# Assessment Schedule – 2024

# Mathematics and Statistics: Demonstrate mathematical reasoning (91947)

### Evidence

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	2(3x-5) + 2(2x + 3) = 56 6x - 10 + 4x + 6 = 56 10x - 4 = 56 10x = 60 x = 6  cm OR alternative method: 3x - 5 + 2x + 3 = 28 5x - 2 = 28 5x - 2 = 28 5x = 30 x = 6  cm Units not needed.	• Correct answer, showing evidence of algebraic working.		
(b)	If $AB = y$ , then AC = y + k; $BC = y + k - 4Perimeter = 5yy + y + k + y + k - 4 = 5y$ (1) 3y + 2k - 4 = 5y 2k - 4 = 2y k - 2 = y Then perimeter = 5y So perimeter = 5(k - 2) Or perimeter = 5k - 10	<ul> <li>Obtaining an equation involving <i>y</i> and <i>k</i>, i.e. reaching stage (1). OR Consistent expression for the perimeter, in terms of <i>k</i>. OR CAO.</li> </ul>	• Correct answer.	
(c)	Using triangle PBC: $PC^{2} = PB^{2} + BC^{2}$ $PC^{2} = 12^{2} + 10^{2}$ $PC^{2} = 244$ $PC = \sqrt{244}$ PC = 15.62  m Using triangle TPC: $TC^{2} = TP^{2} + PC^{2}$ $TC^{2} = 8^{2} + 15.62^{2}$ $TC^{2} = 308$ $TC = \sqrt{308}$ TC = 17.55  m OR alternative method: $TC = \sqrt{8^{2} + 10^{2} + 12^{2}}$ $= \sqrt{308} = 17.55 \text{ m}$	• Finding the length PC. OR Finding length TB= 14.42. OR CAO.	• Correct answer.	

(d)	Volume of one ball = 150 $\frac{4}{3}\pi r^{3} = 150$ $\pi r^{3} = 112.5$ $r^{3} = 35.81$ $r = 3.296 \text{ and diameter} = 6.592$ <b>Rectangular Box:</b> Width = 2 × 6.592 = 13.184 cm Length = 3 × 6.592 = 19.777 cm Volume of the rectangular box = 13.184 × 19.777 × 6.592 = 1718.87 cm <sup>3</sup> Empty space = 1718.87 - 6 × 150 = 818.87 cm <sup>3</sup> Percentage empty space for the rectangular box = $\frac{818.87}{1718.87} \times 100\% = 47.64\%$ <b>Cylindrical Box:</b> Radius = 3.296 cm <sup>3</sup> Height = 12 x 3.296 = 39.553 cm Volume of the cylindrical box = $\pi \times 3.296^{2} \times 39.553 = 1350$ cm <sup>3</sup> Empty space = 1350 - 6 × 150 = 450 cm <sup>3</sup> Percentage empty space for the cylindrical box = $\frac{450}{1350} \times 100\% = 33.33\%$ i.e. cylindrical box has less empty space, with only 33.3% empty, compared to 47.64% empty in the rectangular box = $6r \times 4r \times 2r$ Percentage filled space for rectangular box = $6r \times 4r \times 2r$ Percentage filled space for rectangular box = $\frac{6(\frac{4}{3}\pi r^{3})}{48r^{3}} = \frac{8\pi}{48} = 0.5236 = 52.36\%$ Percentage empty space = 47.64% Total volume of cylindrical box = $\frac{6(\frac{4}{3}\pi r^{3})}{12\pi r^{3}} = \frac{8\pi}{12} = 0.6666 = 66.66\%$ Percentage empty space = 33.33% i.e. cylindrical box has less empty space, with only 33.3% empty, compared to 47.64% empty in the rectangular box	<ul> <li>Calculating the radius of a single tennis ball. OR</li> <li>Consistent volume of rectangular box. OR</li> <li>Consistent volume of cylindrical box.</li> <li>OR</li> <li>Total volume of both boxes in terms of <i>r</i>.</li> </ul>	<ul> <li>Empty space in the rectangular box. OR</li> <li>Empty space in cylindrical box.</li> </ul>	<ul> <li>E//ti</li> <li>Empty space in the rectangular box. AND Cylindrical box AND Correct decision made, but no reference to percentages.</li> <li>OR Correct decision with minor error.</li> <li>E8 / t2</li> <li>Percentage empty space in a rectangular box. AND Percentage empty space in a cylindrical box. AND Decision made that cylinder has less empty space.</li> </ul>
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	ONE question attempted towards solution.	lu	2u	3u	lr	2r	tl	t2

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	$\sin \frac{x}{2} = \frac{5}{15}$ $\frac{x}{2} = \sin^{-1} \frac{5}{15}$ $\frac{x}{2} = 19.47^{\circ}$ $x = 38.94^{\circ}$	• Recognition that $ sin \frac{x}{2} = \frac{5}{15} $ OR equivalent.	<ul> <li>Clear and justified working to show that x = 38.94°.</li> <li>Accept x = 43.27° if calculator is in grad</li> </ul>	
(b)	In triangle CED: $\tan 33 = \frac{CD}{28}$ $CD = 28 \times \tan 33$ $CD = 18.18 m$ Area of triangle CED = $\frac{1}{2} \times 28 \times 18.18$ $= 254.57 m^{2}$ Area of triangle ABF also = 254.57 m <sup>2</sup> Area of triangle ACDF = 30 × 18.18 = 545.50 m <sup>2</sup> Area of stripe = 545.50 - 2 × 254.57 = 36.36 m <sup>2</sup> OR Alternative Method: In triangle CED: $\cos 33 = \frac{28}{CE}$ $CE = \frac{28}{\cos 33}$ $CE = 33.39 m$ Let h be the distance between the parallel lines FB and EF: $\sin 33 = \frac{h}{2}$ $h = 2 \times \sin 33$ $h = 1.089 m$ Area of stripe = area of parallelogram = 33.39 × 1.089 = 36.36 m <sup>2</sup>	<ul> <li>Finding length CD, with evidence of trigonometry. OR Consistent answer, with one minor error. OR Finding length CE, with evidence of trigonometry. OR CAO.</li> </ul>	• Correct value for the area of the stripe.	
(c)(i)	$\tan 60 = \frac{PF}{PB}$ $\tan 60 = \frac{PF}{k}$ $PF = k \times \tan 60$ PF = 1.7321k OR Alternative Method: Because ABF=60° PBF=30° So FB = 2k $PF = \sqrt{FB^2 + BP^2} = \sqrt{(2k)^2 + k^2} = 1.7321k$	• Finding correct value for PF, with evidence of working.		

(ii)	Area ABFE = $\frac{1}{2} \times 1.7321k \times (2k + 4k)$ = 5.1963k <sup>2</sup> Volume = 649.519 5.1963k <sup>2</sup> × 8k = 649.519 41.5704k <sup>3</sup> = 649.519 k <sup>3</sup> = $\frac{649.519}{41.5704}$ k <sup>3</sup> = 15.625 k = $\sqrt[3]{15.625}$ k = 2.5 m Units not required. Accept any appropriate rounding.	<ul> <li>Correct expression for area of ABFE.</li> <li>OR</li> <li>Sensible steps of working towards finding <i>k</i>, from an incorrect expression for ABFE.</li> <li>OR</li> <li>CAO.</li> </ul>	<ul> <li>Consistent value for k, following from error in area of ABFE.</li> <li>OR</li> <li>Correct value of k, but without evidence of clear working.</li> </ul>	<ul> <li>E7 / t1</li> <li>Correct value of <i>k</i>, with a minor error, but with a clear working.</li> <li>E8 / t2</li> <li>Correct value of <i>k</i>, with evidence of clear working.</li> </ul>
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	ONE question attempted towards solution.	lu	2u	3u	lr	2r	t1	t2

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	$x = 0$ gives $y = 5^{0+2} + 4 = 29$ i.e. required point is (0,29) OR y=29	• Correct answer. OR CAO		
(b)(i)	$y = (x + 4)^2 - 1$ OR $y = x^2 + 8x + 15$ OR y = (x + 3)(x + 5)	• CAO	<ul> <li>Correct equation, with some justification.</li> <li>Accept n instead of x.</li> <li>Students do not need y =</li> </ul>	
(ii)	Features are : Crosses x-axis at $(-3,0)$ and $(-5,0)$ . Crosses y-axis at $(0,15)$ . Minimum at $(-4,-1)$ . Line of symmetry of $x = -4$ . Graph will be a positive parabola. Range of $y \ge -1$ . Accept intercepts as $y=15$ and $x=-5$ , $-3$	• One non-trivial feature.	• At least three non-trivial features.	
(c)(i)	y = -1.5x + 11.5 Or equivalent.	• Correct equation.		
(ii)	Algebraic Method : At the intersection points: Solve simultaneously: y = -1.5x + 11.5 and $x - 2y - 9 = 0$ Giving $x - 2(-1.5x + 11.5) - 9 = 0$ x + 3x - 23 - 9 = 0 4x = 32 x = 8 Then $y = -1.5 \times 8 + 11.5$ y = -0.5 i.e. intersection at (8,-0.5) Allow consistency from (c) (i) Allow alternative valid algebraic methods. OR Graphical Method : Draws accurate graph of $x - 2y - 9 = 0$ Intersection at (8,-0.5) identified. Evidence must be shown that the co- ordinates have been found from a graphical method and their graph.	• Line G not drawn accurately and then with a consistent intersection solution. OR Draws accurate graph of Line G x - 2y - 9 = 0. OR Algebraic simultaneous equations, with elimination of one of the variables. OR Solution found from a guess and check method. OR CAO.	<ul> <li>Intersection point identified from clear algebraic evidence.</li> <li>OR Intersection point identified from evidence of a graphical method.</li> </ul>	

(d)	$3^{2x+3} \times 3^{2x} = 3^{4-3y} #(1)$ $3^{2x+3+2x} = 3^{4-3y}$ $3^{4x+3} = 3^{4-3y} #(2)$ 3y = 1 - 4x $y = \frac{1 - 4x}{3}$	• Correctly reaching stage #(1).	• Correctly reaching stage #(2).	<ul> <li>E7 / t1</li> <li>Correct expression for <i>x</i>.</li> <li>OR</li> <li>Correct expression for <i>y</i>, with a minor error.</li> <li>E8 / t2</li> <li>Correct expression for <i>y</i>.</li> </ul>
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	ONE question attempted towards solution.	lu	2u	3u	lr	2r	t1	t2

# **Cut Scores**

Not Achieved	Not Achieved Achievement		Achievement with Excellence	
0 - 6	7 – 13	14 – 20	21 – 24	



#### Solution: Question Three (c)(ii)