MATHEMATICS

Paper 1521/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should encourage candidates to show formulae used, substitutions made and calculations performed. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer. In 'show that' questions, such as **Questions 1(b)(iii)** and **4(b)(i)**, candidates must show all their working to justify their calculations to arrive at the given answer and should not use the given answer in a circular or reverse method. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set.

Comments on specific questions

Question 1

(a) The majority of candidates understood what was required in this part but some were not able to write their fraction in its simplest form, leaving their answer as $\frac{10}{51.5}$ or converting to a decimal.

(b) (i) This part was generally answered correctly by the majority of candidates.

(ii) This part was generally answered well, although a significant number did not follow the instruction 'Write this time in hours', leading to the common errors of 2 hr 15 min or 2.15.

(iii) This 'show that' part was generally answered well although a number of reverse methods using the given value of 22.9 were seen. Common errors also included the use of 2.15, and the use of an incorrect formula, often $S = \frac{T}{D}$. A number of candidates didn't gain the final accuracy mark by not stating the more accurate figure of 22.89 or 22.88…., which is required to show that the speed was 22.9 km/h correct to 1 decimal place.

(iv) This part on finding a percentage reduction was generally answered well. Common errors included the incorrect denominator of 125 instead of 135, and the use of an incomplete partial method often leading to an answer of 0.0741 or 92.6. A number of candidates didn't gain the final accuracy mark by giving their answer as 7.4.

(c) This part was generally answered very well although common errors included 248 (from incorrect use of a calculator), and 2 hr 8 m (answer not in minutes).

Question 2

(a) (i) The sequence in this part proved challenging for many candidates with a number appearing to look for a linear rule and not appreciating that the term to term rule was 'multiply by –3'.

(ii) The sequence in this part proved more accessible for candidates although writing down the term to term rule still proved challenging. Working showing the differences of 1, 3, 5 and 7 usually led to the correct answers of 27 and 38. Common errors for the rule included 'add 2', 'add odd number' and '2 more' which are mathematically insufficient. Answers of 29, 42, 'add next prime number' were also commonly seen, although this is incorrect as the first difference of 1 is not a prime number.

(b) (i) The sequence in this part was generally answered correctly by the majority of candidates.

(ii) Candidates found the remainder of **part (b)** very challenging and it proved to be a good discriminator. Few mathematically correct reasons were seen in this part.

(iii) Many candidates did not appreciate the given information in the previous part and few correct answers were seen. Common errors included $–2n$, $2n$, and $2n + 5$ (from using a common difference of 2).

(iv) A small but significant number of candidates were able to gain full credit in this part, particularly with a follow through applied. A very common error was to use $n = –33$ in their expressions, leading to incorrect answers such as –66, 66, –61 and 75.

Question 3

(a) (i) Many candidates were unable to identify the given shaded irregular polygon, with 'trapezium' being a very common error.

(ii) This part proved challenging for many candidates with the majority not appreciating that the rule $(n – 2) \times 180$ could be used. Common errors included use of incorrect rules, 60° , 120° and a number of numerical answers suggesting that area or perimeter had been attempted. There was little evidence that the alternative method of adding up the identifiable angles from the given diagram, (90 + 90 + 135 + 45 + 225 + 135), had been used.

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

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

(ii) This part was generally answered better with the majority of candidates able to identify the given transformation as a reflection and were able to correctly state the line of reflection as $y = 2$, although common errors included $y = 0$, y-axis and x-axis. A significant number incorrectly identified it as a rotation, with a variety of angles and centres.

(iii) The majority of candidates were able to identify the given transformation as an enlargement, although disenlarge, minimise and shrinkage were common errors. However not all were able to correctly state the three required components. The identification of the centre of enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (6, 5) and (–5, –6) being common errors. A small number gave a double transformation, usually enlargement and translation.

(c) This part was generally answered reasonably well with a good number of candidates able to correctly draw the required rotation, or at least a rotation worthy of the partial mark. However, this part proved very challenging for less able candidates and a significant number were unable to attempt the drawing.

Question 4

(a) (i) The majority of candidates were able to correctly calculate the mean from the given data, although common errors of 13 (range), 9 (median), 70 (total) and $\frac{70}{2}$ were seen.

(ii) The majority of candidates were able to gain full credit for a correct bar chart, although a small yet significant number did not complete the scale on the vertical axis.

(b) (i) This 'show that' part was generally answered very well with a good number of candidates able to correctly justify their answer by working of 900 – (320 + 190), or 900 – 320 – 190, or 320 + 190 = 510 followed by 900 – 510. It should however be noted that sole working of 900 – 510 is insufficient as the value used has not been justified.

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

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

Question 5

(a) The table was generally completed well with the vast majority of candidates gaining full credit. Common errors included y values of –15 and –9 from the x values of –3 and –2.

(b) The quadratic graph was generally plotted well and the majority were able to draw a correct smooth curve. Curves were generally smooth although sometimes rather thick. A small number of candidates incorrectly joined the points with ruled line segments and/or drew a straight line from (–1, –3) to (0, –3).

(c) A significant number of candidates were unable to correctly write down the coordinates of the lowest point of the graph, with common errors including (–1, –3) to (0, –3).

(d) (i) The majority of candidates were able to correctly draw the line of symmetry on their graph, although a variety of incorrect lines were seen.

(ii) A smaller number were able to write down the equation of the line of symmetry. Common errors included –0.5, $x = 0.5$, $y = x^2 + x - 3$ and $y = mx + c$.

Question 6

(a) This part was generally answered very well.

(b) This part was generally answered very well, although the common error of 172.6 (from taking the square root) was seen.

(c) The most common correct answer seen was π although a number of valid square roots were also seen. Many incorrect and varied answers were seen with the majority being prime numbers or odd numbers.

(d) This part was generally answered reasonably well although common errors included products such as 9×35, and simply writing a list of factors.

(e) (i) This part was generally answered reasonably well particularly by those candidates who drew a factor table or factor tree. Common errors included the common factors of 2 and 7, and 140.

(ii) This part was also generally answered reasonably well particularly by those candidates who drew a factor table or factor tree. Common errors included 70, 14, and the partially correct $2 \times 2 \times 5 \times 7$.

(f) (i) This part was generally answered well, although the common errors of $\frac{4}{1000}$, 0.004 and 0.015625 were seen

(ii) Candidates found converting their fraction in **part (i)** to a decimal and rounding this to 2 significant figures challenging with correct answers worth full credit seldom seen. Common errors included 0.0156, 0.015625 and 0.02, all of which scored partial credit, but also 0.15 and 0.01 both of which gained no credit.

Question 7

(a) This part on changing the subject of a formula was generally answered well, although the common errors of $\frac{a-c}{5}$ and $5a - c$ were seen.

(b) This part on expanding and simplifying the given expression was not generally answered well. Partial credit could often be awarded for the correct expansion of one bracket, usually to $4x + 12$, or for correctly collecting like terms to either $-2x$ or 9. Common errors included sign errors in the expansion, incorrect simplification, often to $10x - 15$, or attempting to solve as an equation, often leading to $x = 4.5$.

(c) This part on factorising completely the given expression was generally answered well with many candidates able to gain full credit. A small yet significant number did not appear to understand the term 'factorise'.

(d) This part on solving the given equation was generally answered well with many candidates able to gain full credit. The most common error involved transposition errors, often leading to $8x = 12$.

(e) Candidates found this part on finding the gradient of a given line drawn on a graph very challenging and it proved to be a good discriminator. The two methods of using rise/run from the diagram, or using the formula from two correct coordinates, were equally seen. Common errors included –2, $\pm 1/2$, an incorrect formula (usually inverted), incorrect coordinates used, sign errors within the correct formula, giving the equation of the line, and simply writing down one pair of coordinates. A small number of candidates were unable to attempt this part.

Question 8

(a) (i) The majority of candidates were able to measure accurately at 9.5 cm and then use the given scale to correctly convert to give the actual distance required as 190 m. A small number gave answers of 9.5, or used incorrect conversions such as 0.95×20, 9.5×10 or 9.5×100, or used inaccurate measurements of 9 or 10 cm. Candidates should be encouraged to show their initial measurement as part of their working.

(ii) This part on the measurement of a bearing was not generally answered well with common errors of 75°, 165°, 195°, 295° and 9.5 cm frequently seen.

(b) Candidates found this part quite challenging and it proved to be a good discriminator. A small yet significant number of candidates, however, were able to gain full credit on this drawing question. Whilst many candidates correctly evaluated $210 \div 20$ as 10.5 and gained partial credit for a point the correct distance from *C*, many were unable to place *D* with the required direction of angle *BCD* = 60°. A further common error was not following the given instruction 'complete the quadrilateral *ABCD*' by not drawing the line *AD*.

(c) (i) Candidates also found this part quite challenging and few fully correct answers were seen even with a follow through allowed. Whilst a number of candidates were able to mark the point *E* at 4.5 cm from *C* on their diagram very few correct arcs were seen. A further error was in not appreciating the statement 'from the line *CD* to the line *CB*', and then drawing an arc extending beyond these limits.

(ii) Candidates found this part on finding the length of an arc very challenging and it proved to be a good discriminator. Use of the correct formula was rarely seen with a significant number of candidates unable to attempt this part. A variety of incorrect formulas were seen including use of area and/or the omission of the fraction $\frac{60}{360}$.

Question 9

(a) (i) Although a good number of candidates realised that Pythagoras' theorem was the key to calculating the required length, a very common error was calculating $20^2 + 12^2$. Less able candidates either did not make the connection with the right-angled triangle or did not know Pythagoras' theorem and a variety of ideas were pursued. These included simply adding or subtracting 20 and 12, finding the ratio of the given sides or attempting some trigonometry.

(ii) Candidates also found this part very challenging and, despite the instruction in the question, not all appreciated that the use of trigonometry was the key to answering this part. The most common correct answers came from the use of the cosine ratio with the given lengths of 12 and 20. A variety of incorrect methods were seen including a number of purely numerical calculations involving 12, 20 and 90.

(b) (i) The use of a correct formula to find the volume of the prism was rarely seen although a small number of candidates were able to gain full credit. Common errors included the calculations of $36 \times 20 \times 12$ or $0.5 \times 36 \times 20 \times 12$.

(ii) The use of a correct formula to find the total surface area of the prism was rarely seen although a small number of candidates were again able to gain full credit. Many candidates did not appreciate that this area could be found by calculating the areas of the three rectangles and the two triangles although a good number were able to gain partial credit by calculating one of these sides correctly. The units were generally stated correctly although common errors of cm and cm^3 were seen with a significant number omitting this part of the question.

(iii) Candidates also found this part very challenging with many not realising how to find the value of k once the two areas had been found. The partial mark could often be awarded usually for the correct rectangle area of 720.

(c) The correct completion of the net was rarely seen although a small number of candidates were able to gain full credit. Partial marks were sometimes able to be awarded for one or more correct faces correctly placed, usually the opposite triangular face. A number did not seem to appreciate that the net could be completed by using the two given faces on the grid. Common errors included inaccurate drawing of the triangular face, both rectangles drawn with the incorrect width of 5 cm, an attempted 3-D diagram, with a significant number unable to attempt this part.