by setting up an algebraic equation.

For example, **Question 3(a)(i)** is easier to solve from the linear equation than from trials. **Question 9(a)** involved quadratics and asked for working to be shown and required an algebraic method to gain full marks.

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In this, some candidates worked out that $x = 6$ from trials, but without a rigorous algebraic method they did not show convincingly that this was the only solution.

Comments on specific questions

Question 1

(a) (i) Almost all candidates were able to complete the stem-and-leaf diagram correctly. Some candidates completed the diagram but did not order the rows and others made small errors with the data, usually omitting one or more of the numbers.

(ii) Most candidates were able to correctly find the median. The expected method was to use the ordered stem-and-leaf diagram but some candidates wrote all the numbers out in order again. A few candidates found the mean rather than the median.

(iii) This part proved more challenging with candidates often unsure as to how to find the upper quartile. The usual method is to cover up the median and to find the middle of the remaining values above the median. Common errors included 3 (ignoring the stem), 18 (finding the lower quartile), 22 (inaccurate) and 25 (the highest value).

(iv) This part was answered well by many candidates. The most common errors included incomplete methods such as an answer of $\frac{2}{15}$ or 13.3 per cent, or incorrect methods such as, $\frac{2}{15} \times 100 = 13.3°$. Other errors included using 180 rather than 360, dividing by 360 or using $2\pi r$ or πr^2 with $r = 2$ or 18.

(b) (i) This part was answered well by a good proportion of candidates. The most common errors were usually from misreading the scale or answers of 110 (the middle of the LQ and the UQ) or 100 (the middle of 0 to 200) or 105 (the middle of the lowest and highest values, 40 and 170) or 65 (from $\frac{170-40}{2}$). Some candidates gave the range or the interquartile range.

(ii) Most candidates gave the correct answer for the range. The most common errors included writing 40 and 170 but not calculating the difference, finding the interquartile range, giving the median, and inaccuracies with reading the values or errors with arithmetic.

(iii) Many candidates successfully found the interquartile range. Again the most common errors were giving the UQ and LQ values but not their difference, finding the whole range or errors with reading the scale or giving the median.

(c) (i) Candidates generally set their working out clearly and methodically. Many obtained fully correct answers. With clear working, those making slips with arithmetic often scored 3 marks. Some used the upper or lower boundaries of the classes or other numbers such as 50.5, 70.5, 85.5, 95.5 and 125.5 rather than the mid-interval values, but often their working enabled them to score two of the marks. Those that used the class widths rather than the mid-interval values did not score. Other errors included finding the mean of the mid-interval values, errors with the mid-interval values, finding the cumulative frequencies, dividing by 5 rather than 200 or incorrect answers with no working.

(ii) Only the strongest scripts answered this correctly. Some candidates scored one mark for either $\frac{86}{50}$ or $\frac{114}{60}$. However, most answers did not use the principle of height $= \frac{\text{frequency}}{\text{class width}}$. A very common incorrect answer of 22.8 from $\frac{86}{114} = \frac{17.2}{x}$ took no account of the class widths being 50 and 60. Other attempts showed various sums, differences, products and divisions of the various numbers given in the question.

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Question 2

(a) Many candidates answered this correctly. The most common method was to work out that 1 part was 6 strawberries so $3+2+2$ parts is 42. Other successful methods included recognising that Alex had 1.5 as many strawberries as Chris and to sum $18+12+12=42$. The most common error was a misreading of the question with Alex having 12 strawberries and a total of 28 from $\frac{12}{3}\times 7$.

(b) (i) A good number of candidates answered this correctly. A number of errors were seen from not reading the question carefully. Common incorrect answers seen included \$0.78 (finding the reduction but not the new price), \$6.38 (subtracting 12 cents rather than 12 per cent), \$7.28 (increasing \$6.50 by 12 per cent), \$5.80 (dividing \$6.50 by 1.12), \$7.39 (dividing \$6.50 by 0.88).

(ii) A fair number of candidates recognised this as a reverse percentage question and answered it correctly. A very common error was to increase \$11 by 12 per cent to \$12.32 without candidates realising that 12 per cent of \$11 is not the same as 12 per cent of the original price. Other errors included \$11.12 (from \$11 add 12 cents) and \$11.78 (\$11 + the reduction of \$0.78 found in the previous part)

(c) It was rare to see this part answered correctly with few candidates recognising that the investment would receive interest on interest. Those that did, usually set up an equation such as $1.025\times X=1.066$ to successfully find X. The most common wrong answer seen was $6.6-2.5=4.1$. Other wrong answers included $2.5+6.6=9.1$ and $\frac{6.6}{2.5}=2.64$.

(d) (i) Some candidates answered this question correctly. However, many candidates worked out that 1.6 g was lost on the first day and then wrongly assumed the mass lost 1.6 g on each of the next 4 days, giving $80-5\times 1.6=72$. Other errors seen included using exponential growth rather than decay, or working out $\frac{80}{1.02^5}$. Of those employing the correct method, many worked out the value day by day rather than using 0.98^5 and, as a consequence, errors were seen in arithmetic, numbers within the process were rounded prematurely and often the mass was found after 4 days and not 5.

(ii) Candidates almost always used the same method in this part as the previous part and hence a similar number answered the question correctly. The most successful candidates either took their answer to the previous part or used 80 and multiplied it by 0.98^k for various integer values of k until 67 was straddled. Some set up an equation $80\times 0.98^x=67$ and solved it, often successfully, by trials. Some candidates overlooked the need to give the extra whole days and gave 9 as their answer.

Question 3

(a) (i) The most successful candidates started by writing down a linear equation to solve. Common errors included omitting the x and hence finding Geeta buys 8 apples, writing the terms as a product rather than a sum of expressions, errors when collecting like terms and errors with division. Some candidates did not set up an equation but tried to find x by trials. This is not an efficient method and only those that found the correct answer scored.

(ii) A good number of candidates answered this correctly. Most scored at least one mark by using their **(a)(i)** to work out the amount spent on apples and/or oranges. The most successful converted the \$5.55 to 555 cents at this stage. Others worked in dollars and some then gave the cost of a banana as 0.21 rather than 21 cents. A common error was to calculate $5.55-0.15-0.18$.

(b) (i) A significant number of candidates answered this question correctly. The most effective method was to add the 1 to both sides and then multiply by 16. Those choosing to multiply by 16 first, frequently forgot to multiply the -1 by 16 and arrived at $x=3$. If candidates had checked their answer by substituting it back into the original equation they may have realised when they had made an error.

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(ii) It was rare for candidates to use the previous part to answer this part and start with $2^{-y} = \textit{their } w$. Most candidates started again and usually made the same rearrangement errors as in the previous part. Other weaker scripts started by incorrectly replacing $3(2^{-y})$ by 6^{-y}. Those that correctly arrived at $2^{-y} = 8$ could not always work out the value of y with candidates. This led to incorrect answers such as -4, 3, $-\frac{1}{3}$ or resorting to logs, sometimes successfully.

(c) (i) Candidates answered this question well with most realising that you could add the two equations to eliminate q and find the required values. The most common errors included slips with arithmetic and signs when finding the second variable. Candidates who attempted this question, and who did not score full marks, frequently picked up one mark for one of the values, or, more often for two values satisfying one of the given equations.

(ii) It was extremely rare for candidates to recognise that this part connected to the previous part and most candidates attempted to solve the equations again. Many candidates who scored full marks in the previous part were unable to solve these, often being unsure how to deal with the words. Most candidates who either wrote down or reached $\sin u = 0.5$ and/or $\cos v = 1$ were able to find the principal values but the secondary values proved more elusive, with those drawing sketches of the sine and cosine graphs being the most successful.

Question 4

(a) (i) This question was answered correctly by almost all candidates.

(ii) This question was answered well. Common incorrect answers included working out $g(2) = 4$, working out $g(2)f(2) = 4 \times 3 = 12$ and $g(x)f(2) = (3x-2) \times 3 = 9x - 6$.

(b) Many candidates were able to correctly find the inverse function. Most candidates started by swapping the x and y in the function to $x = 3y - 2$ and then rearranging. The common rearranging errors seen included either not dividing every term by 3 or moving the -2 to the other side with the wrong sign. Other errors included just reversing the signs in $g(x)$ as $g^{-1}(x) = -3x + 2$ or confusing the inverse function with reciprocal as $g^{-1}(x) = \frac{1}{3x-2}$.

(c) This question in general was answered correctly with most candidates showing $\frac{1}{x} = 5^{-2}$ before $x = 25$. Common wrong answers included $\frac{1}{25}$. A few candidates thought that $x \neq 0$ was part of the function and tried to solve $\frac{1}{x} + x \neq 0 = 5^{-2}$.

(d) Most candidates were able to set up the combined function correctly. Common errors seen included $2x - 1 - \frac{1}{x} = \frac{2x-1-1}{x}$ or attempts at solving the equation $2x - 1 = \frac{1}{x}$. In addition, a significant number of candidates thought that $x \neq 0$ was part of the expression and included it in their fraction.

(e) Only a minority of candidates were awarded the mark in this question as 5^{25} was required to be evaluated. Others evaluated it but wrote it down in calculator language such as 2.98 E17 rather than in clear standard form. A very common incorrect answer was 625, found from j(2)j(2) rather than the jj(2) required.

(f) Only a small proportion of candidates answered this correctly with the key to this question being able to rewrite $j^{-1}(x) = 4$ as $x = j(4)$ and hence evaluate 5^4 as 625. Common incorrect methods included $x^5 = 4$ and $5 = 4^x$.

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Question 5

(a) (i)(a) Many candidates were able to convincingly show that angle OAM is 67.5°. Some started from angle $AOB = \frac{360}{8}$ and used either exterior + interior angles = 180 or angles in a triangle, namely *OAM* or *OAB.* Others started from $\frac{(8-2)\times 180}{8}$ with equal success. Candidates who did not score either started with the 67.5° or stated that angles in an octagon total 1080° without evidencing $(8-2)\times 180$.

(b) There were a good number of clear and accurate solutions to this question. All of the methods involved using trigonometry and finding either or both of *OA* and *OM* followed by the area of a triangle using $\frac{1}{2}$bh or $\frac{1}{2}ab\sin C$. The most common errors included premature approximation or forgetting to multiply by $\frac{1}{2}$ or 8 or 16. Many candidates mistakenly multiplied their triangle area by 6 instead of 8. A noticeable number of scripts did not answer this question.

(ii) Again, a good number of accurate solutions were seen in this part with many candidates using the correct formula for the area of a circle with *OA* (or *OB*) as the radius. Common errors seen again included premature approximation or using *OM* as the radius. Many of the candidates who did not attempt the previous part also did not attempt this part.

(b) (i) A good number of candidates correctly found the volume of the container. The common errors included using the wrong formula for the area of a circle, forgetting to find half the area of a circle, or halving twice or not multiplying by 4. Some candidates attempted to find the volume in cm but few of these were able to correctly convert back to m^3.

(ii) Only a few candidates scored full marks on this multi-step and challenging problem solving question. Most candidates treated the shaded area as a semi-circle with radius 0.3 m and therefore usually scored no marks. The most astute answers recognised that the container still had a radius of 0.45 m and that trigonometry was required to find appropriate angles in order to be able to work out useful areas of triangles and sectors within the whole shape.

Question 6

(a) (i) Most candidates were able to read off the graph accurately at $x = 2$. A noticeable minority of candidates incorrectly read the graph at $y = 2$ giving $x = 1.3$ as their answer. In addition, a number of scripts did not answer this question.

(ii) Again, a number of scripts did not offer a response to this question. However, almost all respondents were able to read off the 3 solutions to the equations accurately.

(iii) A good number of candidates were able to give the correct integer value for k. Most of the errors came from not interpreting the question correctly. Common errors included, $k = -8.2$, the smallest non-integer value, $k = -9$, the lowest point on the graph within the range, $k = -1.5$ and $k = -1$, the lowest value and the lowest integer value within the range of the inequality $-1.5 \leqslant x \leqslant 5$.

(iv) A significant proportion of candidates did not make any response to this question. Of those who drew a line on the graph, some satisfied both criteria. Others either intersected the graph of $f(x)$ once or passed through the origin. The majority of lines were ruled and extended to the edges of the grid.

(b) (i) Candidates able to differentiate almost always scored full marks on this question. The most common error seen was for candidates to work out $y = 22$, when $x = 5$.

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(ii) Candidates who completed the previous part were almost always able to set up and solve $6x-12=0$ to obtain the coordinates as required. The most common incorrect answer, $(0,7)$, came from simply substituting $x=0$ into the equation for y.

(c) Again, the candidates with the knowledge of differentiation were almost always able to correctly find the value of p and the value of q.

Question 7

(a) Candidates needed to recognise that the cosine rule was needed to find angle *ACD*. Those that selected it were usually successful, provided they set it up to find angle *ACD* and not *CAD* or *CDA*, which was sometimes the case. Some made errors with the formula with $+2abCosC$ or $-4abCosC$ or $-2abSinC$ seen within it. Common errors included multiplying Cos*C* by the whole of $12^2+14^2-2\times12\times14$ or introducing an extra negative sign when rearranging. Some responses tried to find angle *ACD* by using the sine rule and this often used a wrong assumption such as angle *ABC* + angle *ADC* = 180, possibly thinking quadrilateral *ABCD* was a cyclic quadrilateral. Some candidates wrongly assumed angle $ACD=25°$ as alternate to angle *ACD* or that angle $ACD=ACB=32°$.

(b) Candidates often recognised the sine rule needed to be used and there were many correct rearrangements seen. The best solutions were those where the candidate arrived at $\frac{14\sin25}{\sin123}$ and only then used their calculator. Those giving rounded calculator values at each step risked being inaccurate at the end. Many responses failed to appreciate that the rigour involved meant that they needed to obtain the length of BC to more than 2 decimal place accuracy in order to confirm that its value is indeed 7.05 when rounded and consequently many candidates lost the final mark.

(c) There was generally good understanding that the perpendicular from B to AC was the required length and some indicated this clearly on their diagram. The most efficient method was using right angled trigonometry in triangle BCN, where N is the foot of the perpendicular from B to AC, although some slightly prolonged their work by using the sine rule and $\sin90^0$ term in their solution. Other longer correct solutions were common such as finding the length of AB before using triangle ABN or using the area of triangle *ABC* with $\frac{1}{2}\times14\times7.05\times\sin32=\frac{1}{2}\times14\times h$. A common misconception seen assumed that the shortest distance would be obtained by halving either angle ABC or the line AC.

(d) Many candidates recognised the need to use the cosine rule again, this time in triangle BCD, with most using *their* angle found in **part (a)**. Again, there were many who felt the need to use triangle BAD and, although perfectly correct, created extra work for themselves and often the many stages lost them some accuracy. Similar errors with the cosine rule were seen as in **part (a)**. Despite having evidence that angle $BCD\neq90°$, some answers incorrectly chose to use Pythagoras, calculating 7.05^2+12^2.

(e) A minority of candidates showed understanding of how bearings are measured. Those with understanding simply added their answer from **part (a)** to 270^0. Answers linked to the points of the compass, such as due NE were common, and some candidates gave a distance.

Question 8

(a) (i) Most candidates recognised that the shaded area referred to the intersection of two sets rather than the union.

(ii) Although some candidates shaded both diagrams correctly, it was more usual for one of the two diagrams to be correct. Most candidates offered a response with those who had little understanding seemingly shading regions at random.

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(b) (i) Almost all candidates answered this correctly. The main error came from misreading the question and finding $\frac{2}{11}$, the probability of choosing the letter *A* rather than the probability of not choosing *A*.

(ii) A good proportion of candidates answered this correctly. Many candidates scored one mark for $\frac{2}{11}\times\frac{9}{11}$ but omitted to multiply this by 2 by overlooking the fact that the events could take place in either order. Other errors included adding rather than multiplying the probabilities or methods using non replacement of the cards.

(c) (i) Many candidates were able to complete the Venn diagram correctly. The easiest way to work out the value in the intersection was to work out $3+33+42-50=28$. Some candidates set up correct equations such as $3+(33-x)+x+(42-x)=50$ and solved for x. Errors seen included writing 33 and 42 within the circles and leaving the intersection blank, having the 5 and the 14 the wrong way round or having numbers in all regions which satisfied all the criteria other than the total of 50.

(ii) Almost all candidates were able to give the correct probability from their Venn diagram.

(iii) This question proved very challenging to most. Common misconceptions included not having all 50 candidates in the denominator, not realising that this was a non-replacement question and that the denominator needed to decrease or not including all the candidates who like mathematics. Other errors included adding rather than multiplying the fractions, often giving probabilities greater than 1.

(iv) This question was met with more success. Candidates needed again to recognise that this was a non-replacement question, and that the denominators were 33 and 32 because candidates were selected from the 33 who like English. Again, errors of adding rather than multiplying the fractions was evident with answers often giving probabilities greater than 1.

Question 9

(a) This question was a challenging question, requiring working to be shown, but a number of candidates produced exceptionally clear and detailed solutions, scoring full marks. A number of stages were required, and most candidates were able to earn one or more of the marks. Respondents needed to firstly set up an equation connecting the information and many were successful in doing so, although common errors included using perimeter rather than area or having the 29 on the wrong side of the equation. Many correctly gave the area of the larger rectangle as the quadratic expression, $2x^2-x-1$. Candidates then needed to solve their quadratic equation either evidencing their factorising or using the quadratic formula. Those who found $x=6$ by trials or inspection lost the method mark because they had not proved that this was the only possible positive solution, which the use of the quadratic formula or factorisation showed. Candidates who had a value for x were often able to arrive at a perimeter with a value equal to $2\times$*their* x.

(b) (i) Only a small proportion of candidates were able to start this question by setting up an algebraic equation involving the volumes of the two cubes and the difference between their volumes. These candidates usually worked through the steps showing clear algebraic skills, often being precise with their use of brackets and expanding carefully. Particularly good was the expansion of $(y+1)^3$ with candidates who attempted this question making few errors. Because this was a show question, all brackets, signs and numbers need to be absolutely perfect to score full marks. The majority of candidates who did not score on this question either left it blank or attempted to solve the equation by either rearranging or using the quadratic formula, which was not required in this part.

(ii) A minority of respondents realised that they needed to solve the quadratic equation given in **part (i)** to find *y*. The question required all working to be shown and those who used the quadratic formula usually showed precise substitution into the formula to find both values of *y*. It was then reasonably straight forward to find the volume of the smaller cube. Others attempted to solve the quadratic algebraically, but were hardly ever able to isolate the *y* by using the completing the square method, and so were almost always unsuccessful.

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MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

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

Work should be clearly and concisely expressed. Intermediate values should be written to at least four significant figures, and only the final answer rounded to the appropriate degree of accuracy.

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

General comments

Many candidates were well prepared for the paper and their solutions were often well presented. All candidates appeared to have sufficient time to answer the questions.

Most candidates were unable to give clear geometrical justifications in **Questions 2(a)** and **9(a)**. In some cases, insufficient method was shown to gain credit when answers were incorrect. Candidates should avoid rounding or truncating values prematurely in their working, as this leads to inaccurate final answers and the loss of method marks. This was particularly common in questions where trigonometric ratios were used.

The topics that were answered well were:

- sharing a given amount into a ratio
- conversion of a recurring decimal to a fraction
- percentage reduction to find the original value
- working with linear equations
- rearranging a formula when the subject occurred twice
- mean from grouped data
- cosine rule/sine rule
- transformations

The weaker areas were:

- using geometrical facts and properties with shape and angle
- using geometrical reasons with the correct terminology
- problems involving upper and lower bounds
- problem solving with volume of cones
- sketching a cubic with known turning points

Comments on specific questions

Question 1

(a) Many were successful in this first part. The most common incorrect answers were 3, 5 or 15 coming from trying to find the lowest common factor. Many gave factor trees or factor ladders of 30 and 75 to gain a method mark even when the final answer was incorrect.

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(b) This part involving ratio was very well done and almost all scored full marks.

(c) There were a mixture of responses. Some gave fractional rather than decimal answers and were unable to convert to standard form. Some gave the correct decimal but then were unable to convert to standard form. The most common error was to give 2.6×10^{-2} as the answer rather than an answer to 3 significant figures (or better).

(d) This was answered very well with most showing their working. A few did not understand the significance of the recurring decimal notation and gave answer of $\frac{27}{100}$.

(e) This calculation involving density and mass proved to be straightforward for most. Common errors were in the units, for example cm^3/g or g/cm^2. Some overcomplicated the problem by converting for example to kg and m^3 which was unnecessary and often led to errors.

Question 2

(a) This question involving geometric reasoning was found to be very challenging.

Candidates are expected in this type of question to explain clearly which angle they are finding in the method, and to give a correct geometric reason for this using the correct terminology as given in the syllabus.

The best approach that a few adopted was using the 3 lines of the working space, one line for each angle with a reason.

Most candidates who attempted to give a reason for angle *PQR* = 90 failed to use the correct terminology. Angle is a semicircle = 90° was expected. Examples of incorrect language/reasons 'because *PR* is a diameter', 'two chords from the end of a diameter.....' etc.

For the second mark, many stated 180 – 90 – 29 for PRQ = 61, rather than give the correct geometric reason "Angles in a triangle sum to 180°".

For the final mark same segment or same arc was acceptable. Many gave same chord which is not an acceptable reason.

(b) More responses were successful in this part where written geometric reasons were not required. Many sensibly annotated their diagram with angles which earned method marks for each correct angle step to the answer.

Weaker responses did not identify that angle *ABT* = angle *ATS* = 98° (alternate segment theorem) and some also assumed that *AT* was a diameter, this often led to the answer 53.

Most candidates often gained a partial mark for angle *ATC* = 82°.

Some showed calculations of angles in working but these were not always identified unambiguously by their letters or marked correctly on the diagram and method marks cannot be awarded in these cases.

Question 3

(a) Many were successful and recognised the use of Pythagoras' to calculate the distance between the two coordinates.

A number were unable to deal with the directed numbers when subtracting to find the vertical and horizontal components.

Some answers attempted to find the gradient of the line and misunderstood the question. Of those using the correct method, the most common error was in the accuracy of the answer with 8.2 or 8.24 given on occasions.

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(b) This question involved a number of steps. Most started well by finding the gradient of the line *FG*. Many then completed the second step of finding the gradient of a line perpendicular to *FG*. Many candidates did not consider the midpoint of *FG* for the perpendicular bisector, and those that did usually went on to give the correct equation. The majority of candidates having done the first two steps well then substituted point *F* or point *G* into the equation to find the '*c*' value.

(c) This question challenged many candidates and was the most difficult part of the question. A number were able to recognise that if *H* lies on the *y* – axis, then the *x* – coordinate of the point must equal zero. These candidates gained credit for two answers of the form (0, *j*) and (0, *k*).

A few candidates drew a diagram where it became clear that the distance from point *H*, horizontally to the axis was 5 units and a 5, 12, 13 right-angled triangle was formed.

Having established the distance for the third side of the triangle, candidates needed to add or subtract 12 vertically from the point (0, 4) to give answers (0, 16) and (0, –8). This was completed well by some more able candidates but for many this proved very challenging.

Question 4

(a) This part involved using the cosine rule and was generally done well, but a number of candidates lost marks by giving the answer as 7.05, i.e. truncating, or rounding to 7.1. The majority did use and apply the cosine rule correctly, although a few candidates thought that the opposite angles of a trapezium add to 180° and used sine rule with angle $C = 135°$. A small number of other candidates used angle $B = 38°$ treating triangle *BCD* as isosceles.

(b) (i) This was generally done well with candidates recognising the use of angles in a triangle. A few gave an answer of 90°, although there was no information in the question to suggest this. An error in this part had an impact on the next part.

(ii) This sine rule question was very well answered, and answers were rounded more successfully than **part (a)** because of the figures involved 15.300. Most candidates used their answer to **part (b)(i)** successfully but angles of 90°, 38° and 45° were not allowed method marks as these assumed triangle *ABD* to be right angled or isosceles.

(c) Candidates who tried to find the area of two triangles did much better than those who tried to find the area of the trapezium where the height was needed to be found.

When finding the area of the 2 triangles, most candidates used $\frac{1}{2}ab\sin C$ correctly, with 38° being the included angle in each triangle.

Candidates using the formula for the area of a trapezium found the height to be a real challenge, with many using their answer to **part (a)** as a perpendicular height. The stronger candidates were able to use the diagram efficiently and use $10.9\sin 38°$, and then proceed to use the formula for the area correctly. A few introduced 6.7 for the height with no evidence of method or a more accurate value, thereby not scoring. A correct method is not implied by values given to 2 significant figures without the method leading to that value being shown.

Question 5

(a) This question was generally correctly answered. A surprising number of candidates included the diagonals.

(b) (i) (a) This part was very well done, most using the correct term 'translation' together with the correct column vector. It is pleasing to report that very few used 'transformation' or 'translocation' or 'transition'. The vector was usually correct although a few candidates had the components reversed or made an error with the vertical component. A small number of candidates used incorrect notation for the vector.

(b) This part was also done well with most candidates giving 'rotation' and '90° anticlockwise', so earning two of the three marks. The centre of rotation was less well answered but still there were many correct answers. A small number of candidates gave two transformations, and no marks can be awarded in such cases when a single transformation is asked for.

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(ii)(a) The drawing of the reflection in the line $y = 2$ was answered correctly by almost all candidates.

(b) The drawing of an enlargement with a negative scale factor was a more challenging question. This part was frequently not attempted and enlargements with factor 2 or $\frac{1}{2}$ were quite often seen as well as those that used the correct scale factor but the incorrect centre.

Question 6

(a) This proportion question was generally well answered with candidates correctly using the given data to carry out the calculation. A small number of candidates were perhaps unsure about using this method of proportion because of the word 'estimate' being in the demand of the question.

(b) This was a challenging probability question, unusually involving three different products of two fractions. The stronger scripts were able to cope with the three different combinations of transport and that each could occur in two ways, as well as it being a 'without replacement' situation. A few other stronger responses found the probability of the three same combinations and subtracted this from 1. Many earned partial credit for three correct products but without multiplying each by 2. A few gained one mark by showing one product of two fractions with denominators 12 and 11. A small number of answers treated the question as a 'with replacement' situation.

(c) This reverse percentage question was very well answered with only a small number of responses treating the given amount as 100 per cent.

(d) (i) This lower bound question proved to be quite challenging. As it involved a division, it required the lowest numerator over the highest denominator, each worked out from the 'to the nearest' information given. Many candidates divided the lowest possible numerator by the lowest possible denominator. Most candidates earned one mark by showing one of the four correct bounds. A small number of candidates carried out the calculation using the given values without bounds and then attempted to look at the possible range of answers.

(ii) This part, involving the subtraction of a lower bound from an upper bound, was found to be more successful, although a number of candidates found the difference of the two upper bounds. As in **part (d)(i)** almost all candidates with incorrect answers did earn one mark by showing one correct bound.

Question 7

(a) Candidates usually scored full marks, confidently working with midpoints and frequencies. The main error when working with midpoints was using an incorrect value for the midpoint in the 25 to 40 group. A small proportion of responses worked with the incorrect approach of using group widths multiplied by frequencies.

(b) There were many completely correct solutions. The majority of candidates knew that the bars of the histogram would have to be the correct interval width and most showed an understanding that the heights of the bars are calculated using frequency densities. A significant number of answers did not take sufficient care with drawing the correct bar heights, particularly the 25 to 40 intervals. A common error was to not use the intervals from the frequency table and have five equal bar widths in their diagram.

(c) (i) This part was usually correctly answered. A relatively common error was to state the frequencies.

(ii) Almost all candidates correctly answered this question part, including some who had incorrectly completed their cumulative frequency table in the previous question part, but were able to go back to the frequency table and make a fresh start.

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Question 8

(a) This question part was well answered. Most rearranged the given equation and correctly solved $7 = 14p$. The main errors were that a number of responses went on from $7 = 14p$ to give the answer 2, along with a few others who made errors in the first step of rearranging the equation.

(b) Many candidates were comfortable with the methodology involved and the strongest responses adopted the following steps:

Rearrange the given equation to have both terms containing m on one side of the equation.

Remove m as a common factor from the terms in m.

Divide both sides of the equation by the bracket to isolate the term in m.

This produced many clear and concise solutions.

The majority of errors resulted in not isolating the terms in m in the first step leading to some answers that contained several terms in m.

(c) The majority of candidates adopted a correct approach to combine the two fractions under a common denominator. Following this first step, fewer candidates could process the algebra to remove the fractions. Some candidates had difficulty with solving the correct 2 term equation, they seem to be more confident with the methods required to solve three term quadratics. The best solutions were concise with obvious care taken to ensure that their working contained no sign errors.

(d) The most common method which yielded full marks for candidates was to make x the subject of $x + 2y = 12$ and substitute this into the second equation. This provided an equation in one variable y that could be simplified into a 3– term quadratic equation to solve. A similar method making y the subject of the first equation tended to produce more complex algebra, with candidates having to work with a fraction and a more difficult expansion. Another common approach was for candidates to multiply the first equation by 5, and then eliminate x to work towards a 3 – term equation in y. This often resulted in sign errors. The best solutions were able to solve a 3 – term equation by either factorisation or by using the formula. It is important that when using the quadratic equation formula candidates show the full substitution and each step of working. Some candidates showed two correct solutions but did not show full working including the method to solve the quadratic equation and did not score full marks as a consequence.

(e) This part was well answered, with many candidates familiar with the standard techniques for the expansion of brackets. Other answers made a promising start with two of the brackets but then made sign errors and errors with indices when multiplying. A small number of responses achieved the correct expansion but then attempted some form of factorisation.

Question 9

(a) This proved to be a challenge for almost all respondents. The strongest solutions made a very clear specific link between the named pair of equal angles in each triangle and gave a reason. These solutions had a logical style of presentation line by line for each pair.

A feature of the strongest solutions was the clarity of knowing that similar triangles would have 3 pairs of equal angles and in conclusion they stated this fact.

Weaker solutions were not specific in the statements made, e.g. ‘they both have a right angle’, ‘they both share an angle’ without saying which pairs of angles they were referring to.

Many responses made assumptions about 45° angles and listed equal sides which were incorrect.

(b) (i) This was a very well answered part with clear working shown. The only common error was for candidates to lose accuracy by working with a two significant figure value as a scale factor. This error also impacted on their accuracy in **part (b)(ii)**.

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(ii) The most common method used was to find the scale factor, then square to find an area scale factor, taking care to not prematurely round any numerical values. This is an area of the syllabus where candidates appear to lack confidence. Most realise it has something to do with a scale factor, many used length scale factors, others sometimes seem to be confused on whether to divide or multiply. The area of triangle method was used by a relatively small number of candidates some of whom lost accuracy due to the premature approximation of numerical values.

Question 10

(a) Most candidates rearranged the inequality as far as $2n < 7$ or $n < 3.5$. Some solved it as an equation and others reversed the inequality to give $n > 3.5$. Many candidates gave the inequality as the answer rather than the positive integers that satisfied the inequality as required by the question. Those that did list integers often included 0 as well as 1, 2 and 3. A small number of candidates did not understand the term integer and included some decimal values in their list.

(b) (i) Most responses understood that the three given equations should be used to set up the inequalities to define the region. Those who inserted inequality symbols into the three given equations answered this part more successfully than those who attempted to rearrange them first to give explicit equations for y, such as $y = 80 - 0.8x$. When equations were rearranged, some made sign or arithmetic errors or omitted an x. Some responses did not appreciate the difference between the dashed and solid lines defining the region and gave all the inequalities as strict inequalities, using < and >, rather than $\leqslant$ for the solid boundary. A small number of answers used $\geqslant$ in place of > as well as $\leqslant$ in place of <. Some reversed all the inequalities and others just restated the given equations. A small number gave three sets of coordinates as the answer.

(ii) This part proved challenging. Some responses found a point in the region and used its coordinates to evaluate the expression $3x + y$. Some used trial and error with a number of points in an attempt to get the largest result. Those that understood the term integer usually reached the correct result, although many used decimal values in an attempt to find the largest possible result. A minority of responses identified the point (7, 2) and gave that as the answer.

Question 11

(a) (i) The majority of candidates used the correct formula to set up the equation $2\pi r = 28$. It was often shown rearranged to $r = \frac{28}{2\pi}$ or $r = \frac{14}{\pi}$. Many answers did not show the result evaluated to more figures than the value 4.46 given in the question. This was required to demonstrate that they had performed the correct calculation. Some equated the area of the rectangle and the curved surface area of the cylinder leading to the same result. A small number worked from the volume found in **part (a)(ii)** to show the value for the radius, which was not acceptable as they had used 4.46 to calculate the volume. Others started by using $r = 4.46$ to show AD was approximately 28 which was also unacceptable. A minority of responses used incorrect formulas such as the area of a circle or the surface area of a solid cylinder.

(ii) Most respondents knew the formula for the volume of a cylinder and calculated the answer correctly. Some quoted the formula incorrectly, for example $2\pi r^2 h$, πr^2 or πrh.

(iii) Many candidates identified the correct angle in the cylinder and calculated its value correctly. It was common to see a triangle drawn on the diagram of the cylinder, annotated with its dimensions and the required angle indicated which often led to the correct answer. The most efficient method was to use tangent to find the angle, although some candidates used Pythagoras' to work out the distance NA and then used either sine or cosine. Some responses truncated their answer to 65.9, which was outside the acceptable range, so did not gain full credit. Common errors were to use 28 as the height of the cylinder, to calculate angle NAB, to use the radius rather than the diameter, or to start from a triangle on the rectangle rather than the cylinder.

(b) Many candidates were able to start this question using the given formula and replacing h with $2r$. Many found it difficult to rearrange the formula $\frac{1}{3}\pi r^2 \times 2r = 310$ correctly to find the value of r. Common errors in the rearrangement were to take a square root rather than a cube root or to divide by 3 rather than multiplying by 3. Those who found a value for r usually doubled this value to find h, but this was often given as the answer rather than using their values of r and h to find the

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slant height. Those who distinguished between the height and the slant height usually showed correct Pythagoras using their values of r and h, although in some cases $\sqrt{r^2+2r^2}$ was used in place of $\sqrt{r^2+(2r)^2}$. Some answers were out of the accepted range because the radius was prematurely rounded to 5.3. A small number of scripts linked this part to **part (a)** and used the radius 4.46 to find the height.

Question 12

(a) There were some fully correct answers to this part with candidates differentiating the function correctly, equating the derivative to 6, substituting $x = 2$ and rearranging to show that $k = 1.5$. In a few cases the derivative was incorrect, for example $3x^2 - 2kx + 1$ and others equated to 0 rather than 6.

It was clear, however, that many did not know that the derivative of the function gave the gradient, and these started by substituting $x = 2$ and $y = 6$ into the given cubic function. Others attempted to use the method for the gradient of a straight line. Some of these substituted $k = 1.5$ and attempted to show the result from that point.

(b) More answers were aware that they needed to use the derivative to find the stationary points than had used it for the gradient in **part (a)**. Many showed a correct derivative here and equated to 0, however not all were able to solve the equation $3x^2 - 3x = 0$ with errors in factorising common. Some answers gave the two correct stationary points without showing any evidence of differentiation, often from using a table of values. Some quoted the coordinates of any two points on the curve, often including (0, 1).

(c) The most common response in this part was a positive cubic curve but the curve often did not have stationary points positioned correctly, even if they had been found correctly in **part (b)**. In some cases, the curvature was poor with shapes that suggested that, if continued, there would be a further maximum or minimum. Some negative cubic curves were seen and also quadratic curves, reciprocal curves, or straight lines were seen. A small number of answers did not show an understanding of what is required of a sketch, and made a table of values, added scales to the axes and attempted to plot points, rather than using the general shape of a positive cubic, and the stationary points found in **part (b)** to identify the correct shape and position of the curve.

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MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key messages

To do well in this paper candidates need to be familiar with all aspects of the syllabus. The recall and application of formulae in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions. Work should be clearly and concisely expressed with intermediate values written to at least four significant figures, with only the final answer rounded to the appropriate level of accuracy. Candidates should show full working with their answers to ensure method marks are considered when final answers are incorrect.

General comments

Many candidates seemed well prepared for the paper and demonstrated a clear knowledge of the wide range of topics tested. Candidates used their time efficiently and attempted all of the questions. The standard of presentation was generally good, however there were occasions when candidates were not awarded marks as they did not show clear working. For some candidates, working tended to be more haphazard and difficult to follow, making it difficult to award method marks when the answer was incorrect. There were a few candidates, at the lower end of the scale, where entry at core level may have been a more rewarding experience. All candidates need to be aware of the need to retain sufficient figures in their workings so that their final answer is accurate; a number of marks were lost due to the premature approximation of values. Centres should continue to encourage candidates to show the formulas they use and the calculations performed

Some candidates are working in pencil and then overwriting in pen, which can make responses unclear. Care needs to be taken with the written presentation of some figures. Candidates mis-reading their own figures was a common occurrence, especially between 0 and 6, between 1 and 7 and between 4 and 9. Calculations involving percentages need to show an explicit method. For example, in **Question 3(a)(iii)**, $(1 + 30.48\%)\,x = 2226$ did not earn a method mark until the percentage was dealt with correctly, i.e. $(1 + \frac{30.48}{100})x = 2226$. Candidates need to spend a few moments checking the validity of their answers. For example, in **Question 2(b)**, after enlarging a shape with an area of 20 cm^2 candidates should be expecting an area greater than the original and not less.

Comments on specific questions

Question 1

(a) Nearly all candidates answered this correctly. Giving the journey time of 47 minutes was the most common error while some candidates misread the timetable and gave the arrival time at North Moor.

(b) Many candidates gained full marks. The most efficient method of subtracting 08 27 from 10 30 was sometimes seen but many opted to calculate the times for the three separate parts of the journey and then adding them up. This sometimes led to errors with candidates treating the times as decimals. Other common errors usually involved omitting one of the three parts, usually the walking or waiting parts of the journey.

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(c) The majority gained full marks in this part and the method of distance divided by time was widely understood. Most successful were those dividing by $\frac{70}{60}$ or $1\frac{1}{6}$ or division by 70 then multiplication by 60. Others converted the time to a decimal value. Many of these did not retain the full decimal value on their calculator and opted instead to round the decimal. This often led to inaccurate final answers. Writing 70 minutes as 1.10 hours was a common wrong conversion.

(d) Many fully correct answers were seen. Most candidates calculated the numbers of adults and children using the ratio before multiplying by the appropriate ticket cost. Others found the total cost of 5 adults and 3 children and then multiplied the result by seven. Some candidates mistakenly calculated the total cost for the children as $\frac{3}{4}$ of the total cost of the adults. Most errors were due to arithmetic slips or rounding the answer to the nearest dollar.

Question 2

(a) (i) Many candidates made good attempts at reflection in the line $y = x$ with just a few plotting one vertex incorrectly. Those that drew the line $y = x$ usually made fewer errors such as mis-plotting one of the vertices or drawing a triangle with the correct size and orientation but displaced by a square. Weaker candidates tended to treat this as a reflection in either the x- or y-axis or as a rotation of 180°.

(ii) The majority of candidates had a good understanding of translation and a small minority were able to give the correct image. The scale proved to be the biggest issue and many simply counted squares with the result that translations of $\begin{pmatrix} -0.5 \\ 1.5 \end{pmatrix}$ were given by the majority.

(iii) Almost all candidates recognised that the transformation involved enlargement and usually gave a correct centre. A correct scale factor of –1.5 was often seen but 1.5 was a common error. Some were uncertain how to explain the negative scale factor and often introduced a second transformation of rotation which spoiled their previous good work.

(b) Most candidates gave a correct area for the enlarged quadrilateral. Others did not show an understanding of the relationship between area and linear scale factors and 24 was a very common wrong answer. Others divided 20 by the scale factor (either squared or not).

Question 3

(a) (i)(a) Most candidates showed the correct method and gave the answer to at least three significant figures. A common error involved finding the number of tigers in Bangladesh as a percentage of the number in Nepal. Other errors included subtracting 100 from a correct answer or truncating a correct answer to 186.

(i)(b) Many candidates successfully expressed the ratio in its simplest form. Those that did not, often gave the unsimplified ratio of 106 : 371 : 2226 as they were unable to identify the only common factor of 53. A few candidates gave a ratio in unitary form e.g. 1 : 3.5 : 21. Those that attempted to give answers involving decimals often lacked accuracy with many of the decimals having only two significant figures.

(ii) For many candidates, calculating the correct percentage proved to be straightforward. Others started correctly but omitted the final step, either 133.3 – 100 or, to a lesser extent, 0.333×100. A common error involved treating the question as a repeated percentage increase over the five years and $2226\,(1 + x/100)^5 = 2967$ was often seen. Other errors involved division by 2967 rather than 2226 and a significant number gave their answer as 33 without showing a more accurate value in their working.

(iii) Some candidates had a good understanding of reverse percentage calculations and reached the correct integer answer. Many did not recognise it as a reverse percentage question and either increased or decreased 2226 by 30.48%. Others thought the 30.48% represented a yearly value and used $(1 \pm 30.48\%)^4$ in their working.

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(b) This question proved to be challenging for some candidates. Stronger candidates often showed clear and efficient working and, barring occasional slips, usually obtained the correct integer answer. Weaker candidates often appeared not to understand how to approach the question. Most were unable to recognise the initial x-value as $x = 0$ in order to find $a = 2000$ and often worked with a variety of incorrect equations. Some found incorrect values for a and b but were then able to use these correctly. A higher proportion of candidates made no attempt at a response.

Question 4

(a) Many candidates were able to show the required result. Dividing 360 by 12 and subtracting the result from 180 was a less popular method than using $(12 - 2) \times 180$ and dividing the result by 12.

(b) (i) A wide variety of trigonometry methods were used, from simple sine or cosine, the sine rule and the cosine rule. Many were able to make an appropriate start but not all earned all the method marks. As this was a 'show that' question candidates needed to reach an explicit statement for the radius. For example, some stated $\cos 75 = \frac{3}{r}$ and then jumped directly to $r = 11.6$ without showing the explicit statement $r = \frac{3}{\cos 75}$. To show that the radius is 11.6, correct to one decimal place, it was necessary to give an answer to two or more decimal places (11.59…) in order to show that it rounded to 11.6 . There were a number of attempts where 11.6 was used in a calculation (quite often to find either the circumference or the area of the circle) and then the reverse process to give 11.6 as the answer which gained no marks at all.

A high proportion of candidates made no attempt at a response.

(ii)(a) Most candidates answered this correctly. On rare occasions, some mistakenly took the radius to be 6 cm, and others found the area, but the vast majority were comfortable with the demand.

(ii)(b) There were many correct answers given for the perimeter of the minor segment. A few confused sector with segment, others confused perimeter with area and some did not add on the length of the chord. A high proportion of candidates made no attempt at a response.

(c) Stronger candidates had no difficulty in reaching the correct answer. Most opted to use $\frac{1}{2}ab\sin C$ but some increased the amount of work to do by calculating the perpendicular height of the triangle before finding the area and then on to the prism. Some candidates appeared not to understand the volume required, often working out the volume of a cylinder instead. Others used the formula for the volume of a cone. A far higher proportion of candidates made no attempt at a response.

Question 5

(a) (i) Many candidates were able to identify the interval containing the median time. The two most common errors were $10 < t < 20$, the middle interval, followed by $0 < t < 60$.

(ii) Many candidates demonstrated a good understanding of the mean of grouped data and many obtained the correct answer. A few made slips, usually with one of the midpoint values. Incorrect methods usually involved the use of the class widths instead of midpoint values.

(b) (i) This was very well answered. The answer was sometimes incorrectly given as a decimal or percentage, usually after a correct fraction was seen in the working.

(ii) A majority of correct answers were seen. Some appeared confused over whether to treat the question as with or without replacement. Those who understood the method usually obtained the correct answer. Some did not take into account the order in which they were picked and an answer of $\frac{25}{252}$ was a common wrong answer. Others did not take into account that the two people were chosen from those taking less than 20 minutes and probabilities with denominators of 80 and 79 were also common errors.

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(c) (i) The vast majority of candidates completed the table correctly.

(ii) A large majority of candidates drew accurate graphs, most of which were curves with a significant number of polygons. Plotting the points was usually well done. Drawing a block diagram was the most common error and a few plotted the points correctly then drew a line of best fit.

(iii) This part was well answered. Some showed a line from 64 or a dot at the appropriate place on their graph while others gave just an answer. A significant number of candidates did not pick up on the 80th percentile, instead finding the time corresponding to a cumulative frequency of 80 leading to the very common error of 60. A small number of candidates misread the scale.

(iv) Many candidates had no difficulty in interpreting the graph correctly and gave a correct percentage with all the appropriate working. Some only calculated the percentage that took less than 45 minutes. Others slipped up by not using an integer reading in their calculation. A few ignored their graph and calculated the value by referring to the table and often did so correctly.

Question 6

(a) Candidates seemed well prepared and most had no difficulty in simplifying the expression. Writing $a(1 – 3) + b(7 – 2)$ was the most common error.

(b) Yet again, candidates seemed well prepared and many fully correct answers were seen. If errors occurred, they usually resulted from $4(x – 5) = 4x – 5$ or from $–(3 – 2x) = –3 – 2x$. Some weaker candidates treated the question as a two-bracket expansion resulting in a quadratic expression. A few candidates spoiled their correct expression by equating it to zero and solving.

(c) Many candidates were competent in manipulating the algebraic fraction and fully correct answers were in the majority. Errors arose either when dealing with the negative sign in the numerator or when expanding the bracket in the denominator which was not required. Having reached a correct answer some spoilt it by incorrect cancelling of some of the terms.

(d) Yet again many candidates were able to rearrange the equation and obtain the correct answer. Few errors were seen but those that were usually involved errors with signs when rearranging the terms.

(e) Many opted either for expanding the bracket as the first step or clearing x from the denominator. These steps were almost always correct. Having collected the x terms weaker candidates went wrong when trying to deal with the yx term. Most errors usually involved dividing the right-hand side by y rather than dividing all terms by y. Alternative approaches were seen but not all were successful

Question 7

(a) Most candidates were successful with this question. The cosine rule was widely used and a few drew a perpendicular line within the triangle and used a less efficient alternative method. Errors were sometimes seen in the actual cosine formula used such as sin(76) instead of cos(76) or +2 instead of –2. Others reached 9749 – 9020cos76 correctly but followed it with 729cos(76). A few candidates lost marks by omitting the square root and some truncated the answer to 86.9 . Some weaker candidates assumed the triangle was isosceles and that $BA = BC$.

(b) Those that were successful in the previous part were often successful in this part with the majority recognising that the sine rule was the most efficient method. Others used the cosine rule again while a few found angle ABC first and then used angle sum of a triangle. Many gained full marks or method marks following on from an incorrect value for BC. A few candidates rounded values within their calculation which led to final answers that were outside the required range. Some inefficient and time-consuming methods were seen, mostly unsuccessful. An answer of 76 was a common error from weaker candidates.

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(c) This question was answered with varying degrees of success. The trigonometry was less involved and many candidates gained full marks. However, a significant number of candidates misplaced the position of the gate. Some assumed *G* was at the midpoint of *AB*, not realising that the line *CG* needed to be perpendicular to *AB*. Others had their perpendicular line from *A* to *BC*. Those who correctly positioned the gate often only calculated *GC*, probably triggered by the mention of the shortest distance in the question. A high proportion made no attempt at a response.

(d) This part also produced varied results. Stronger candidates were usually able to calculate the acute angle correctly but many failed to realise that the other possible angle was 180 – 54.13 . Some gave two angles that added to 90° while others attempted a second calculation to find the other angle. Weaker candidates often calculated the area of triangle *ABC* but could not progress further as they were unable to form an equation linking this to the area of triangle *PQR*. Some answers were outside the required range due to premature rounding within the calculations.

Question 8

(a) (i) Many correct midpoints were seen. Errors included incorrect arithmetic with negative numbers, adding the *x* and *y* coordinates but forgetting to divide by 2 and subtracting the coordinates before dividing by 2.

(ii) There were many correct answers, but also quite a few where the values were reversed. The vector $\begin{pmatrix} 3 \\ 11 \end{pmatrix}$ was a common incorrect answer resulting from the addition of the coordinates rather than the subtraction.

(iii) Many candidates were able to find the magnitude of their vector from the previous part. Not all candidates had a good understanding of magnitude and a significant proportion made no attempt at a response. Giving an answer to 1 decimal place only and subtracting the squares of the components were two of the most common errors seen.

(iv) Again, many correct answers were seen. Candidates of all ability levels made good attempts with weaker candidates more prone to arithmetic errors, particularly in the calculation of *c*.

(v) Candidates, in general, were slightly less successful in this part. Not all found the correct gradient for the perpendicular line and +4 and $-\frac{1}{4}$ were common errors and some candidates used the same gradient of –4. In the calculation of *c*, some used the coordinates of *A*, *B* or the midpoint, none of which were on the line. Some used the correct coordinates of (5, 4) but slipped up by substituting into their equation with the *x* and *y* the wrong way round.

(b) There were many fully correct solutions with working set out clearly. Many others knew the correct method but a variety of slips were seen in the working. At the initial stage several rearranged the linear equation incorrectly, often using $y = 5x - 8$. Errors were also seen in the substitution and the simplification to a quadratic equation. Some ignored the instruction to show all working by not showing the process of solving the quadratic and at the final stage some forgot to find the corresponding values of *y*.

Question 9

(a) Some good sketches of a negative cubic were seen with clearly indicated intercepts. Some candidates were not confident with curve sketching but produced acceptable graphs after calculating and plotting some points. Some curves were spoilt by incorrect curvature at the two extremes. Drawing a sketch of a positive cubic was another common error. Candidates would be well advised to clearly label the intercepts on their graph rather than rely on graph scales, for example scales going up in fives.

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(b) (i) This was answered well by a large majority of candidates. Most opted to expand the first two brackets and almost always did this correctly. Some expanded $(3 - x)(3 + x)$ first using the difference of two squares which gave a simpler and more efficient solution. The most common error was to omit brackets around the expansion of the first pair of brackets giving incorrect expressions such as $3 - x + 3x - x^2(3 + x)$. Attempts at expanding all three brackets simultaneously were rarely successful with either terms omitted or extra terms included.

(ii) The use of differentiation to find the turning points was clearly understood by many candidates and most of them made a good start to the question by setting the derivative to 0. The resulting quadratic was almost always solved by using the quadratic formula with only a few attempting to complete the square. Many solutions were fully correct and slips with the signs and answers not given to 2dp were the most common errors. A number of candidates ignored the instruction to show all working and gave only the solutions and these candidates were unable to earn the method marks for use of the formula.

(iii) Only the strongest candidates reached a correct solution. Some substituted their solutions into the original equation but they often failed to link them correctly to *a* and *b* or did not give the appropriate integer values as their answers. A common incorrect method involved substitution of their solutions into the second derivative. A very high proportion of candidates made no attempt at a response.

Question 10

(a) Most candidates made a positive start by calculating the length of *AC*. Many of these realised that they needed to use Pythagoras in triangle *ABC* with sides labelled as x and $2x$. Only the better candidates dealt with $(2x)^2$ term correctly and $2x^2$ was a common error. Those that did have $4x^2$ often went on to find the correct value of x. Most multiplied the value by 2 but a small number forgot to complete this step. Some candidates opted to label *AB* as x and *BC* as $\frac{1}{2}x$. Similar problems occurred when squaring $\frac{1}{2}x$. Some weaker candidates assumed that the cross-section was a square and used $BC = 6$ cm with Pythagoras in triangle *ABC* and a few simply doubled it based on the given information.

(b) This proved to be a positive end to the paper for a large majority of candidates. Most opted to use simple trigonometry with sine ratio the most popular. Others opted for other methods such as the cosine rule. These less efficient methods tended to lead to inaccurate answers due to premature rounding of some of the values. Most candidates did not identify the required angle on the diagram which was not a problem when the working was correct. Common errors usually involved finding angle *AGC*, finding angle *GAB* and to a lesser extent finding angle *FAB*.

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