Mark Scheme

GCSE Mathematics and Numeracy Unit 3 Higher Tier SAMS	Mark	Comments
1.(a) (Perimeter =) $10x - 12$ or $2(5x - 6)$ (cm) ISW	B2	Award B1 for sight of one of the following: • $2 \times (3x - 1) + 2 \times (2x - 5)$ or equivalent • $6x - 2$ • $4x - 10$ • $5x - 6$.
1.(b) $10x - 12 = 48$ or $2(5x - 6) = 48$ $10x = 60$ or $5x = 30$ $x = 6$	B1 B1 B1	FT until second error. Mark final answer. FT from $10x = k$ or $5x = k$ Unsupported correct answer implies B0 B0 B1. Award B1B1B0 for a final answer of $60 \div 10$ or $\frac{60}{10}$. If FT leads to a whole number answer, it must be shown as a whole number. Otherwise, accept a fraction.
2.(a) Position at 260° from Pwllheli Position at 310° from Fishguard Position marked or two intersecting lines	 M1 M1 A1	Allow dots or crosses or any unambiguous indication that the correct bearings have been drawn. FT if at least M1 previously awarded and two intersecting lines. (Lines must originate form P and F).
2.(b) (The 'real' distance between Fishguard to Courtown=) 5.6 × 2 000 000 ÷ 100 000 or equivalent 112 (km)	 M2 A1	May be seen in stages. Award M1 for one of the following • 1 cm represents 20 km • 1 cm represents 20 000 m • 5.6 × 2 000 000 • 11 200 000 (cm) • 112 000 m • 5.6 × 'their 20' where 'their 20' is from a place value error in conversion • a number with digits 112, where any other digits are all zeros. CAO.
Organisation and Communication.	OC1	For OC1, candidates will be expected to: • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical • write a conclusion that draws together their results and explains what their answer means

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3. Sight of 190 (Total number of calls = 22 + 48 + 62 + 34 + 14 + 10) Sight of any of the following: • (80% of 190=) 152 (calls) **AND** (less than 30 seconds =) 132 (calls) • (20% of 190=) 38 (calls) **AND** (more than 30 seconds=) 58 (calls) • (132 calls = $\frac{132}{190} \times 100 = 69.4(7..)\%$ • (58 calls = $\frac{58}{190} \times 100 = 30.5(2..)\%$ Conclusion 'No'.	B1 M2 A1	Check the graph for answers. FT 'their 190'. M1 for sight of either of the following: • (80% of 190=) 152 (calls) **OR** (less than 30 seconds =) 132 (calls) • (20% of 190=) 38 (calls) **OR** (more than 30 seconds=) 58 (calls) FT provided conclusion from correct working only and M2 previously awarded.
4.(a) 13 (cm)	B2	Award B1 for one of the following: • sight of 2.01 and 1.88 • sight of 201 and 188 • sight of 0.13 (m) • 2.01 – 'their 1.88' correctly converted to cm (× 100) • 'their 2.01' – 1.88 correctly converted to cm (× 100) • 'their 2.01' – 'their 1.88' correctly converted to cm (× 100) • 'their 2.01' AND 'their 1.88' correctly converted to cm (× 100) • 10 cm (from 1.85 – 1.75).
4.(b)(i) Explanation with reference to mass and height increasing or decreasing together e.g. "the heavier players are taller" "as mass decreases so does the height" "they both increase"	E1	
4.(b)(ii) (Height =) 1.78 (m) AND (Mass =) 119 (kg)	B1	
4.(c) Straight line of best fit, following the trend with some points above and some below the line.	B1	Allow intention of a straight line.
4.(d) Explanation of why it is not an appropriate estimate, e.g. "the diagram only considers the trend of players up to 122(kg)" "out of range".	E1	Allow "the heights of the four players around 120 kg are very different so using the line in this region is not appropriate".

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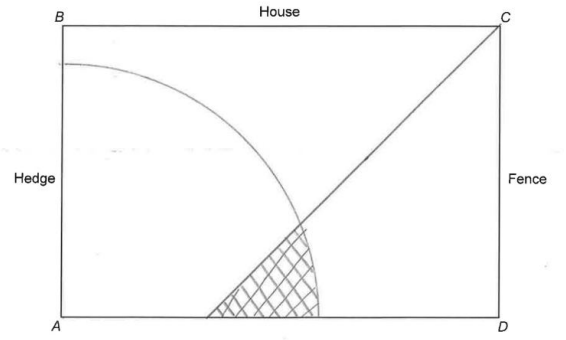
4.(e) 8 × 113.25 + 7 × 94.86 ÷ 15 104.668 or 104.67 or 104.7 or 105 (kg)	M1 m1 A1	(906 + 664.02 = 1570.02) CAO
Accuracy of writing.	W1	For W1, candidates will be expected to: • show all their working • use correct mathematical form in their working • use appropriate terminology, units, etc
5. (*QR* =) $\frac{2\times36}{8}$ or equivalent = 9 (cm) (*PR*^{2} =) $8^2 + 9^2$ or equivalent *PR*^{2} = 145 or (*PR* =) √145 (x =) 12(·041...cm)	M1 A1 M1 A1 A1	Check diagram for answers. Award M1 for $\frac{8\times QR}{2} = 36$. May be implied in later working (M1A1). Note: (*PR*^{2} =) 64 + 81. FT 'their derived 9'. Final answer of x = 145 is M1A0A0. FT provided their answer > 'their 9' and > 8. FT from M1 for the correctly evaluated square root of 'their 145' provided their answer > 9. *Alternative method to find x* *A correct and complete method (using trigonometric relationships)* *M2* *(x =)* 12(·041...cm) *A1*
6. Unambiguous angle bisector of BCD ± 2° Arc centre A with radius 7 cm ± 2 mm Correct region identified  	 B1 B1 B1	All lines and arcs must be of sufficient length to be able to select the correct region. Any valid method may be used to bisect the angle e.g. using a protractor or a pair of compasses. FT provided B1 awarded for the arc.

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7. (Volume of cylinder =) $\pi \times 2.3^2 \times 5$ = 83(.095….) or 26.45π (cm^3) (Density of metal =) 423.1 ÷ 83(.095….) Accept an answer between 5 and 5.1 (g/cm^3)	M1 A1 M1 A1	May be seen or implied in later working. Accept an answer between 83 and 83.11 inclusive. FT 423.1 ÷ 'their derived volume of cylinder', provided π has been used in its calculation.
7. Alternative method: *(Density of metal =)* $\frac{423.1}{\pi \times 2.3^2 \times 5}$ *Accept an answer between 5 and 5.1 (g/cm^3)*	*M2* *A2*	*Award M1 for sight of $\pi \times 2.3^2 \times 5$.* A1 for sight of $\frac{423.1}{26.45\pi}$ or $\frac{8462}{529\pi}$ or $\frac{15.9(96\ldots)}{\pi}$ or any other simplified fraction with **one** step left to carry out.
8.(a) $250 < x \leq 350$	B1	
8.(b) Midpoints 100, 200, 300, 400 100 × 23 + 200 × 84 + 300 × 116 + 400 × 28 (= 2300 + 16800 + 34800 + 11200 = 65100) ÷ 251 259.3(6..) miles or 259.4 or 259 miles or equivalent	B1 M1 m1 A1	 FT 'their midpoints' within or at the bounds of the appropriate groups, provided no more than one of 'their midpoints' lies outside the group. ISW Allow 260 miles from correct working.
9. $\frac{\pi \times r^2}{2} = 113.5$ or equivalent r^2 = 72.2(56…) or $r^2 = \frac{227}{\pi}$ r = 8·5(00…) (area of trapezium=) $\frac{2 \times 8.5 + 22}{2} \times 8.5$ or equivalent = 165.75 (cm^2)	M1 m1 A1 M1 A1	Check diagrams for answers. Sight of 72(.256…) implies M1m1. FT 'their r^2', provided M1 awarded. 9 must not be from incorrect working. FT 'their derived or stated r'. Accept 165.8 or 166 (cm^2). Mark final answer.
10. (*AB* =) 8.3 ÷ sin 34 = 14.8(4…cm)	M2 A1	Award M2 for 8.3 ÷ cos 56. Award M1 for one of the following: • sin 34 = $\frac{8.3}{AB}$ • cos 56 = $\frac{8.3}{AB}$ Allow 15 provided not from incorrect working.

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11.(a) Abergwyn median =(£) 250 000 Caermaes median = (£) 270 000 (Abergwyn IQR =) (£) 320 000 – (£)170 000 (£) 150 000	 B1 B1 M1 A1	
11.(b) Caermaes indicating a valid reason referring to the appropriate values in the table e.g. "Caermaes median is higher" "Half of Caermaes' houses are less than £270000 and half or Abergwyn's are less than £250 000" and the prices are less spread out"	E1	FT the conclusion based on 'their median values in the table in (a)'. Do not allow reasons based on the spread of the data alone, e.g. "Caermaes are less spread out" "Caermaes is higher" "Caermeas IQR is less" Award E1 also for one of the following: • reference is made to the medians followed by IQR "Caermaes median is higher, and their prices are less spread out" • 'can't tell' chosen and valid reason indicating that the raw data is not available and that the data-points could be clustered together at one end of each group or quartile.
11.(c) 1.012 × 270 000 or equivalent £273 240	M1 A1	Award M1 for a complete full method. FT 'their £270 000' from part (a), provided it is between £200 000 and £300 000.
12. 13200 × 460 ÷ 3 = 2024000 (cm^3) = 2.024(m^3)	M1 A1 B1	Or equivalent. Strict FT of a correct conversion of their volume in cm^3 to m^3, provided M1 awarded.
12. Alternative method *(13200 =) 1.32 (m^2) AND (460 =) 4.6 (m)* *= 1.32 × 4.6 ÷ 3* *= 2.024(m^3)*	 *B1* *M1* *A1*	 *Or equivalent.* *FT 'their 1.32' × 'their 4.6' ÷ 3* *CAO*
13. $\frac{42}{360} \times 2 \times \pi \times 7$ or equivalent = 5.1(…) or $\frac{49}{30}\pi$ (Perimeter =) 19.1(…cm) OR $14 + \frac{49}{30}\pi$	M1 A1 A1	 Allow 5 provided not from incorrect working. Mark final answer. FT 'their 5.1(…cm)' + 14 Allow 19 (cm) provided not from incorrect working.

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14.(a) $\frac{1280}{20 \times 1300}$ (× 100) = 4.9(%)	M2 A1	Award M1 for sight of one of the following: • 26 000 • 20 × 1300 • the digits 49(23…) (place value error). FT 'their 20 × 1300'.
14.(b) (Number of people under 45 =) 5 × 1100 + 10 × 1520 + 10 × 1060 + 20 × 1300 (= 5500 + 15200 + 10600 + 26000) = 57300 (people) (Population all ages = 76 × 1618 =) 122968 (Number of people over 45 = 122968 – 57300 =) 65668 (people)	 M1 A1 B1 B1	 Allow M1 for the sum of 4 products with any 2 correct CAO. May be implied in later working. FT 'their 122968' – 'their 57300' provided M1 awarded. Allow correctly rounded answers provided they are from correct working.
15. $x = \frac{-(5) \pm \sqrt{(5)^2 - 4 \times 3 \times (-1)}}{2 \times 3}$ $x = \frac{-5 \pm \sqrt{37}$ $6}$ x = 0.18, with x = –1.85	 M1 A1 A1	Trial and improvement method gains M0. Allow one slip in substitution, but must be correct formula CAO. Both solutions must be given for A1.
16. Finding the correct scale factor • $\frac{\sqrt[3]{72}}{\sqrt[3]{243}}$ or $\sqrt[3]{\frac{72}{243}}$ or equivalent • $\frac{\sqrt[3]{243}}{\sqrt[3]{72}}$ or $\sqrt[3]{\frac{243}{72}}$ or equivalent • $\frac{3}{2}$ or 1.5 or equivalent • $\frac{2}{3}$ or $0.\dot{6}$ or equivalent (Height =) 18 × $\frac{2}{3}$ or 18 ÷ $\frac{3}{2}$ or equivalent = 12 (cm)	B1 M1 A1	May be implied in further working. Award B1 for any correct equivalent expression. Implies previous B1 provided not from incorrect working. FT 'their $\frac{2}{3}$' or 'their $\frac{3}{2}$' provided first B1 awarded. CAO. Note: 243 ÷ 72 = 1.5 followed by either 18 ÷ 1.5 = 12 or 8 × 1.5 = 12 is awarded B0M0A0.

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17.(a) Tangent drawn at 60 seconds Idea of difference in y ÷ difference in x Correct gradient from difference in y ÷ difference in x	 M1 m1 A1	 Allow one error in counting squares or in reading the scale for m1 only Accept the gradient as a proper fraction or decimal or percentage. Allow negative values. Mark final answer.
17.(b)(i) ½ × 20 × (36 + 0 + 2(34 + 29 + 20)) OR ½ × 20 × (36 + 68 + 58 + 40) = 2020 (m) or 2.02 km	 M2 A1	 Award M1 for one of the following: • 1 slip in substitution of values • 1 of the vertical readings omitted with all others correct. FT from M1 is available provided it comes from a calculation with no vertical readings omitted.
17.(b)(i) Alternative method $\frac{(36+34)}{2}\times 20+\frac{(34+29)}{2}\times 20$ $+\frac{(29+20)}{2}\times 20+\frac{(20+0)}{2}\times 20$ *= 2020 (m)* or 2.02 km	 *M2* *A1*	 *(= 700 + 630 + 490 + 200)* *Award M1 for one of the following:* • *the sum of these 4 areas with one error (may be repeated) in the substitution of values* • *sight of 4 correct areas with the intention to add them (possibly omitting one).* *FT from M1 is available provided it comes from the sum of 4 areas.*
17.(b)(ii) Explanation e.g. 'Increase the number of strips' 'Use strips of smaller width'	 E1	
18. Finding the appropriate angle 108°	 B1	Check diagram for answers.
(Distance between Manchester and Lisbon =) $\sqrt{605^2+1440^2-2\times 605\times 1440\times\cos 108}$ = 1725.7(045…) (km)	 M2 A1	 (=$\sqrt{2978056.211}$) FT 'their 108(°)' provided < 140. M1 for $605^2 + 1440^2 - 2 \times 605 \times 1440 \times \cos 108(°)$. CAO. Mark final answer. Award A1 for truncated or rounded answer e.g. 1725 (km) or 1726 (km).
12 × (605 + 1440 – 1725.7) or equivalent An answer between 3831 and 3832 (litres) inclusive	M1 A1	Award M1 for correct full method. (= 12 × 319.3) FT 'their 1725.7(…) provided cosine rule previously attempted'. Award A1 for truncated or rounded answer.

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How to read the mark scheme

- ‘M' marks are awarded for any correct method applied to appropriate working, even though a numerical error may be involved. Once earned they cannot be lost.
- ‘m’ marks are dependant method marks. They are only given if the relevant previous ‘M’ mark has been earned.
- ‘A' marks are given for a numerically correct stage, for a correct result or for an answer lying within a specified range. They are only given if the relevant M/m mark has been earned either explicitly or by inference from the correct answer.
- 'B' marks are independent of method and are usually awarded for an accurate result or statement.
- ‘S’ marks are awarded for strategy
- ‘E’ marks are awarded for explanation
- ‘U’ marks are awarded for units
- ‘P’ marks are awarded for plotting points
- ‘C’ marks are awarded for drawing curves
- ‘OC’ marks are awarded for ‘organising and communicating’, a strand of OCW (organising, communicating and writing accurately)
- ‘W’ marks are awarded for ‘writing accurately’, a strand of OCW (organising, communicating and writing accurately)
- ‘SC’ marks are awards for special cases
- CAO: correct answer only
- ISW: ignore subsequent working
- FT: follow through

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Assessment mapping

Qn	Topic	Max mark	AO1	AO2	AO3	Common Qn (FT)	Common marks (FT)	OCW
1	Forming and solving	5	5					
2	Plotting Bearings + scale	7	3	4		13	3	*
3	Mali's frequency diagram	4		4		14	4	
4	Scatter diagram + units + mean	10	4	5	1	15	6	*
5	Pythagoras, area and perimeter of triangle	5			5	16	5	
6	Loci - Gruff's garden	3		3		17	3	
7	Cylinder + density	4		4		18	4	
8	Grouped frequency table	5	5					
9	Semi circle and trapezium	5			5			
10	Trig - missing side	3	3					
11	Cumulative + Box plots	7	6		1			
12	Pyramid + units	3	3					
13	Perimeter of sector	3	3					
14	Histogram	7	3	4				
15	Quadratic formula	3	3					
16	Similar glasses - volume	3		3				
17	Trapezium rule	7	6	1				
18	Cosine, Sine and Bearings	6			6			
	Totals	**90**	**44**	**28**	**18**		**25**	

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