2023 Sec 4NA Math Prelim Paper 2 Marking Scheme

Qn		Working	Mark Awarded	Sub-total	Remarks
1	(a)	7.004869155 = 7.00 (to 3 s.f.)	B1	1	
	(b)(i)	2.589×10^{-6}	B1	1	
	(ii)	$\left(5.97\times10^{6}\right)\div\left(7.34\times10^{2}\right)$ $= 8.133514986\times10^{3}$ $=8.13\times10^{3}$ (to 3 s.f.)	M1 A1	2	
2		Sum of interior angles in a pentagon $= (5-2)\times180°$ $= 540^{o}$ Angle *FED* = angle *EDC* = angle *DCG* $= 540^{o} \div 5$ $= 108^{o}$ $x = 180^{o} - 108^{o}$ (adj angles on a straight line) $= 72^{o}$ $540^{o} - 90^{o} - 108^{o} - 108^{o} - 108^{o}$ $= 126^{o}$ $(2y - 3) + (y + 15) = 126$ $3y + 12 = 126$ $3y = 114$ $y = 38^{o}$	M1 M1 A1 M1 A1	5	M1 for equation formed.
3	(a)(i)	The total number of students in each class may be different so it is not accurate to compare using the size of the sector or its angle.	B1	1	
	(ii)	Grey eyes in Class 1A → 30^{o} 30^{o} → 3 students 1^{o} → $\frac{1}{10}$ student 360^{o} → $\frac{1}{10}\times360$ = 36 students	M1 A1	2	
	(iii)	$\frac{45}{360}\times100\%$ = 12.5%	M1 A1	2	

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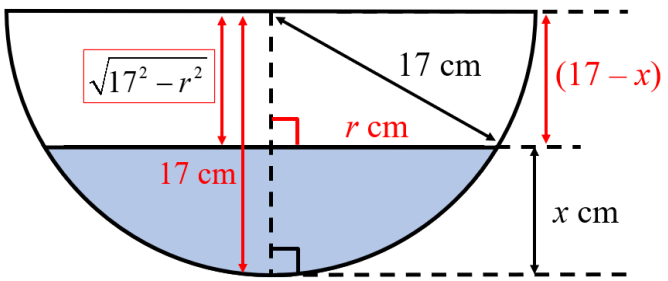
	(b)(i)	Median = $\frac{23+24}{2}$ = 23.5	B1	1	
	(b)(ii)	Total = 08 + 09 + 12 + 15 + 15 + 16 + 18 + 18 + 21 + 23 + 24 + 24 + 26 + 27 + 27 + 27 + 28 + 29 + 30 + 30 = 427 Mean = 427 ÷ 20 = 21.35 [Alternative solution] Mean = (08 + 09 + 12 + 15 + 15 + 16 + 18 + 18 + 21 + 23 + 24 + 24 + 26 + 27 + 27 + 27 + 28 + 29 + 30 + 30) ÷ 20 = 21.35	M1 A1 [M1] [A1]	2	
	(b)(iii)	P(scored more than 25 marks) $= \frac{8}{20}$ $= \frac{2}{5}$	M1 A1	2	
4		Let r be the radius of the water surface. $\pi r^2 = 225\pi$ r = 15 cm By Pythagoras' Theorem, $\sqrt{17^2 - 15^2}$ = 8 cm x = 17 – 8 = 9  	M1 M1 M1 A1	4	
5	**(a)**	60 000 cm = 60 000 / 100 000 km = 0.6 km	B1	1	

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	(b)	$13 \times 0.5 = 7.8$ km	B1	1	
	(c)	1 cm to 0.6 km 1 cm^2 to 0.6^2 km^2 1 cm^2 to 0.36 km^2 $\frac{4.8}{0.36} = 13\frac{1}{3}$ cm^2	M1 A1	 2	
6		$(5x - 4)(x + 2) = 0$ $5x - 4 = 0$ or $x + 2 = 0$ $x = \frac{4}{5}$ or $x = -2$	M1 A2	 3	No marks given for any other methods used.
7	**(a)**	Volume of cone $= \frac{1}{3}\pi r^2 h$ $= \frac{1}{3}\pi \times 12^2 \times 5$ = 753.9822369 cm^3 Volume of cylinder $= \pi r^2 h$ $= \pi \times 12^2 \times 8$ = 3619.114737 cm^3 Volume of composite solid = 753.9822369 + 3619.114737 = 4373.096974 = 4370 cm^3 (to 3 significant figures)	M1 M1 A1	 3	
	(b)	By Pythagoras' Theorem, $\sqrt{5^2 + 12^2}$ = 13 cm	B1	1	
	(c)	Curved surface area (cone) $= \pi rl$ $= \pi \times 12 \times 13$ = 490.088454 cm^2 Curved surface area (cylinder) $= 2\pi rh$ $= 2\pi \times 12 \times 8$ = 603.1857895 cm^2 Surface area of circle (base) $= \pi r^2$ $= \pi \times 12^2$	M1 M1 M1		

Qn		Working	Mark Awarded	Sub-total	Remarks
		$= 452.3893421$ cm^2 490.088454 + 603.1857895 + 452.3893421 = 1545.663586 = 1550 cm^2 (to 3 significant figures)	A1	4	
8	**(a)**	$A(-2, 5)$, $B(4, 2)$ Length of AB $= \sqrt{(-2-4)^2 + (5-2)^2}$ $= \sqrt{45}$ = 6.7082 = 6.71 units (to 3 s.f.)	B1	1	
	(b)	y-intercept = 4 Gradient = $-\frac{1}{2}$ Equation: $y = -\frac{1}{2}x + 4$	B1	1	M1 for both y-intercept and gradient
	(c)	(1, 3.5)	B1	1	
	(d) (i)	(1, –1)	B1	1	
	(ii)	Length of AB $= \sqrt{45}$ = 6.7082 units (from (a)) Length of BC $= \sqrt{(4-7)^2 + (2-(-4))^2}$ $= \sqrt{45}$ = 6.7082 $AB = BC$ Yes, Claire is correct.	M1 A1	2	M1 for calculating the length of BC. A1 for stating that Claire is correct.

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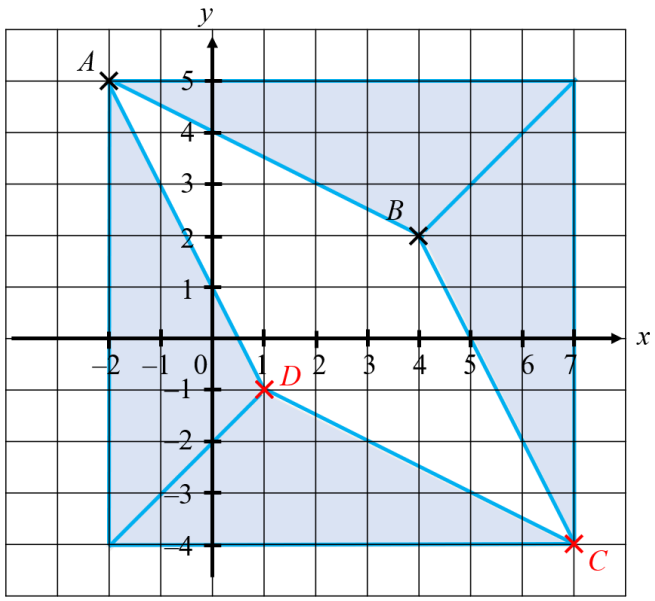
	(iii)	 Area of *ABCD* = Area of square – Area of 4 triangles $= (9\times9)-4\left(\frac{1}{2}\times9\times3\right)$ = 81 – 54 = 27 units^2	M1 A1	 2	
9	**(a)**	–3	B1	1	
	(b)	Refer to annex for graph. Plotted points: • 2 marks for all 7 correctly plotted points. • 1 mark for at least 4 correctly plotted points 1 mark for smooth curve	 B3	 3	
	(c) (i)	2.25 (Acceptable range of 1.75 to 2.75, inclusive) (+/- 1 square)	B1	1	No marks awarded if students have conducted any form of calculations to find the values of *x* or *y*.
	(ii)	–1.55 (Acceptable range of –1.6 to –1.5 inclusive) (+/- 1 square)	B1	1	
	(d)	1 mark for tangent drawn. Gradient = 0	M1 A1	 2	No marks awarded if no tangent is drawn.
10	**(a)**	Total distance = 1.5 + 40 + 10 = 51.5 km	 B1	 1	

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	(b)	135 min = $\frac{135}{60}$ h = 2 h 15 min Silver award	 B1	 1	
	(c)	$\frac{40}{22}$ $=1\frac{9}{11}$ h	M1 A1	 2	
	(d)	Shortest possible time if trains intensely for swimming = $\frac{1.5}{5}+\frac{40}{22}+\frac{10}{8}$ = $3\frac{81}{220}$ h = 3 h 22 min (rounded off to nearest minute) Shortest possible time if trains intensely for running = $\frac{1.5}{3}+\frac{40}{22}+\frac{10}{11.9}$ = $3\frac{415}{2618}$ h = 3 h 10 min (rounded off to nearest minute) Susan should train intensively for running as 3 h 10 min < 3 h 22 min or 3 h 10 min (running) would result in the bronze award while 3 h 22 min (swimming) would result in the consolation prize.	M1 M1 A1 A1 [A1]	 4	A2 for any reasonable answers.
11	**(a) (i)**	Estimated mean = $\frac{2(145)+11(155)+18(165)+6(175)+3(185)}{2+11+18+6+3}$ = $\frac{6570}{40}$ = 164.25 cm	 B1	 1	
	(ii)	Standard deviation = 9.588404455 = 9.59 cm (to 3 s.f.)	 B1	 1	
	(iii)	The students in Class B are taller			

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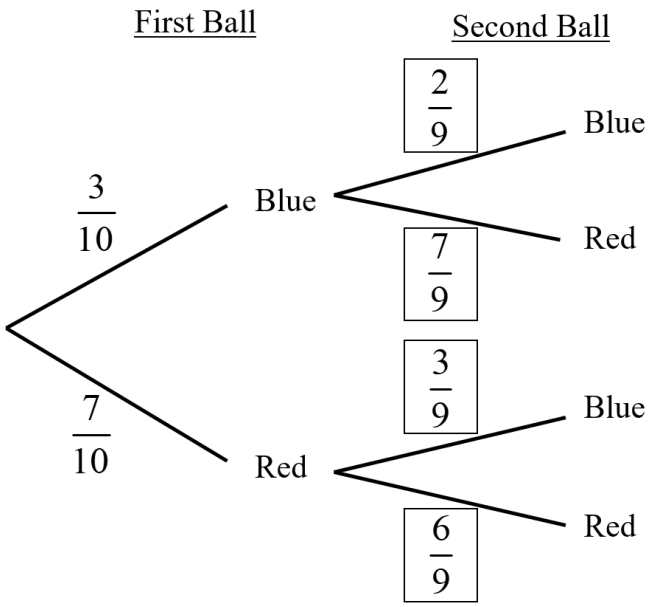
		because 169.3 > 164.25 or because the mean height of Class B is more than that of Class A.	 B1	 1	1 mark given when both answer and explanation are given.
	(iv)	The students in Class B have more consistent heights because 7.8 < 9.59. or because the standard deviation of Class B is less than that of Class A.	 B1	 1	1 mark given when both answer and explanation are given.
	(b) (i)	Probability tree diagram:  	 B2	 2	B1 for every two correct answers.
	(ii)	P(different colours) = P(blue, red) + P(red, blue) $= \left(\frac{3}{10}\times\frac{7}{9}\right)+\left(\frac{7}{10}\times\frac{3}{9}\right)$ $= \frac{7}{15}$	 M1 A1	 2	
12	**(a)**	Cosine Rule $a^2 = b^2 + c^2 - 2bc\cos A$ $259^2 = 213^2 + 105^2 - 2(213)(105)\cos\angle ABC$	 M1 M1		M1 for use of Cosine Rule.

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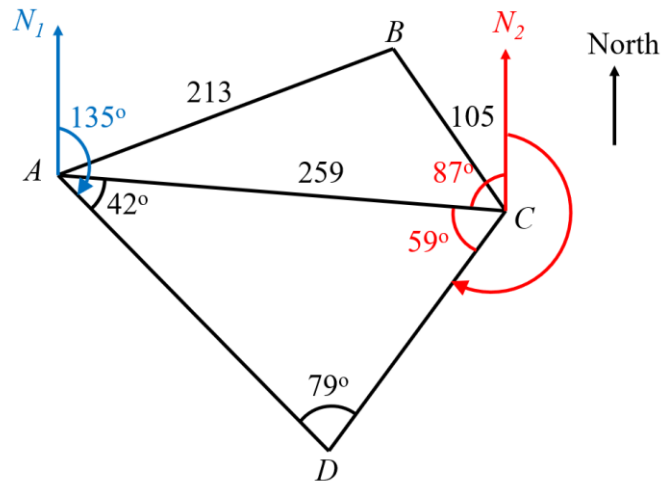
	$\measuredangle ABC = \cos^{-1}\left(\frac{259^2 - 213^2 - 105^2}{-2(213)(105)}\right)$ = 103.8229497° = 103.8° (to 1 d.p.) (shown)	A1	3	
(b)	Sine Rule $\frac{AC}{\sin \measuredangle ADC} = \frac{CD}{\sin \measuredangle CAD}$ $\frac{259}{\sin 79°} = \frac{CD}{\sin 42°}$ $CD = \frac{259 \sin 42°}{\sin 79°}$ = 176.5485206 = 177 km (to 3 s.f.)	M1 A1	2	M1 for use of Sine Rule.
(c)	Let N_1 be the North of A and N_2 be the North of C.  $\measuredangle N_1AD = 135°$ $\measuredangle N_1AC = 135° - 42° = 93°$ $\measuredangle ACN_2 = 180° - 93°$ (interior angles, N_1A // N_2C) = 87° $\measuredangle ACD = 180° - 42° - 79°$ (sum of angles in a Δ) = 59° Bearing of C from D = 360° – 87° – 59° (angles at a point) = 214°	M1 M1 A1	3	M1 for finding 93°. M1 for finding angle ACD.