Principal examiner reports for teachers

Principal examiner reports for teachers summarise what candidates did well and what candidates needed to improve for this examination series only.

This report is to be used in conjunction with the question paper and mark scheme.

For guidance on teaching and learning we provide resources for many of our syllabuses.

Resource	Where to find it
Grade descriptions – Grade descriptions describe the level of performance typically demonstrated by candidates achieving the different grades awarded for a qualification.	School support hub Select: Subject > Resource finder > Syllabus and specimen materials
Schemes of work – Schemes of work are designed to support you in your teaching and lesson planning.	School support hub Select: Subject > Resource finder > Teaching and learning
Lesson planning – Guidance on how to plan a lesson.	Lesson planning
Resource plus – There may be additional resources such as teaching packs containing lesson plans, resources and worksheets and videos for aspects of your syllabus.	School support hub Select: Subject > Resource finder > Teaching and learning
Teaching tools	Teaching Tools
Exemplar candidate responses	School support hub Select: Subject > Resource finder > Teaching and learning
Learner guide – A guide for students to help them understand what the course involves.	School support hub Select: Subject > Resource finder > Teaching and learning
Community forums – Do you have a question or something to share? Our online forums are great way to keep up to date with your subject and the global Cambridge community.	Community forum on the school support hub
Access to scripts for this series.	Access to scripts service
Results analysis is available for some syllabuses.	Results analysis
Test maker is available for some subjects.	Test maker

Other services from Cambridge International Education

- **Digital mocks service**
- **Insight assessments**
- **Professional development**
  - Focus on assessment
  - Online marking workshops

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/12
Non-calculator (Core)

Key messages

What candidates did well

- Many candidates demonstrated understanding of the key topics and were able to respond successfully to straightforward questions. Some candidates also made progress on the more challenging parts of the paper.

What candidates needed to improve

- On non-calculator papers, candidates can improve accuracy by writing out all calculation steps, as this helps to reduce errors in mental arithmetic.
- Poor operations on directed numbers in a number of questions caused loss of marks more often than understanding the syllabus topic in the question.
- The whole syllabus needs to be covered to prepare candidates effectively for the examination.

Comments on specific questions

Question 1

(a) **Comprehensive responses**

- The majority of candidates gave the correct answer for the subtraction.

Limited responses

- Common errors were responses of 1311 and 1313 while a minus sign was occasionally seen before the correct answer.

(b) **Comprehensive responses**

- Around half of the candidates gave the correct answer to the division by 2.

Limited responses

- Many did not perform the division correctly, with 47 being the most common incorrect answer from an error with the place value of 4.
- 40.7 was seen occasionally.

(c) **Comprehensive responses**

- Many candidates found the correct multiple of 6.

Limited responses

- Some listed multiples of 6 without identifying the specific required one.
- Common incorrect answers included 3 and 24.

Question 2

(a) **Comprehensive responses**

- While the simple calculation was rarely seen, most candidates worked out the height correctly and completed the bar chart with correct height and width of the bar.

Limited responses

- There was some evidence of incorrect calculation of the height as 7 was seen.
- Misinterpretation of the question was seen a number of times for a height of 3, the difference between the other two bar heights.

(b) **Comprehensive responses**

- Nearly all candidates could find the difference between the heights of the two given bars.

Limited responses

- Misunderstanding of what was required was evident. The answer that was given were just the heights of racing or road bikes. in answers of the heights of the racing or road bikes.

Question 3

(a) **Comprehensive responses**

- Changing from a decimal to a percentage was well known.

Limited responses

- Some thought they just needed to add a % sign so had 0.47%, while 4.7, 0.047, 470 and 4700 were seen occasionally.
- Some changed it to a fraction, $\frac{47}{100}$ without expressing it as a percentage.

(b) **Comprehensive responses**

- While not as well answered as the previous part, there was a very good response to changing a fraction to a decimal.

Limited responses

- A wide range of incorrect responses were seen, for example 0.9, 9.00, 0.009 and 100.9.
- The reciprocal $\frac{100}{9}$ was seen. This responses indicate that candidates have misunderstood how to read the fraction.

Question 4

(a) **Comprehensive responses**

- The fraction of the total squares had first to be calculated, there were quite a lot of candidates shading the correct number of squares.

Limited responses

- The interpretation of the 3 in $\frac{3}{10}$, which resulted in 3 shaded squares of a 3 by 3 square shaded quite often.
- 15 shaded in three vertical columns, again from the 3 in $\frac{3}{10}$.
- It was rare to see an attempt to calculate $\frac{3}{10}$ of 40.

(b) **Comprehensive responses**

- Some candidates did work out that two sections in each ring had to be shaded.

Limited responses

- Most candidates had little idea of how to work out the shading which meant a lot of no responses and a great many seeming more like guesses than any thought-out attempt.

Question 5

(a) **Comprehensive responses**

- Candidates familiar with the term-to-term rule for a sequence usually gave a correct answer.

Limited responses
- Some candidates gave general expressions in terms of *n*, rather than providing a specific answer as required by the question.
- Many gave answers of 10, subtract 54, multiply by 10, or listed all the differences between the numbers.

(b) **Comprehensive responses**
- Most candidates found the first of the next two terms and went on to find the second one, having realised a difference of 6 between the terms.

Limited responses
- Errors were made in subtracting 6, usually resulting in –4 or –2 for the second of the terms.
- A few cases were seen of extending the other end of the sequence with 33 and 39 or even quoting two consecutive Terms from the list. The numbers aren't consecutive.

Question 6

Comprehensive responses
- Many candidates made some progress on at least one of the constructions, even though construction arcs were often not seen.

Limited responses
- It was quite rare to see both isosceles triangles since many simply repeated the first one on the second 4 cm line.
- An equilateral triangle with sides of 4 cm was often seen.

Question 7

(a) **Comprehensive responses**
- Most candidates were able to add the two expressions clearly.

Limited responses
- Some tried to combine unlike terms even after a correct answer was seen.

(b) **Comprehensive responses**
- Some candidates were able to subtract terms correctly, while others had at least one term correct from combining terms.

Limited responses
- Some candidates needed to accurately subtracting an expression containing a negative value.
- There were attempts to solve inequalities to give a numerical answer.
- Some used the answer to part **(a)** as the first expression rather than starting with the original expressions for the subtraction.

Question 8

Comprehensive responses
- Most candidates understood prime numbers and found at least one of the two between 20 and 30.

Limited responses
- A small proportion gave two even numbers.
- Each of the odd primes were regularly given and it was rare.
- Some candidates had primes (or other numbers) outside the required range.

Question 9

(a) **Comprehensive responses**

- Many candidates worked out the squaring and cubing correctly and most understood that they then had to subtract these.

Limited responses

- Some candidates did not find the difference as required, or were unclear about its meaning.
- Those not understanding indices usually gave responses of 10 and 6 leading to an answer of 4.

(b) **Comprehensive responses**

- The term reciprocal was well understood leading to many correct answers as a fraction or a decimal.

Limited responses

- Those who were not familiar with reciprocal gave a variety of responses, most commonly 2 or $\frac{4}{1}$.

(c) **Comprehensive responses**

- Answers between 4 and 5, especially those with decimals indicated an attempt at a square root of a number between 16 and 25. A few gave correct answer using this method such as root 17.

Limited responses,

- Many responses were terminating decimals between 4 and 5, in particular 4.5, while some gave answers such as $\sqrt{4.5}$.

Question 10

Comprehensive responses

- Many candidates understood the properties of parallel lines and angles in a triangle and on a straight line and were able to identify the labelled angles correctly.

Limited responses

- The results for angles *a* and *b* were often the wrong way round while angle *c* was correct. This suggests that angles on a line and in a triangle were well understood however, some candidates needed to apply the properties of alternate angles and corresponding angles more accurately.

Question 11

(a) **Comprehensive responses**

- There was quite a good response to this part.

Limited responses

- Many felt the brackets should be round just two terms and did not consider more included.
- There were some who had two pairs of brackets, ignoring the clear instruction.
- Common errors were (–1 + 5), (5 –3) and (6 × 5).

(b) **Comprehensive responses**

- A fair number of candidates had the brackets placed correctly but not as many as for part **(a)**.

Limited responses

- A common error was to include the minus sign before 80 inside the brackets.
- Other errors were (4 – 80 + 20), (80 + 20 ÷ 10) and (20 ÷ 10).
- Most candidates did not attempt this part of the question. Candidates could improve by reviewing the required method for this type of problem.

Question 12

Comprehensive responses
- Some candidates managed to put both numbers as powers of 3 and then multiplied them correctly.

Limited responses
- While many candidates managed to write at least one of 9 and 27 as powers of 3, the step of multiplying them was usually a step too far.
- It was common to see 3^2 and 3^3 but then instead of adding the powers they left the answer as $3^2 + 3^3$.
- Multiplying 9 by 27 and giving the answer as 3^{243} was seen from a significant number, as was 81 from dividing 243 by 3. Candidates could improve by reviewing the rules for calculating with powers and the laws of indices.

Question 13

Comprehensive responses
- There were a few candidates who realised that the digit 5 was needed in the answer and had it in the second decimal place position.
- Just a few attempts were seen to write 0.0025 as $\frac{25}{10000}$ and then $\frac{1}{400}$ which could have led to the acceptable answer of $\frac{1}{20}$.

Limited responses
- Some candidates identified that 5 was part of the answer. However, answers such as 0.5, 0.05, or 0.005 were seen, indicating that candidates needed to pay closer attention when working out the correct position.
- It was quite common to see answers with the digits 25 such as 2.5, 250000 or 2.5×10^{-4}.

Question 14

Comprehensive responses
- Most candidates demonstrated a clear understanding of stem-and-leaf diagrams and completed this question successfully.

Limited responses
- Some did not appear familiar with the topic as they entered the whole numbers in the leaf section of the diagram.
- Some candidates showed the correct values but not in numerical order.

Question 15

(a) **Comprehensive responses**
- The probability of not winning was well understood and most candidates could do the simple calculation correctly.

Limited responses
- Subtracting the decimal from 1 was often given as 99.3 or (100 – 0.3) or left as 100 – 0.7.
- The given probability of winning, 0.7, was often seen as the answer.

(b) **Comprehensive responses**
- Many had the correct answer to the expected number of wins.

Limited responses
- It was clear that looking back to the stem for the probability was not done by a considerable number of candidates since responses did not include the use of 0.7.
- There was a wide variety of incorrect responses.

Question 16

Comprehensive responses
- Many candidates did the necessary first step of finding the side of the cube from the volume and most then continued to draw a correct net of the cube.
- There was little variation in the nets of correct cubes with the cross being by far the most popular.

Limited responses
- Candidates who attempted to draw nets with a side length larger than 3cm were unable to fit this on the grid. In these cases, it is good practice for candidates to check their answer as this cannot happen.
- Some candidates drew a net with only five faces, representing an open box.
- A significant number of candidates did not understand nets and attempted a 3-dimensional shape.
- Quite a few took the 8 cm^3 to indicate that a single 8 by 8 square was required.
- A few candidates omitted internal lines in their nets. Candidates can improve by ensuring all necessary internal lines are included.

Question 17

Comprehensive responses
- Many candidates used the correct formula for area of a circle and realised the diameter had to be halved, resulting in a start at finding the shaded area and some fully correct answers.

Limited responses
- Some candidates calculated their answers using a value of π.
- Some candidates used the given diameters in the formula for area and obtained answers such as 336π.
- Many candidates found both areas but did not subtract one from the other as required.
- Some did not check the formula page meaning circumference was worked out rather than area.

Question 18

Comprehensive responses
- The question was well answered with most candidates correctly and fully factorising the expression.

Limited responses
- A few candidates partially factorised the expression, taking out a factor such as 3.
- Some candidates attempted to factorise by taking $3x^2$ or 6 as a common factor, which did not lead to a complete factorisation. A small number of responses did not demonstrate understanding of the factorisation process by producing answers that were far from being factorisations.

Question 19

(a) **Comprehensive responses**
- Nearly all attempts showed understanding of the topic.

Limited responses
- Missing one of the numbers from the diagram or placing a number in more than one location.
- Some were confused between multiples and factors as some included multiples greater than 12 on the diagram.
- A significant number thought they only had to enter the numbers inside the circles.

(b) **Comprehensive responses**
- A small number of candidates were familiar with the notation $n(A \cap B)$.

Limited responses
- Most candidates gave the list of numbers in the intersection or made no response.

Question 20

Comprehensive responses
- Most candidates were clearly familiar with solving simultaneous equations, mostly by elimination, but this was a particularly demanding question with so many negatives in the question

Limited responses
- Some candidates made errors when deciding whether to add or subtract equations, particularly when working with negative signs.
- When multiplying to make the coefficients of x or y equal signs were often placed incorrectly.
- Some candidates using the substitution method encountered difficulties when working with a denominator in the substitution, leading to errors in their solutions.
- $-4 \div -2$ was often found to be -2, spoiling an otherwise promising solution.

Question 21

(a) **Comprehensive responses**
- Many candidates identified the transformation correctly and a considerable number of them found the centre correctly.

Limited responses
- It was extremely rare to see a correct scale factor with 3 or –3 often seen or no attempt made at all.
- Some transposed the coordinates of the centre with (1, –5) seen.
- Few candidates identified more than one transformation, and responses with incorrect transformations, translation and rotation were seen.

(b) **Comprehensive responses**
- There were quite a number who managed to draw a correct image.

Limited responses
- Some rotated the triangle around the wrong centre of rotation or rotated the wrong triangle.
- Some candidates drew more than one triangle in their response.
- A few had the right idea although at least one of the vertices on their image was beyond reasonable accuracy.

(c) **Comprehensive responses**
- Some candidates found all 3 points correctly, while others had the right idea although made arithmetic slips, for example (11, 10) or (16, 1), which were often seen.

Limited responses
- Many did not make any attempt at this part of the question.
- The point (7, 4), common to object and image, was often the only point of the three correct.
- Some gave answers for, or showed an attempt at, a reflection in the line $y = 7$.

Question 22

(a) **Comprehensive responses**
- Most candidates were familiar with expanding brackets and there were many fully correct solutions.

Limited responses
- The common errors were adding 5 and 3 instead of multiplying them and having 11 instead of $11x$ for the addition of $5x$ and $6x$ or simply missing the x on one of these terms.
- A small proportion of candidates did not understand how to start this question or they produced answers which were not close to the three term form expected.

(b) **Comprehensive responses**
- The few successful solutions almost entirely came from splitting the shape into rectangles.

Limited responses

- Only a tiny number used the result of part **(a)** in order to work out a solution from subtracting the areas of the two rectangles.
- Very few candidates managed to work out the remaining two sides of the shape in order to calculate two areas of rectangles and then add them.
- Many did not attempt this part of the question or tried a calculation involving perimeters.

Question 23

Comprehensive responses

- The bounds question was answered correctly by some candidates.

Limited responses

- Some candidates combined decimals and mixture of units in their response.
- Most were reluctant to write an answer with 2 decimal places.
- A small proportion changed to centimetres but only gained one mark for a 'correct' answer if they did not change back to metres.
- Another small proportion gained a mark for one correct or both correct but reversed.

Question 24

(a) **Comprehensive responses**

- Many candidates could either correctly change kilometres to centimetres or correctly change a large number to standard form. Few candidates got both parts correct.

Limited responses

- Incorrect responses using the figures 25 (provided ≥ 25) were often 'correctly' converted to standard form while a correct value was often left as the answer with no conversion attempted.
- Little or no working was common which meant the two stages of multiplying by 1000 and then by 100 were not thought out clearly.

(b) **Comprehensive responses**

- While the same comments apply as to part **(a)** candidates can improve by practising the required manipulation negatives indices.
- A small proportion of candidates did work through to a fully correct answer.

Limited responses

- Many responses as numbers or in standard form were greater than 30 from multiplying by powers of 10. Candidates can improve by showing understanding of the relation between cubic centimetres and litres.
- A quite significant number of responses did not have an answer with the digit 3 preceded or even followed by zeros.
- There was a high proportion of no responses to this part.

Question 25

Comprehensive responses

- Those who understood 'writing to one significant figure' usually rounded two of the numbers correctly.
- Candidates well practised on this type of question often made arithmetic slips due a decimal number being involved, even when using correct cancelling before multiplication.

Limited responses

- Incorrect rounding was common, particularly 0 or 4 for 0.43 while the other numbers were very often rounded to 2 significant figures.
- Some candidates did no rounding as instructed leading to lengthy calculations.

Question 26

Comprehensive responses

- This regular multiplication of mixed numbers question was well answered with many correct solutions.

Limited responses

- Changing mixed numbers to improper fractions was well done although many candidates used careless cancelling or multiplication.
- While a correct improper fraction was often seen, the final step of cancelling to the whole number was incorrect or left the whole number answer as a fraction with denominator of 1.

Question 27

(a) **Comprehensive responses**

- It was clear from a large majority of responses that solving linear equations was a topic understood. Unfortunately that was not the question.

Limited responses

- While most candidates identified the correct wrong line, almost all indicated that the +2 had to be subtracted first and did not consider the error made in a correct method of multiplying by the denominator 5.
- Some gave other lines as incorrect, even line *A* which was just the question.
- A significant proportion did not attempt this question.

(b) **Comprehensive responses**

- A more straightforward question to end the paper was done quite successfully by those who attempted it.

Limited responses

- Many incorrect responses gave the reciprocal of the correct answer.
- Another common error was to bring a square root into the answer since a squared term was in the formula.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/22
Non-calculator (Extended)

Key messages

What candidates did well

- Candidates usually showed clear method and full working on questions worth multiple marks.
- Most candidates had secure algebraic manipulation skills across a range of questions and levels.
- Many candidates have sound basic skills such as knowledge, probability, transformations and many of the number topics such as writing numbers in standard form, percentages, ratio and simplifying surds.
- Many candidates had good knowledge of mathematical terminology, both when reading and answering the question.

What candidates needed to improve

- Working should be presented in a logical order so that it is clear to see the method being applied.
- Incorrect working should be crossed out rather than erased or written over.
- Candidates should check calculations carefully to avoid simple arithmetic errors.
- Candidates should check the common sense of their answers for example the total cost of the tickets in **Question 5(b)** should not have been lower than the cost of one ticket.
- Candidates should practice non-calculator methods to make calculations simpler for example increasing something by 5% is not easy on a non-calculator paper as multiplying by 1.05 it is easier to find 10% by dividing by 10 then halve that to find 5% then add.
- Interpreting a factorised cubic equation to form a sketch showing the intercepts was not done well, particularly interpreting the repeated root.
- Candidates would benefit from more practice of using methods other than the formula to solve quadratics, particularly in preparation for a non-calculator paper, for example **Question 18(b)** was much more successfully solved by those completing the square and **Question 19(b)** was much more successfully solved by those factorising.
- Candidates would benefit from more practice on understanding of the symmetry of quadrilaterals.
- Questions involving Venn diagrams and set notation need further practice.
- Candidates would benefit from practicing finding the most efficient methods for solving right-angled trigonometry questions.
- Care needs to be taken with clarity when writing expressions and equations, for example in **Question 18(a)** many candidates wrote the letter *r* to be almost identical to π.

Comments on specific questions

Question 1

(a) **Comprehensive responses**

- Many candidates correctly answered this question usually with little or no working shown.
- Some used fractions so $\frac{7}{10} \times \frac{7}{10} = \frac{49}{100}$ and then they correctly converted this to a decimal.

Limited responses

- Some completed the multiplication correctly then inserted the decimal point in the incorrect place giving answers such as 4.9 or 0.049.
- Some misinterpreted 0.7^2 as 0.7×2 or $0.7 + 0.7$ and gave either the answer 1.4 or 0.14.

(b) **Comprehensive responses**

- Successful responses showed working such as writing as a fraction $\frac{2}{0.04}$ then multiplying both the denominator and the numerator by 100 to give $\frac{200}{4}$ leading to an answer of 50.
- Some converted 0.04 to $\frac{4}{100}$ and changed $2 \div \frac{4}{100}$ to $2 \times \frac{100}{4}$ to reach $\frac{200}{4}$ leading to an answer of 50.

Limited responses

- Some attempted a type of long division of 2 ÷ 0.04 and usually gave an answer of 5.
- Some found 2 ÷ 4 = 0.5 then adjusted the wrong way so instead of multiplying by 100 they divided by 100 to reach 0.005.
- A few did the division the wrong way round, writing 0.04 ÷ 2 = 0.02.

Question 2

(a) **Comprehensive responses**

- Many candidates indicated that a parallelogram had a rotational symmetry of order 2.

Limited responses

- Most candidates indicated that a parallelogram had 1, 2 or 4 lines of symmetry rather than 0.
- A few candidates indicated that a parallelogram had order of rotational symmetry of 0, 1 or 4.

Question 3

(a) (i) **Comprehensive responses**

- Many candidates chose the prime number.

Limited responses

- The most common incorrect response was –11.

(ii) **Comprehensive responses**

- Almost all candidates could identify the cube number.

Limited responses

- A few candidates thought 9 was a cube number.

(iii) **Comprehensive responses**

- Many candidates wrote down the correct factors.

Limited responses

- Some candidates chose 50 and – 50, or 50 and –11 or 50 and 15 or gave 50 and 11 when 11 was not in the list.

(b) (i) **Comprehensive responses**

- Most candidates correctly identified the probability.

Limited responses

- A few candidates gave an incorrect fraction, although it usually had 7 in the denominator.
- Choosing the negative numbers to give $\frac{2}{7}$ and choosing all the numbers to give 1 were the most common incorrect answers.

(ii) **Comprehensive responses**

- Most candidates understood expected value and gave the correct answer.
- Those who made an error in **Question 3(b)(i)**, often correctly followed through from this.

Limited responses

- A few candidates did not fully process their answer to give a whole number for example leaving the answer as $\frac{700}{7}$.
- Some candidates gave their answer as a fraction out of 140.

Question 4

Comprehensive responses

- Most candidates successfully simplified the first term to give the correct answer.
- Some candidates factorised their answer correctly to $a(2a+3)$.

Limited responses

- A small number simplified the expression correctly then spoilt their answer by thinking the terms could be collected, giving a common incorrect answer of $5a^2$.
- Others obtained the correct answer in their working then made a transcription error to the answer line which is not permitted in algebra questions.

Question 5

(a)

Comprehensive responses

- Most candidates correctly divided each term of the ratio by 6 or in stages by dividing by 2 and then by 3.
- Division by 3 and by 2 was often more successful than a single division by 6.

Limited responses

- Some candidates indicated their intention to divide each term by 6, or in parts by 3 and by 2, then made an arithmetic error in one or more of the calculations, usually when dividing 72 by 6.
- Some attempted to make one of the ratios equal to 1 not appreciated that ratios in simplest form do not contain decimals.
- Some candidates simplified the ratio by dividing by an integer other than 6 and had decimals or fractions in their final ratio.
- A small minority divided all numbers by (30 + 24 + 72).

(b)

Comprehensive responses

- Most found the cost of 2 stall tickets and 3 circle tickets correctly.
- Some found 5% of the cost using an efficient non-calculator method such as finding 10% and then half of that.
- Some candidates found the tax on each type of ticket separately and then added up the ticket costs and the tax costs.

Limited responses

- Some found the cost of 2 stall and 2 circle tickets instead of 3 circle tickets.
- Candidates who used a method more suitable to calculator use such as 1.05×132 were more likely to make arithmetic errors or place value errors.
- Some candidates thought that 5% of the cost of each ticket equated to 10% of the cost of two tickets rather than 5% of the cost of two tickets.
- Some candidates subtracted the fee from the total cost instead of adding it to the total cost.
- Some candidates used the incorrect multiplier 0.5 instead of 0.05 to find 5%.
- Some answers were clearly just the fee of $6.60 and there was an omission of the ticket costs.
- Some candidates attempted to use fractional methods such as $\frac{5}{100} \times 24$ which often resulted in arithmetic slips when cancelling.

(c) **Comprehensive responses**

- The most successful method was to split the problem into two parts, first finding the number of seats sold in the stalls by doing $\frac{5}{6} \times 1200$ before using the ratio aspect of the question.
- Some used an efficient method to do the calculations, usually dividing by 6 first and then multiplying by 5.
- The 10 : 7 ratio was understood by many to be equivalent to $\frac{7}{10}$ and most first divided by 10 and then multiplied by 7.

Limited responses

- Some correctly found the number of seats sold in the stalls as 1000 and made no further progress.
- Some candidates treated the 1000 as the total number of stalls and circle seats and attempted to find $\frac{7}{17}$ of 1000.
- Some thought they were using the total number of seats and not the number of sold seats, so they found $\frac{7}{10}$ of 1200.
- Some candidates found $\frac{1}{6}$ of 1200 or they completed their solution with 1200 – 1000, both giving the answer of 200.

Question 6

Comprehensive responses

- Some candidates found the correct answer by forming equations with the unknowns and solving by use of algebraic techniques.
  For example,
  $a + b + c + d = 40 \rightarrow d - a = 12 \rightarrow d = a + 12$
  Then
  $\frac{b + c}{2} = 13 \rightarrow b + c = 26$
  Substituting into the first equation $a + 26 + a + 12 = 40 \rightarrow a = 1$ *so* $d = 13$
  Reasoning b and c must be ≤ 13 and sum to 26 $\rightarrow b = 13$ and $c = 13$
- Some candidates used some equations to narrow down the range of values and reasoning skills to choose the correct answer.

Limited responses

- Most candidates used trial and improvement to find answers that fulfilled some of the three criteria. Most regularly seen were values which had a range of 12 and a median of 13, the most common of which were 2 13 13 14 or 2 12 14 14 .
- Many candidates gave values with a correct total of 40, values 1 12 13 and 14 being a common response here, although many wrote them in the order 1 12 14 13 thinking they had given a median of 13 and a range of 12.
- Some candidates did not give 4 values.
- Quite a few candidates did not offer any response.

Question 7

(a) **Comprehensive responses**

- The minority of candidates who realised the required line was vertical wrote the correct answer with no working necessary.

Limited responses

- Most candidates thought the equation should be in the form $y = mx + c$, not remembering the simpler form of equation for lines parallel to the axes. Most common among these was

misinterpreting the gradient of the given line (y = 2) as 2 and so obtaining a line with perpendicular gradient $-\frac{1}{2}$.

- Also common was using –1 as the gradient.
- Some recognised the given gradient was 0 and were unable to proceed beyond attempting $m_2 = -\frac{1}{0}$.
- Others decided the gradient should be 0 and so obtained the incorrect answer y = 5 using the given point.

(b) **Comprehensive responses**

- Some candidates realised that the given $y = 2$ should be substituted into the line $y = 20 – 6x$ and were able to solve the equation, showing clear working, to find both coordinates correctly.

Limited responses

- Some used the given $y = 2$ to write $(k, 2)$ to obtain one correct coordinate and then stopped or showed no working for their incorrect value for the x-coordinate.
- Many made slips when solving $2 = 20 – 6x$ often incorrectly dealing with the negatives after reaching $–18 = –6x$.
- A few made an arithmetic error when dividing 18 by 6.
- Some incorrectly simplified $2 = 20 – 6x$ to $22 = 6x$.
- Some candidates used $y = 5$ from the given point in part **(a)**, instead of $y = 2$ from the given line L, so reaching an incorrect pair of coordinates.
- Others attempted to solve simultaneously the given equation $y = 20 – 6x$ with their answer from part **(a)**, confusing this for given line L.
- A few found where the line crossed the x-axis by solving the equation $20 – 6x = 0$.
- Occasionally the coordinates were reversed.
- There were a lot of candidates who offered no response to this question.

Question 8

Comprehensive responses

- Many candidates correctly listed all 4 integers in the given interval.

Limited responses

- Some candidates gave three of the four correct integers, with –3 being a common omission.
- Some candidates did not realise that 0 was an integer.
- A small number included 1 in their list.
- Some candidates gave an answer of just one integer in the range, rather than all integers in range.

Question 9

Comprehensive responses

- Candidates often began by drawing a horizontal line to split the trapezium into a rectangle and a right-angled triangle.
- Most of these then correctly identified the vertical height of the triangle as 21 — 15.
- Candidates correctly applied Pythagoras to find the length of the sloping side as 10 cm.
- Many then successfully added 10 cm to the sum of 8, 15 and 21 to obtain 54 cm.

Limited responses

- Some did not realise they could use Pythagoras' theorem to find the length of the sloping side.
- A few made arithmetic errors following $\sqrt{8^2 + 6^2}$, often in finding 8^2 so that they did not reach the square root of a square number.
- A small minority made errors in the addition of the four numbers.
- A few included two lengths of 8 cm in finding the perimeter.
- The calculation 21 – 15 was very occasionally processed incorrectly.
- Some calculated the area of the trapezium.
- A few just added the three given sides and so a common incorrect answer was 44.

Question 10

Comprehensive responses
- Almost all candidates attempted to create an algebraic equation to solve.
- The most successful candidates drew a diagram to assist in their solution.
- Following a correct diagram many candidates applied knowledge of angle rules with parallel lines to correctly form an equation such as $2x + 50 – 60 = 180$ or $2x + 50 + 120 = 360$.
- Most candidates could correctly isolate x from their equation and solve to find x even if their initial equation was not correct.

Limited responses
- Many candidates started with an incorrect equation, the most common being 2x + 50 + 60 = 360 and 2x + 50 + 60 = 180.
- Many candidates did not do a diagram to help.

Question 11

(a) (i) **Comprehensive responses**
- Almost all candidates correctly drew the translation.

Limited responses
- A small minority of candidates could not interpret the negative signs, or miscounted.

(ii) **Comprehensive responses**
- Many candidates correctly drew the reflection.

Limited responses
- Quite a few candidates reflected in either the y-axis or the x-axis.
- Some candidates drew a rotation of 180°, with the centre of rotation either at (0, 0) or (1, 1) or (0, 1).
- It was common to see a reflection drawn with the line of reflection at $y = x + 1$.

(b) **Comprehensive responses**
- Most candidates understood the requirement to give the angle and direction of rotation, along with the centre.

Limited responses
- Some candidates did not fully describe the transformation.
- Some candidates thought that the rotation was 90° anticlockwise and some did not give any direction.
- The centre of rotation was sometimes incorrect, with common incorrect points being (–2, 6), (– 2, 5) or (–2, 4).
- A small number of candidates gave more than one transformation.

Question 12

(a) **Comprehensive responses**
- This was correctly answered by the majority of the candidates.

Limited responses
- A few did not multiply a power of 10 by a value between 1 and 10, for example a common incorrect answer was 23×10^4.
- The most frequent error was to give a power of –5 rather than 5.
- Other common incorrect answers were to miscount the number of zeros evident in answers such as 2.3×10^4.

(b) **Comprehensive responses**
- Many correctly amended the terms so that the powers of 10 were the same value in order to answer this question.
- A small number factorised to form calculations such as $10^{31}(4.2 \times 10 – 4.2)$ or $(4.2 \times 10^{31})(10 – 1)$.

Limited responses

- Quite a few candidates made arithmetic errors when subtracting 0.42 from 4.2.
- Sometimes the powers of 10 were not adjusted correctly, for example 4.2×10^{31} becoming 42×10^{32} instead of 0.42×10^{32}.
- A few candidates reached an answer including the figures 378 with an incorrect power of 10.
- A small number of candidates wrote out the question in nonstandard form, with lots of zeros and tried to subtract, usually making place value errors.
- A small number of candidates added instead of subtracting.
- A small number of candidates had the misunderstanding $10^{32} - 10^{31} = 10^{1}$ in their working.

(c) **Comprehensive responses**

- A few candidates were able to amend 80×10^{50} to 8×10^{51} in order to reach an expression where both parts could be cube rooted.

Limited responses

- Most candidates did not realise they needed to amend the terms to allow cube rooting to take place.
- A common misinterpretation was not to cube root both parts, giving an answer such as 8×10^{17} or 2×10^{51}.
- Some candidates wrote an answer such as $8^{\frac{1}{3}} \times 10^{\frac{51}{3}}$ misinterpreting standard form.
- Occasionally the power of $\frac{1}{3}$ was thought to be the same the same as a power of –3.
- Quite a few candidates offered no response to this question.

Question 13

(a) **Comprehensive responses**

- A few candidates expressed the empty set using the correct set notation, namely Ø or { }.

Limited responses

- Many candidates gave the incorrect answer 0.
- Some candidates used incorrect notation for the empty set, such as {Ø} or ( ) or used words, rather than set notation, such as 'nil', 'null' or 'empty'.
- Some candidates thought that there were some elements in this set.

(b) **Comprehensive responses**

- A small number of candidates had the correct answer of 9.

Limited responses

- A small number correctly listed the 9 elements of the set, without stating the number of elements.
- Some candidates appeared to be giving what they thought were the elements of the set rather than the number of elements in the set.
- Quite a few candidates offered no response to this question.

Question 14

Comprehensive responses

- Many candidates showed an understanding of the formula for the total interior angles in a polygon.
- Some candidates found the correct value of $x = 15$ by considering the triangle *BCD*. These generally went on to complete the question correctly.
- Many candidates correctly used their value for x in a formula for the total interior angles in a polygon.
- Using $\frac{360}{180-(135+15)}$ was more successful than using $\frac{180(n-2)}{n} = 135 + 15$.

Limited responses

- Many thought that 135 was the interior angle of the polygon and equated that to $\frac{180(n-2)}{n}$.
- Some candidates started with an incorrect equation of 135 + x = 180.
- Some candidates understood that 135 + x was the size of one interior angle in the polygon and equated it to the correct formula, these candidates attempted to solve this equation with two unknown values.
- Few candidates tried to complete without finding the value of x.
- Some candidates found rearranging $\frac{180(n-2)}{n}$ = 135 + 15 challenging. Candidates are advised that dividing 360 by the exterior angle was almost always the more successful method.
- Some had complicated attempts involving setting up and solving simultaneous equations in the two unknowns, x and n, which were occasionally successful.

Question 15

Comprehensive responses

- Most candidates recognised the need to find a common value for each root.
- The majority of candidates saw that 10 was a factor of both surds and could write them as $\sqrt{4\times10}$ and $\sqrt{16\times10}$.

Limited responses

- Following a correct start of $\sqrt{4\times10}$ and $\sqrt{16\times10}$, some candidates then wrote $4\sqrt{10}$ and $16\sqrt{10}$.
- A few candidates used a common root of 40 to give an answer of $3\sqrt{40}$ and did not appreciate that this could be simplified further.
- $2\sqrt{10} + 2\sqrt{40}$ was often seen, indicating that the candidate did not fully understand the need to create surds with the same root value in order to combine.
- Quite a few candidates thought $\sqrt{40} + \sqrt{160} = \sqrt{40+160}$ so $\sqrt{200}$ was often seen and $10\sqrt{2}$ was sometimes seen.
- $2\sqrt{5} + 4\sqrt{5}$ followed by $6\sqrt{5}$ as an answer was sometimes seen.

Question 16

(a) **Comprehensive responses**

- Many candidates found the correct values of 35 and 105.

Limited responses

- Some candidates found either 35 or 105 correctly, 105 was more commonly correct than 35.
- A common error was to think x was 75.
- Sometimes y was thought to be 75.

(b) **Comprehensive responses**

- Some candidates gave a complete reason using the correct geometric language, including the terms ‘angle’, ‘centre’ and ‘circumference’.

Limited responses

- Many candidates did not use the correct geometrical language for ‘circumference’, instead using the words ‘edge’, ‘perimeter’ or ‘on the circle’.
- Some candidates wrote down calculations rather than using geometrical language.
- A small number of candidates gave the definition of an obtuse angle rather than explaining why the angle was 150°.

(c) **Comprehensive responses**

- Some candidates found the correct value for the area of the major sector, leaving their answer in terms of π.
- Most candidates were able to give their answer in its simplest form in terms of π.

Limited responses

- The most common error was to find the area of the **minor** sector; this answer was usually given in its simplest form of 15π.
- A small number of candidates found an arc length, rather than the area, of the major or the minor sector.

Question 17

(a) **Comprehensive responses**

- Some candidates were able to write that $cos30 = \frac{12}{AC}$ and to rearrange this equation to make AC as the subject.
- Some candidates were able to state that cos 30 was equal to $\frac{\sqrt{3}}{2}$.
- A few candidates were able to simplify $\frac{12}{\frac{\sqrt{3}}{2}}$ often by writing it as $12 \times \frac{2}{\sqrt{3}}$.
- A small number were able to rationalise the denominator of the surd $\frac{24}{\sqrt{3}}$ to reach the required form by multiplying the numerator and denominator by $\sqrt{3}$.

Limited responses

- Quite a few candidates were not able to correctly process $\frac{\sqrt{3}}{2} = \frac{12}{AC}$ to reach AC in the required form.
- Some used an inefficient method such as sin 30 or tan 30 in an attempt to find AB and from there to find AC using further trigonometry or Pythagoras' theorem.
- Some used an incorrect value for cos 30 in the correct equation.
- Some attempted to use the cosine rule in the triangle to find one of the unknown sides.
- Quite a few found the length of AB and gave this as the answer for AC.
- It was common to see $AC = 12 \times \frac{\sqrt{3}}{2} = 6\sqrt{3}$.
- Quite a few candidates were not able to correctly rationalise the denominator of the surd, as a result the answer was often $\frac{24}{\sqrt{3}}$.

(b) **Comprehensive responses**

- Many candidates realised that they needed to work out the perpendicular distance from B to AC and they marked the angle at the line with a right-angle symbol.
- Some candidates realised BC was the hypotenuse of the right-angled triangle formed.
- Some used sin 30 to find the length and also knew that sin 30 = $\frac{1}{2}$, they usually correctly evaluated the required length.

Limited responses

- Many realised that they needed to work out the perpendicular distance from B to AC then they were unable to find the required length with a correct method.
- Quite a lot of candidates drew a line from B to AC and assumed that it bisected the angle at B so the other two angles were given as 45° and 105°, then the sine rule was often attempted.
- Candidates did not always appreciate the sine rule with an angle of 105 was not going to be a correct method as that is not a result they are expected to know on a non-calculator paper.
- Some had the correct triangle then they did not use BC as the hypotenuse.
- Some candidates made the solution more demanding by using the sine rule or, very demanding by using the cosine rule which required one further side to be found.

- A small number used an area method approach and wrote $\frac{1}{2} \times 8\sqrt{3} \times h = \frac{1}{2} \times 12 \times 8\sqrt{3} \times \sin 30$ which was not always as successfully completed.

Question 18

(a) **Comprehensive responses**

- Many candidates systematically developed an expression for each surface area and equated them. For example:
  Total surface area of the cone $\pi r^2 + \pi rl = \pi r^2 + \pi r \times 12$
  Total surface area of the hemisphere $\frac{4\pi \times 4^2}{2} + \pi 4^2 = 32\pi + 16\pi$
  Combining to $\pi r^2 + \pi r \times 12 = 48\pi$

- Many candidates then simplified the equation they created by substitution and manipulation of the terms using mathematical processes resulting in the required result.
  That is $\pi r^2 + \pi r \times 12 = 48\pi$
  Then $r^2 + 12r = 48$
  Finally $r^2 + 12r - 48 = 0$

Limited responses

- Some candidates used an incorrect formulae for the base circle area for the hemisphere such as $2\pi \times 4$.
- Some candidates only partially divided by π such as, $r^2 + \pi r \times 12 = 32 + 16$.
- A few candidates assumed r = 4 applied to the cone as well as the hemisphere giving, $\pi r 4^2 + \pi r \times 12 = \frac{4\pi \times 4^2}{2} + \pi \times 4^2$ leading to $\pi r \times 12 = \frac{4\pi \times 4^2}{2}$.
- Some candidates missed out the circle bases altogether for each shape.
- Some candidates incorrectly eliminated πr^2 from both sides of the initial expression not realising the radius was different for the shapes, so $\pi r^2 + \pi rl = \pi r^2 + \pi r \times 12$ then $\pi rl = \pi r \times 12$.

(b) **Comprehensive responses**

- Many candidates were able to reach $\frac{-12 \pm \sqrt{336}}{2}$ after correctly using the quadratic formula to solve the equation.
- A few were able to simplify the fractional result $\frac{-12 + \sqrt{336}}{2}$ to a correct mixed surd.
- A small number of candidates used the most efficient method of completing the square following $(r + 6)^2 = 84$ with $r = -6 \pm \sqrt{84}$ which was then more successfully simplified to the required form to reach the correct positive value of r.

Limited responses

- Quite a few candidates missed the negative sign in $-b$ when using the quadratic formula so $\frac{12 \pm \sqrt{12^2 - 4 \times [1] \times -48}}{2}$ was commonly seen.
- A common error was to incorrectly evaluate their quadratic determinant by producing 144 – 192 instead of 144 + 192.
- A common error was to incorrectly simplify their fraction created by the quadratic formula by only dividing one of the numerator terms by the denominator instead of both, for example $\frac{-12 \pm \sqrt{336}}{2} = -6 \pm \sqrt{336}$.
- Some attempted to divide $\sqrt{336}$ by 2 as well, often incorrectly such as

$\frac{-12 \pm \sqrt{336}}{2} = -6 \pm \sqrt{168}$.

- Quite a few candidates offered no response to this question.

Question 19

(a) **Comprehensive responses**

- Many candidates were able to subtract the values in the coordinates in the correct order.

Limited responses

- A common error was to subtract the values in the coordinates in the wrong order, resulting in the answer $\begin{pmatrix} 8 \\ 4 \end{pmatrix}$.
- Some used addition, resulting in the answer $\begin{pmatrix} 0 \\ 10 \end{pmatrix}$.
- Some made arithmetic errors when dealing with the negative value.
- It was common to see partially correct answers such as $\begin{pmatrix} -8 \\ 4 \end{pmatrix}$ or $\begin{pmatrix} 8 \\ -4 \end{pmatrix}$ where one subtraction was the right way round and the other subtraction was the wrong way round.

(b) **Comprehensive responses**

- A few candidates recognised the need to use Pythagoras' theorem to find the distance between *A* and *C* and to equate that to the given length.
- Some evaluated $(4\sqrt{10})^2$ correctly to 160.
- Some manipulated the equation correctly to form a three-term quadratic which was then solved either by factorisation or correct use of the quadratic formula, usually more successfully solved by factorising.
- Some found the horizontal distance of 12 using Pythagoras' theorem and then used -4 ± 12.
- Successful candidates often drew a sketch to help understand the question.

Limited responses

- Many added the coordinates rather than subtracting.
- Many made an error with the negative sign and so $(x - 4)^2$ was very common, often alongside the correct subtraction of $(7 - 3)$.
- Some expanded the brackets within the equation incorrectly, the most common error seen was $(x + 4)^2 = x^2 + 16$.
- Of those who reached the correct quadratic $x^2 + 8x - 128$ there were often errors when attempting to solve this using the formula it was common for there to be arithmetic errors reaching and square rooting 576.
- Some dealt with the $4\sqrt{10}$ incorrectly with a common error being to only square the $\sqrt{10}$ instead of both the 4 and the $\sqrt{10}$, so 40 was a common result of $(4\sqrt{10})^2$.
- Quite a few candidates offered no response to this question.

(c) **Comprehensive responses**

- Most candidates were able to find the gradient of the line *AB* and use that to write down the required perpendicular gradient.
- A small number of candidates used the ratio correctly to find the coordinates of *D* which was then substituted correctly.
- Successful candidates often drew a diagram to help understand the situation.

Limited responses

- Most were unable to find the correct coordinates of the point *D*.

- Some made the correct start of finding $\frac{3}{4}$ of the distance between *A* and *B* from **(a)** and then used $\begin{pmatrix} 6 \\ 3 \end{pmatrix}$ incorrectly to reach *D* as either (6, 3) or (–6, –3), rather than adding the distances to the coordinates of *A*.
- Many candidates used the midpoint of *AB* as *D*.
- Many candidates used one of the given points as *D*, most commonly point *B*.
- Some made errors in calculating the required gradient, often with the negative value involved.
- A few did not understand the relationship between the gradients of perpendicular lines and used the original gradient in the equation.
- A few candidates tried to use a scale diagram to find the required point which usually did not have the required accuracy.
- A lot of candidates offered no response to this question.

Question 20

(a) **Comprehensive responses**

- Many candidates were successful on this question and typically worked in stages, either removing the brackets to apply the power $-\frac{2}{3}$ to the two parts of the product or dealing correctly with the negative power to write as '1 over'.
- Depending on their approach candidates either had $\frac{1}{9}$ or x^{-6} appearing in their working early on usually leading to the answer in one of the expected forms.

Limited responses

- Usually the negative power was applied correctly to the x^9 to give x^{-6}, or x^6 in the denominator.
- A small number of candidates left 3^2 (or 3^{-2}) in their answer rather than simplifying to 9.
- Some candidates managed to apply the fractional power to 27 to reach 9 then did not deal with the negative to put the 9 in the denominator.
- When writing algebraic terms involving fractions candidates must ensure clarity in their writing to avoid ambiguity, for example, with $\frac{1}{9x^6}$ appearing as $\frac{1}{9}x^6$ or $1/9\,x^6$, or $\frac{1}{6}x^{-6}$ appearing as $\frac{1}{9x^{-6}}$.
- When dealing with simplifying 27 and x^9 separately, care needs to be taken when recombining as often this led to the negative aspect of the index to be forgotten.
- Some candidates did not apply the brackets correctly, which led to only simplifying the power of *x*.

(b) **Comprehensive responses**

- Most candidates managed to reach the correct answer on this part, giving their answer usually as $\frac{2}{5}$ or less commonly as 0.4.
- Typically they realised 49 was 7^2 and correctly simplified and equated the powers to form a linear equation which they could usually then solve.
- A small minority of candidates used $7 = 49^{\frac{1}{2}}$ to get in terms of base 49.

Limited responses

- Some candidates, having successfully reached a correct linear equation, made arithmetic errors in solving their equation.
- A common error was treating or misreading 7^x on the left as 7^2 when equating powers.
- Some candidates equated the powers as given in the question, taking no account that they were not powers of the same base.

- $5x = 2$ was frequently incorrectly followed by the answer $x = \frac{5}{2}$ or 2.5.
- A small number of candidates attempted to solve by trialling specific values, this strategy rarely worked as an approach as the solution was not an integer (which they frequently trialled).
- A few candidates offered no response to this question.

Question 21

Comprehensive responses

- Many candidates correctly factorised both the numerator and the denominator.
- Many successful attempts split the x terms of the numerator to $2x^2 + 8x – 5x – 20$ which led to $2x(x + 4) – 5(x + 4)$ and the denominator to $a(x + 4) – 3b(x + 4)$ which led to $(a – 3b)(x + 4)$.
- If correctly factorised almost all then cancelled the common factor of $(x + 4)$ in the numerator and denominator.

Limited responses

- Many were unable to correctly factorise the numerator often resulting in two brackets of the form $(x + a)(x – b)$ rather than $(x + a)(2x – b)$.
- A common attempt to factorise the numerator would be $x(2x + 3) − 20$.
- Candidates tried to use the quadratic formula to solve the numerator or factorise the numerator resulting in factors with fractions or decimals such as $(x – 2.5)(x + 4)$.
- In factorising the denominator, there would be an inconsistent common factor caused by the negative sign outside the second bracket, so they would write, for example, $a(x + 4) – 3b(x − 4)$.
- Candidates factorised the denominator and left the numerator unfactorised.
- Having completed both factorisations successfully, a small number of candidates did not cancel the $(x + 4)$ factor.
- Some candidates attempted to cancel a common factor whilst having only a partial factorisation of the denominator.
- It was common to see cancelling taking place in the same stage as the factorisation.
- Some would cancel the x's before collecting like terms.

Question 22

(a) **Comprehensive responses**

- Candidates who expanded the two brackets correctly usually continued to reach a correct final simplified answer.
- Almost all candidates could correctly expand at least two brackets.

Limited responses

- Some candidates expanded and simplified two brackets correctly, and then made an error when multiplying by the third bracket.
- Some candidates obtained a correct unsimplified answer, and then made an error when simplifying, such simplifying the two terms $–3x^2 + 2x^2$ to x^2.
- Some candidates expanded two brackets by writing four correct terms, then made an error when simplifying the four terms before multiplying by the third bracket, this error was most commonly $– 3x – 3x = – 9x$.
- Candidates expanded $(x – 3)^2$ as $x^2 + 6x + 9$ or as $x^2 – 6x – 9$.
- Quite a few candidates changed $(x – 3)^2$ in to $(x – 3)(x + 3)$ rather than $(x – 3)(x – 3)$.
- Some candidates omitted terms when multiplying their quadratic expression (the result of multiplying two brackets) by the remaining bracket.
- A small number of candidates attempted to expand all three brackets in one go resulting in an expression that was not cubic.

(b) **Comprehensive responses**

- Many candidates were able to sketch a positive cubic curve with a minority also able to add labels for some or all of the intersection points correctly.

Limited responses

- Many candidates sketched a positive cubic that crossed the y-axis at 45 only, and labelled a root at 3 or –5, sometimes both, usually no repeated root was indicated.
- Some candidates sketched a negative cubic with a correct intercept on the y-axis, and a correct labelled root at 3 or –5.
- Some candidates sketched a positive cubic with roots at –5, 3 and 5, or –5, –3 and 3.
- Candidates drew a positive or negative cubic and didn't label an intercept on the y-axis or any roots.
- Some candidates labelled the axes with some numbers or wrote a table of values and did not sketch a curve.
- Some candidates sketched a positive or negative quadratic with a correctly labelled root only.
- Some candidates did not label the values of the intercepts on the axes of their graphs.
- A few candidates offered no response to this question.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/32
Calculator (Core)

Key messages

What candidates did well
- Many candidates demonstrated expertise with the content and presented their solutions well.
- Questions requiring the direct application of mathematical processes were usually answered well.
- Diagrams were usually drawn well using the correct equipment.

What candidates needed to improve
- Candidates need to show formulae used, substitutions made and calculations performed.
- Candidates need to recognise the mathematics involved in a multistage question and then to set out the working clearly.
- Candidates need to give their answer to the required degree of accuracy.

Comments on specific questions

Question 1

Comprehensive responses
- Many candidates gave the correct answer.

Limited responses
- Few used incorrect words such as eighty, hundred and seventy.

Question 2

Comprehensive responses
- Many candidates gave an area in the accepted range.

Limited responses
- Some candidates multiplied the straight sides of the shape 6×4 or the whole grid 8×6.
- Some candidates only counted the number whole squares within the shape.

Question 3

Comprehensive responses
- Some candidates drew an accurate and complete diagram.

Limited responses
- Some drew an incomplete diagram, often with 1 or 4 correct lines.
- A few added incorrect lines.

Question 4

Comprehensive responses
- Many candidates gave the correct answer, usually by working in stages.

Limited responses

- Few made arithmetic errors in the multiplication, addition or subtraction.

Question 5

(a) **Comprehensive responses**
- This question was answered correct by nearly all candidates.

Limited responses
- A small number of candidates needed to provide the required steps in the working of rounding their answer to 46 or 46.4.

(b) **Comprehensive responses.**
- This question was again answered very well. Most candidates gave the answer as 9.01 with a few giving the answer of 901/100.

Limited responses
- The most common wrong answer was –0.8735 (not calculating the denominator and numerator separately for example $6.589 – 2.985 \div \sqrt{0.16}$).

Question 6

(a) **Comprehensive responses**
- Few candidates gave the correct reflex angle.
- Many measured the acute angle.

Limited responses
- Many gave the incorrect angle of 30°.
- Some gave angles such as 60°, 150°, 180°, 45° and 360°.
- A significant number made no attempt at a response.

(b) **Comprehensive responses**
- Some candidates subdivided the reflex sector correctly.
- Angles, whether correct or not, were usually drawn accurately.
- Some that measured the acute angle in the previous part found the reflex angle in this part and usually went on to draw the correct sectors.

Limited responses
- Some candidates subdivided their angle found in **part (a)** and then made no attempt to subdivide the reflex sector.
- Several candidates needed to use the required angle found in **(a)** as instructed and subdivided 360° into two sectors.
- Many candidates made no attempt at a response.

Question 7

(a) **Comprehensive responses**
- Most measured *AB* to the expected degree of accuracy.

Limited responses
- A very small number gave an inaccurate answer, or did not attempt this part.

(b) **Comprehensive responses**
- Few candidates drew the correct perpendicular line.
- Many drew a line of length 8cm in the wrong position.

Limited responses
- A few incorrectly calculated the length as 5 + 0.6 = 5.6.

Question 8

Comprehensive responses

- A few candidates wrote the two given fractions as fractions with a common denominator of 24 or 48.
- A few candidates showed a clear method of adding the fractions together and dividing by 2.

Limited responses
- Many candidates converted the fractions to inaccurate or incorrect decimals.
- Many candidates worked in decimals and could not convert back to the exact fraction.
- Many candidates found the middle of 1 and 3 as 2 and the middle of 6 and 8 as 7 and gave an incorrect answer of $\frac{2}{7}$.

Question 9

(ai) **Comprehensive responses**
- Few candidates drew the correct diagram.
- Many drew the hour hand pointing to 1.

Limited responses
- Some drew minute and hour hands of the same length.

(aii) **Comprehensive responses**
- Many were able to give the correct time of 1612.

Limited responses
- Some candidates successfully converted 170 minutes to 2 hours 50 minutes and then made errors in attempting to add this on to 1322.
- Some candidates attempted to convert 170 by dividing by 60 and were then unable to proceed with the time interval of 2.83.
- Column addition of 13 22 and 170 resulted in another common incorrect answer of 15 32.

(b) **Comprehensive responses**
- Few candidates gave the correct speed.
- Some divided by an incorrectly converted time value for 1 hour 15 minutes, commonly 1.15.

Limited responses
- Some divided by 75 minutes.
- A few incorrectly divided time by distance, commonly 75 ÷ 45.

Question 10

(a) **Comprehensive responses**
- Some candidates gave an answer in the accepted range.
- Some answers were written as a 2-figure angle rather than a 3-figure bearing.

Limited responses
- The most common incorrect angle was 258, the reflex angle at *B*.
- Other incorrect angles included the reflex angle at *A* and 102. Sometimes 102 was indicated on the diagram as angle *ABN*(*orth*) and in some cases this may have come from reading the wrong scale on the protractor.
- Many candidates gave the distance *AB* in cm or this distance converted to metres using the given scale.

(b) **Comprehensive responses**
- Few responses were correct.

Limited responses
- Many candidates gave the scale 1 : 2 or 1 : 200.
- Many candidates gave the distance *AB* for example 9.6 cm or 1920 m.
- A significant number did not attempt this part.

(c) **Comprehensive responses**

- Few responses were correct.

Limited responses
- Most candidates multiplied their previous answer by 4 rather than dividing by 4.
- A significant number did not attempt this part.

Question 11

(a) **Comprehensive responses**
- Many gave the correct value of 7.

Limited responses
- Some gave the answer as 7/40, coming from 40/360.

(b) **Comprehensive responses**
- Few responses were correct.

Limited responses
- Some used the value for milk instead of juice, often giving the incorrect answers of 126 or 14.
- Some gave the incorrect answer of 22 (students).

Question 12

Comprehensive responses
- Many were able to give the correct surface area.
- Some did not double at the relevant stage.

Limited responses
- Some found the volume.
- Few made arithmetic errors, missed one or more faces, or used 10 + 3 + 4.

Question 13

Comprehensive responses
- Few candidates produced fully correct responses. Many candidates were able to demonstrate partial understanding by providing some correct steps or reasoning. The most common correct criteria was the median of 8 in the correct position closely followed by the highest number of 11 in the correct position.

Limited responses
- Some candidates did not take into account that all values had to be different, for example [–3], 6, 8, 8, 11. The most common wrong answers were 14 or 17 for the highest number or values which did not total 30.

Question 14

Comprehensive responses
- Many candidates solved the equation successfully by expanding the bracket and collecting the x-terms to one side.
- Most errors resulted from sign errors, usually 79 – 35 instead of 75 + 39.

Limited responses
- Some candidates solved the equation successfully by expanding the bracket and collecting the x-terms to one side.
- Some made errors when expanding the bracket, usually $10x - 7$.
- Errors were made in the rearrangement such as 79 – 35 or $\frac{79}{35}$ and $10x - 35$ simplified as $-25x$.
- Most candidates made an attempt at a response.

Question 15

Comprehensive responses
- Some gave the correct answer in euros.
- Some lost accuracy by premature rounding at the conversion stage.

Limited responses
- Few incorrectly converted in the first stage.
- Few gave the answer as $3.5.

Question 16

(a) **Comprehensive responses**
- Most candidates completed an accurate diagram.

Limited responses
- A few candidates did not draw all of the borders of the shape.
- A few candidates did not shade the required squares.
- A few candidates drew the diagram with incorrect dimensions such as 5 by 5, 6 by 4 or 7 by 5.

(b) **Comprehensive responses**
- A few candidates did not simplify their answer for the total number of squares in diagram n.
- Some candidates gave quadratics with only one coefficient correct for the total number of squares.

Limited responses
- Some candidates had only one or two of the numbers for the 4th diagram correct.
- Many candidates used numbers rather than algebra for the nth diagram column.
- Some candidates gave a quadratic expression for the number of grey squares in the nth diagram.

(c) **Comprehensive responses**
- A few candidates gave the correct algebraic expression.
- A few gave incorrect algebraic expressions such as n, n – 1 or n(n – 1).

Limited responses
- Most candidates gave a numerical value rather than an algebraic expression.
- Some candidates did not attempt this part.

(d) **Comprehensive responses**
- A few candidates answered this correctly.
- A few candidates showed the correct calculation and made calculation errors.
- Many candidates recognised that they needed to multiply 22 by another number, such as 23, 22 or 20, rather than 21.

Limited responses
- Some candidates gave a calculation that used 44, such as 1000 – 44, 1000 ÷ 44, 1000 + 44, or 442.
- Some candidates gave an incorrect answer with no method shown.
- A few candidates did not attempt this part.

Question 17

(a) **Comprehensive responses**
- Many candidates gave the correct volume.

Limited responses
- Some used a less accurate value for π, commonly just 3.14 or $\frac{22}{7}$.
- A few used $\frac{1}{2}$ instead of $\frac{1}{3}$ in the formula for volume of a cone and others chose an incorrect formula.

(b) **Comprehensive responses**

- Few candidates gave the correct area.
- Some attempted to split the given shape into triangles and a rectangle. Candidates need to ensure that each area is calculated accurately to reach the correct solution.

Limited responses

- A variety of incorrect formulas were used.
- Units were very often incorrect: stating m, m^3 and cm^2 were all common errors.

Question 18

(a) **Comprehensive responses**

- Many candidates drew the correct ruled line across the whole grid.

Limited responses

- Some lines passed through the correct intercept (0, 3) with an incorrect positive or negative gradient. A common line was $y = 3$.
- Other incorrect lines included $y = 0.5$, $y = 3.5$ and lines that joined (–4, 0) to (0, 4) for example, making reference to the numbers appearing within the question.
- Many other incorrect lines were drawn and a significant number did not attempt this part.

(b) **Comprehensive responses**

- Many correct equations were given, some in the unsimplified form $y = 0x + 7$.

Limited responses

- Common incorrect answers were $y = x + 7$ and $y = 7x + 0$
- Many other incorrect answers were given and a significant number did not attempt this part.

Question 19

Comprehensive responses

- Few gave the correct diameter.
- Most found the correct circumference for the first stage and then incorrectly used it or left it as their answer.

Limited responses

- Some gave the correct radius.
- A few used a less accurate value for π, commonly just 3.14 or 22/7.

Question 20

Comprehensive responses

- Few were able to calculate the value of the required angle.
- Some used the given perimeter in the first stage of their working.
- Some used a trigonometrical ration in the second stage.

Limited responses

- Some used an incorrect formula for the perimeter, or made arithmetic errors.
- Few incorrectly used an area formula.
- A small but significant number of candidates did not attempt this part.

Question 21

(a) **Comprehensive responses**

- Few candidates were able to give the correct answer as a power of k.

Limited responses

- Most common wrong answers were $\frac{1}{k^2}$ or k^2 or $-k^2$ or $k^{\frac{1}{k}}$ or $k^{\frac{1}{k\times k}}$.
- A significant number made no attempt at this response.

(b) **Comprehensive responses**

- Many candidates correctly simplified the expression.

Limited responses

- The most common incorrect answers were $12w^2$, $7w^8$ 12^8. $15552w$ $(3^5 \times 4^3)$ $w^3\left(3w^2 \times 4\right)$.
- Some gave answers of $15552w$ $(3^5 \times 4^3)$ or $w^3\left(3w^2 \times 4\right)$.
- Some made no attempt at this response.

Question 22

Comprehensive responses

- Some candidates calculated the correct value of the investment and gave their answer to the nearest dollar.
- Some did not round their answers while some rounded to the nearest $10 or the nearest $100.

Limited responses

- Few candidates gave a correct rounded value of the investment.
- Many gave incorrect answers with no supporting working.
- Some attempted a simple interest calculation.
- Some substituted into the compound interest formula incorrectly.

Question 23

Comprehensive responses

- Few candidates worked out the correct time.
- Few found the lowest common denominator as their first step, and then generally went on to give the correct answer.
- Some listed the times or multiples, and often had incomplete lists or arithmetic errors.

Limited responses

- A few added 30 and 34 mins to 0800 to give 0904.
- A few made no attempt at this response.

Question 24

Comprehensive responses

- Many candidates showed the correct calculation.
- Some candidates gave inaccurate answers such as 13 or 13.34.
- A few candidates did not subtract 100 from 113.3.

Limited responses

- Some candidates divided by 1360 rather than by 1200.
- Some candidates found the profit as 160 and did not go on to find the percentage profit.

Question 25

Comprehensive responses

- Few candidates gave the correct length.
- Some did not appreciate that the first stage was to use the given area to find the height of the triangle.
- A few correctly used Pythagoras after finding the height.

Limited responses

- Some attempted to use trigonometry.
- A significant number made no attempt at this response.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/42
Calculator (Extended)

Key messages

What candidates did well

- Many candidates demonstrated expertise with the content and presented their solutions well.
- Most candidates demonstrated competence in questions requiring the direct application of mathematical processes.
- Many candidates demonstrated expertise in basic algebraic manipulation and solving linear equations.

What candidates needed to improve

- When candidates are required to show a given result, they should show every step in their method making only one change in each line of working. They should not use the given result in their method.
- Candidates must remember to use more than 3 figures in their intermediate calculations to ensure that the final answer is accurate.
- To derive a result to a given degree of accuracy candidates must show at least one more degree of accuracy before reaching their conclusion.
- Candidates need to ensure they do not miscopy the numbers given in the question or miscopy their own numbers within their working. For example, in **Question 15(a)(iii)** the term $–80x$ in the working was sometimes transcribed as $–8x$ on the answer line.
- Candidates must remember not to round final answers at all when the value is exact.
- Errors should be crossed out rather than being over-written.

Comments on specific questions

Question 1

Comprehensive responses

- Many candidates gave the correct value in figures, 7 250 000.

Limited responses

- Some candidates gave their answer in standard form without showing the value written in figures which does not address the demand of this type of question.
- Many candidates wrote 7.25000000 or 7.250000.
- Some candidates added an incorrect number of zeros to the figures 725.
- A few candidates omitted the 2 and wrote 7500000.

Question 2

Comprehensive responses

- Most candidates gave both correct values for the angles.
- Most successful candidates annotated the diagram.

Limited responses

- Few candidates gave incorrect values.

Question 3

Comprehensive responses
- Most candidates gave the correct value rounded to 1 decimal place as instructed.

Limited responses
- Some candidates incorrectly rounded 8.660 to 8.6 or rounded to 8.66.
- Some candidates made the error of working out $10-\left(\frac{7}{8}\right)^3$ first before multiplying by 2 and then rounded their value correctly to 1 decimal place.
- A few candidates making this error did not show a more accurate decimal before rounding to 1 decimal place.

Question 4

Comprehensive responses
- Most candidates gave the correct cost in rupees.

Limited responses
- Some candidates rounded 51 750 to 51 800. However, when an exact amount of money is required, candidates should give the precise value without rounding.
- A few candidates multiplied 576 by 1.28 instead of dividing.

Question 5

(a) **Comprehensive responses**
- Some candidates found the correct arrival time in New York local time, 17 38.
- Some candidates began by finding the arrival time in Mumbai time first, 04 08, and some began by finding the departure time in New York time first as 01 20.

Limited responses
- Many candidates were able to find the arrival time in Mumbai time, 04 08.
- A common error was then to add 10.5 hours to the correct arrival time in Mumbai time instead of subtracting.
- Another common error was to add 10.5 hours to the departure time in Mumbai time instead of subtracting, to find the departure time in New York time.
- Other common errors seen were the answers 05 38 and 17 38 pm.

(b) **Comprehensive responses**
- Most candidates correctly converted the length of time 16 hours 18 minutes to 16.3 hours and completed the correct division to give an answer of sufficient accuracy.

Limited responses
- Some candidates divided 12 800 by 16.18 or other incorrect conversions of the time into hours, or by 978 minutes.
- A common error was to divide 12 800 by a time found in part **(a)**.
- Most candidates divided 12 800 by a time.
- A few candidates multiplied distance by time.

Question 6

Comprehensive responses
- Most candidates found the correct probability as a decimal, fraction or percentage.

Limited responses
- Some candidates multiplied 27% by $\frac{3}{5}$.
- Some candidates subtracted 27% from $\frac{3}{5}$.

- A few candidates added 27% and $\frac{3}{5}$ correctly and then omitted subtraction from 1 or subtracted instead from 3 or 5.

Question 7

(a) **Comprehensive responses**
- Most candidates completed the substitution and evaluated correctly.

Limited responses
- Few candidates wrote -15^2 instead of $(-15)^2$ and then to use –225 in their evaluation.

(b) **Comprehensive responses**
- Most candidates re-arranged the equation correctly to make *t* the subject.

Limited responses
- Many candidates made a correct first step in re-arranging the equation to $p^2 - r^2 = -8t$, for example, before an error in the next step, for example, a sign error sometimes followed a correct first step to give $t = \frac{p^2 - r^2}{8}$.
- After the correct formula $t = \frac{p^2 - r^2}{-8}$ was seen, some candidates incorrectly manipulated the negative signs to give $t = \frac{p^2 + r^2}{8}$.
- A few candidates made a sign error in their first step and wrote $p^2 + r^2 = 8t$.

Question 8

Comprehensive responses
- Few candidates correctly identified a pentagon.

Limited responses
- Many candidates wrote hexagon as their answer and there were a variety of other polygons such as triangle, square, rhombus, rectangle and octagon given as answers.
- Some candidates did not name a polygon and instead named a prism or a pyramid for example.

Question 9

(a) **Comprehensive responses**
- Some candidates showed every step in the process to determine the given value for the capacity to the nearest litre.

Limited responses
- Most candidates showed the substitution of $r = 40$ into the correct volume formula for the sphere.
- Few candidates showed the explicit step to convert cm^3 to litres of division by 1000.
- Few candidates showed the value of the capacity to at least 1 decimal place before stating the given value to the nearest litre.

(b) (i) **Comprehensive responses**
- Many candidates calculated the required time correctly and rounded their value correctly to the nearest second.
- Some candidates prematurely rounded their time in minutes to 14.9 to then get the inaccurate answer 14 minutes 54 seconds after a correct method was shown.

Limited responses
- Many candidates succeeded in calculating the time in seconds and then showed division by 60 to convert to time in minutes.

- Some candidates gave their answer as a decimal, such as 14.88 minutes. This was then converted to 15 minutes 28 seconds.
- Some candidates made errors when converting units from litres to millilitres for example.

(ii) Comprehensive responses

- Most candidates correctly calculated the percentage of the container filled.
- Some candidates calculated the percentage of the container that was unfilled.

Limited responses

- Most candidates substituted correctly into the formula for the volume of a cylinder.
- A common error seen was to invert the correct division and instead divide the cylinder volume by the volume of water.
- Some candidates did not convert correctly from litres to millilitres leading to an answer with correct figures and incorrect place value.
- Some gave inaccurate answers as a result of premature rounding of the volume of the cylinder before completing the division.

Question 10

Comprehensive responses

- Some candidates gave a fully correct solution by setting up two simultaneous equations and then solving them showing full working.
- Many candidates were able to identify that opposite angles of a rhombus are equal and another property such as angle sum is 360 or angle properties of parallel lines and use them to write down two correct simultaneous equations.

Limited responses

- Some candidates were able to recall the angle properties of a rhombus correctly to create a correct pair of simultaneous equations.
- Some candidates were able to show a correct method to solve *their* simultaneous equations either by elimination or substitution.
- A common error seen was to use opposite angles of the rhombus add to 180.
- Some when solving their equations made sign errors when adding or subtracting equations.
- Some candidates only multiplied some terms in their equations before elimination rather than multiplying all terms.

Question 11

(a) Comprehensive responses

- Most candidates began by stating $a = \frac{v-u}{t}$ or $0.25 = \frac{v-20}{48}$ and then showed at least one further step in their working to reach $v = 32$.
- Some candidates began with $v = u + at$ and then stated $v = 20 + 0.25 \times 48$ to again complete successfully to $v = 32$.

Limited responses

- A common error was to repeat the use of V as their variable within a stepped method so that $V = 0.25 \times 48 = 12$ and then also V = *32* was seen.
- A few candidates began by using the value 32 for V creating a circular argument to finish back again with $V = 32$.
- A few candidates could not recall the relevant formulae and instead attempted to use area under the graph.

(b) Comprehensive responses

- Many candidates were able to find the distance travelled in km.
- Some candidates correctly found the area under the graph correctly and then omitted to convert from metres to kilometres.

Limited responses

- A few candidates attempted to change the units of speed from m/s to km/h to start and then made arithmetic or conversion errors.
- Most candidates were able to find either the area of the trapezium or the area of the triangle. A common error was area = $(32 \times 48) + (\frac{1}{2} \times 17 \times 32)$.
- Some candidates attempted to use distance = speed × time instead of area under the graph.
- A few candidates when finding the area of the trapezium made the error of using sides of 20 and 48 instead of 20 and 32 in the formula.

Question 12

Comprehensive responses

- Most candidates successfully solved the equation by cross multiplying by 3 and 5 to eliminate the fractions, expanding the brackets and collecting the x terms to one side.

Limited responses

- Some candidates made sign errors when collecting the x terms to one side after eliminating the fractions and expanding brackets.
- Candidates who began by collecting the fractions to one side of the equation often made sign errors or did not equate to 0.
- Candidates who collected the fractions on one side over a common denominator of 15 and equated to 0 sometimes then made the error $0 \times 15 = 15$.

Question 13

Comprehensive responses

- Most candidates identified the equations for the lines that bordered the region R.
- Some were able to give the correct inequalities having obtained the correct equations.

Limited responses

- Many candidates made an error with one or more of the inequalities either by reversing the direction of the inequality or by including/excluding equality inappropriately.
- Some candidates made the error $y = 0.5x + 2$ or $y = -2x + 2$ instead of $y = -0.5x + 2$.
- Some candidates incorrectly identified the y intercepts of the border lines, for example $y = x + 1$ instead of $y = x - 1$.
- $x \leq 3x$ was a common error.

Question 14

Comprehensive responses

- Most candidates used the volume scale factor correctly to find the height of the smaller bottle.

Limited responses

- The most common error was to use the factor $\left(\frac{1.35}{0.4}\right)$ instead of $\sqrt[3]{\left(\frac{1.35}{0.4}\right)}$.
- A few candidates used the factor $\sqrt[2]{\left(\frac{1.35}{0.4}\right)}$ or $\left(\frac{1.35}{0.4}\right)^3$.

Question 15

(a) (i) **Comprehensive responses**

- Many candidates found the correct range and recorded this as three distinct values.

Limited responses

- Some candidates misunderstood the concept of range and treated it as a statistical range, giving 10 (from $14 - 4$) as the answer.

- Some candidates gave a list of every integer from 4 to 14 as their answer or gave an answer as an interval $4 \leq x \leq 14$.
- Some candidates gave $-2 \leq x \leq 3$ or a list of integers from –2 to 3.

(ii) **Comprehensive responses**

- Most candidates found the correct inverse function.

Limited responses

- Some candidates were able to carry out a correct first step to getting the inverse function then made a sign error when rearranging or transferring a correct answer to the final answer line.
- Some candidates found the reciprocal of the function rather than the inverse function.

(iii) **Comprehensive responses**

- Many candidates were able to substitute f(x) into g(x) and form a correct expression.
- Some candidates went on to simplify the expression correctly.

Limited responses

- Many candidates made sign errors when expanding the squared bracket, notably with the squared term.
- Some candidates multiplied the terms in the bracket by 2 before squaring.
- Some candidates squared the two terms in the bracket rather than expanding double brackets.
- Some candidates reached the correct simplified expression in their working then made errors transferring it to the final answer line.
- A few candidates thought that the composite function fg(x) was found by multiplying f(x) by g (x).

(b) **Comprehensive responses**

- Few candidates understood that $h^{-1}(10\,000)$ could be solved by equating h(x) and 10 000.
- Those that recognised that they needed to write 10 000 as a power of 10 and then equate the power with $\frac{2}{x}$ were successful.

Limited responses

- Many made the common error of calculating h(10 000).

Question 16

Comprehensive responses

- Some candidates were able to set up two equations in a and b using the boundary conditions of $x = 0$ and $x = 30$ and then correctly solve for a and b.

Limited responses

- Many who set up the equation $80 = ab^0$ and identified that $b^0 = 1$ were able to reach a solution for a.
- Some candidates gave the 2 significant figure value 0.95 for b rather than 3 significant figures as required.
- Some candidates were unable to rearrange $20 = 80b^{30}$, with errors such as $80b$ = seen.
- Some candidates set up two equations and attempted to solve as a pair of simultaneous equations which was not appropriate in this case.
- A few candidates interpreted 2.30pm as18 minutes past 2.

Question 17

Comprehensive responses

- Many candidates found the correct gradient using the derivative of the equation of the curve.
- Some candidates differentiated correctly then could not make any further progress. T
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- They solved $3x^2 - 5x = 0$ and substituted $x = \frac{5}{3}$ into the equation of the curve.

Limited responses

- Some candidates found the value of y at the given point rather than the gradient.
- Some candidates made errors when differentiating, such as incorrect terms $2x^2$, -5 instead of $-5x$ and the inclusion of the constant term 3.
- Some candidates found the gradient of a chord between the given point and the (0, 3).

Question 18

(a) **Comprehensive responses**

- Most candidates used the appropriate midpoints to find the correct estimate of the mean.

Limited responses

- A few candidates used the class width of the interval instead of midpoints.
- Some candidates made errors in identifying one or more of the midpoints.

(b) **Comprehensive responses**

- Many candidates used the given information for the second bar correctly to find the heights of the other bars. This involved finding the frequency densities and multiplying by $14 \div \frac{35}{20} = 8$.

Limited responses

- Some candidates gave the frequency densities 1.3, 2.4, 0.2 as their answers, and did not then scale them up to get the height of the bars for the other intervals.
- A few candidates gave the incorrect answers 5.2, 14.4, 2.4 after multiplying the frequencies by $\frac{14}{35}$, without taking into account the unequal class widths.

(c) **Comprehensive responses**

- Some candidates gave the correct answer $\frac{72}{287}$ from $2 \times \frac{36}{42} \times \frac{6}{41}$.
- Some candidates gave the answer $\frac{36}{287}$ without consideration that the delayed train could come from either of the two intervals.

Limited responses

- Some candidates wrote down one correct probability, usually $\frac{36}{42}$, and made no further progress.
- Some candidates used 'with replacement' and calculated $[2\times]\frac{36}{42} \times \frac{6}{42}$.
- Some candidates used the sample space as all 90 trains and this error was often compounded by using the 'with replacement' approach.

Question 19

(a) (i) **Comprehensive responses**

- Many candidates understood the parallel nature of the vector to $\overrightarrow{AB}$ and gave the correct answer $-\mathbf{q}$.

Limited responses

- A few candidates did not appreciate the reverse direction of the vector to $\overrightarrow{AB}$ and gave the answer **q**.
- A few candidates gave an answer involving **p** and **q** for example 3**p** + 3**q**.

(ii) **Comprehensive responses**

- Some candidates gave the correct answer of $-2\mathbf{p}$.

Limited responses

- Some candidates realised that $\overrightarrow{BE}$ was twice as long as $\overrightarrow{OA}$ and gave the answer + 2**p**, without taking into account the direction.
- Many candidates did not understand the parallel nature of $\overrightarrow{BE}$ to $\overrightarrow{OA}$. As a result, a common error was to give an answer involving **p** and **q**, for example –**p** – 2**q**.

(iii) **Comprehensive responses**

- Some candidates gave the correct answer of **q** – **p**.

Limited responses

- Many candidates used the fact that $\overrightarrow{OE} = \text{p} + \text{q} + \overrightarrow{BE}$ or gave a correct route for $\overrightarrow{\text{OE}}$, for example, $\overrightarrow{\text{OA}} + \overrightarrow{\text{AB}} + \overrightarrow{BE}$.

(b) **Comprehensive responses**

- Some candidates gave the correct answer 2**p** + 2**q**.

Limited responses

- Some candidates realised that $\overrightarrow{\text{OG}}$ was parallel to $\overrightarrow{OB}$ and gave an answer of the form k(**p** + **q**).
- Some candidates produced a partially correct answer for example 4**p** + 2**q**.
- Some candidates extended the diagram to *G* with no further work.

Question 20

(a) **Comprehensive responses**

- Most candidates were able to apply the formula for the general area of a triangle to give a correct answer
- Most candidates gave their answer to an appropriate degree of accuracy.

Limited responses

- A few candidates used the incorrect formula, treating the triangle as a right-angled.
- The most common incorrect answers involved using incorrect trigonometric formulae, for example, applying the cosine rule.

(b) **Comprehensive responses**

- Most candidates were able to apply the sine rule using the correct angles and sides.
- Many candidates then correctly found the required angle *CAD*, to greater accuracy than 1 decimal place, which was required in this 'show that' question.

Limited responses

- Many candidates did not keep a value to at least 4 significant figures throughout their working and rounded angle *ADC* was rounded to 60.2 before the second stage of the question.
- Some candidates did not show the subtraction of angle *ADC* from 180º explicitly, instead giving an implicit calculation of the form: 60.2º + 34º + ∠*CAD* = 180º.
- Some candidates used angle *CAD* = 85.8º when this was the given value to be shown.

(c) **Comprehensive responses**

- Few candidates accurately conceptualised the three-dimensional aspect of the problem and answered the question correctly.
- Some candidates identified the required right-angled triangle involving *BD* and 205 m and correctly found the length of *BD* using the cosine rule in triangle *BAD.*

Limited responses

- Some candidates that calculated one or both of the lengths *BC* and *CD* did not link this with finding the length of *BD*.
- Many made incorrect assumptions such as the perpendicular distance from *D* to *AC* added to the length *CB* would give the length of *BD*.
- Many calculated a variety of lengths which rarely led to them finding the length of *BD*.
- Some having considered the correct triangle and having found *BD*, calculated 90° – the required angle instead of the angle of depression

Question 21

Comprehensive responses

- Most candidates knew that bounds needed to be found before $\frac{\text{volume}}{\text{length x width}}$ was calculated and were able to identify that the lower bound of the volume needed to be used with the upper bounds of the height and width.

Limited responses

- Some candidates used the lower bound for volume and mistakenly used the lower bounds for the length and width.
- Some calculated the height using the given figures and attempted to give the bounds for their answer.
- Some candidates tried to use the surface area formula rather than the volume of the cuboid.

Question 22

Comprehensive responses

- Most candidates recognised the sequence as a geometric progression and often gave a correct expression for the *n*th term, 6^{n-2}, or an equivalent form of this.

Limited responses

- Some candidates recognised this as a geometric progression and gave incorrect answers that were of the right form, such as 6^{n-1}, or an equivalent form.
- A few candidates treated the sequence as an arithmetic progression

Question 23

Comprehensive responses

- A few candidates gave a fully correct answer with correct working.
- Some candidates solved the equation correctly to give $A = -39.8°$ followed by at least one correct value of A in the range 0° to 360°. The values of B were often then calculated correctly.
- Those candidates who sketched the tan graph or drew other trigonometrical diagrams were most successful in finding the two values for A and hence for B.

Limited responses

- Some candidates, having solved the equation correctly for tan$A$, stated incorrectly that A = 39.8° or 219.8°.
- Some candidates incorrectly thought the given equation was equivalent to 5tanA= –0.5.
- A few candidates, who could not solve the equation, were able to recognise that the two values of B should differ by 180°.