REVISE
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3.23 — Cumulative frequency

Mark schemes for the 3.23 question pack

Spec 4.2.18 — Unit 3

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 11 questions in the corresponding revise.wales question pack (30 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes. Pack layout © revise.wales.

Autumn 2016		
4(a)(i) 52 hours	B1	
4(a)(ii) 10 girls	B1	
4(a)(iii) FALSE TRUE TRUE FALSE	B2	B1 for any 3 correct answers If no marks, award SC1 for an answer TRUE, TRUE, TRUE, TRUE (as it is a repeat misunderstanding/error)
4(b) Statement 1: Complete method to calculate the interquartile range Girls' IQR (59 or 58 - 33 or 32 =) 25 to 27 AND Boys' IQR (46 or 45 – 19 or 18 =) 26 to 28 AND Trefor correct if IQR boys > IQR girls or Trefor incorrect if IQR boys ≤ IQR girls Statement 2: Conclusion, e.g. 'Incorrect, as the median for the boys is 40 hours which is lower than girls median (52 hours)'	M1 A2 E1	Based on sight of method for either boys or girls, or either IQR correct provided not clearly from incorrect working A1 for either IQR correct Ignore incorrect time notation, e.g. '26.30 hours' for 26.5 hours Conclusion must include statement that 'boys' median is 40 hours' FT for a reason based on 'their 52 hours', (a)(i) and 40 hours. Accept responses based on comparisons of the modal groups 50 to 60 hours (with 52) girls and 40 to 50 hours (with 60) boys Accept comparisons of the estimated means, boys 33·8(571…hours) and girls 45·2(857…hours)

5(a) 45 (seconds)	B1	
5(b) 30	B1	
5(c) 0.9(0) × 70 = 63 (passengers) (In 60 seconds) 65 (passengers left) OR 63 passengers within (58 or) 59 seconds OR 63 (passengers) in less than 60 seconds Conclusion that the target was met	M1 A1 B1 E1	 Ignore incorrect units Check the diagram for indication, provided values are written FT 'their 63' provided M1 previously awarded Depends on M1, B1 previously awarded *Alternative:* *By 1 minute, 65 passengers left B1* *(100 ×) 65/70 M1* *0.92(8…) or 0.93 or 92(.8%) or 93(%) A1* *Conclusion that target met E1* *(Depends on M1, B1)* *Alternative:* *For candidates **clearly** considering the number of passengers left on the plane, must be evidence of this before awarding marks* *(0.1× 70=)* *7 (passengers left on the plane) B1* *(After 1 minute) 70 – 65 M1* *5 (passengers) A1* *Conclusion that target met E1* *(Depends on M1, B1)*

3(a)(i) Median in the inclusive range 16.8 to 17 (minutes) Interquartile range 19 to 19.3 - 14 to 14.3 Answer in the range 4.7 to 5.3 (minutes)	B1 M1 A1	
3(a)(ii) Reason, e.g. 'the points on the diagram have been joined with straight lines', 'the data has been grouped, so actual times have been lost', 'the raw data is more detailed (than graph)', 'not exact using a cumulative frequency diagram', 'it is just an estimate using the diagram'	E1	Allow, e.g. 'the raw data is more detailed than Meirion's data' (although both Meiron's data!), 'the points could be joined by a curve' Do not accept, e.g. 'seconds can not be presented'
3(b) 34 – 12 22 (of his customers)	M1 A1	
3(c) Sight of either of the following: • (80% of 120 =) 96 (customers) **OR** (20 minutes is) 102 (customers) • (20% not cleaned in 20 minutes is) 24 (customers) **OR** 18 (customers more than 20 minutes) Sight of any of the following: • (80% of 120 =) 96 (customers) **AND** (20 minutes is) 102 (customers) • (20% not cleaned in 20 minutes is) 24 (customers) **AND** 18 (customers more than 20 minutes) • (96 customers is)19.3 to 19.8 (minutes) • (102 customers is 102/120 × 100 =) 85% • (102 customers is 102/120 × 100 =) 85% • (18 customers is 18/120 × 100 =) 15% Conclusion 'yes'	M1 M1 A1	Accept readings on the graph Accept readings on the graph CAO from correct working only and M2 awarded Accept 'no as 85% (**not** 80%) in less than 20 minutes'

6(a) 20 to 25 minutes	B1	
6(b) 'No' indicated or unambiguously implied, with a reason, e.g. 'only shows data for groups', 'it was in the group 40 to 45 minutes', 'doesn't show how many runners finished in 45 minutes', 'the last 2 runners took between 40 and 45 minutes'	E1	Do not accept any reason implying 'Yes' Allow 'No' with, e.g. 'the graph shows the cumulative frequency not the actual times', 'doesn't show the actual times' Do not accept, e.g. 'it goes to the nearest 5 minutes', 'it shows frequency not times of results', 'it doesn't show how many runners finished between 40 and 45 minutes'. 'because it can be an average'
6(c) **70%** (within 30 minutes)' (80% within) **35** (minutes)'	B1 B1	
6(d) Difference 26 - 24.5 to 24.8 Answer in the range • 1.2 to 1.5 (minutes), or • 1 minute 12 seconds to 1 minute 30 seconds	M1 A1	Do not accept an answer in the correct range from incorrect working Mark final answer If units are given they must be correct

9(a) Explanation e.g. 'Because cumulative frequency is not accurate. It's an estimate', or 'Because the data is grouped. The median could be anywhere between 60 and 80', or 'The marks between 60 and 80 may not be evenly distributed', or 'The 24 marks between 60 and 80 may not be split evenly either side of 70', or 'The 13th mark between 60 and 80 may not be 70' 'The 30.5th mark is greater than 70'	E1	Do not accept e.g. 'This is only an estimate', or 'Because the data is grouped'
9(b) 12	B1	

5(a)(i) $1800 \leq x < 2000$	B1	Accept '(£)1800 to (£)2000', or '(£)1800 – (£)2000'
5(a)(ii) Reason based on agreement due to the 4 people earning £5800 to £7800 per month or the majority of lower wages, e.g. 'the data is skewed', 'only a few of the employees will earn more than the mean wage', 'because most people employed are in the lowest 2 groups of the monthly wage' 'as the majority earn between 1800 and 2100'	E1	Allow, e.g. 'because there is a great difference between the monthly wages', 'the big numbers would affect the mean', 'more than half are in the first group' Do not accept, e.g. 'she doesn't know the exact values', 'using the median would be better', 'because there are no employees that have between 2400 and 5800 monthly wage', 'there are 64 in the first group'
5(b)(i) (2200, 48) joined to (2400, 72) joined to (3000, 80)	B2	Joined with a curve or a straight line B1 for a cumulative graph with either of the following: • correct plots but not joined, • 'their 2 plots' joined provided 1 plot 'correct' including FT plot at (3000, $48 < y \leq 80$)
5(b)(ii) £2160	B1	
5(b)(iii) 22.5(%) OR answer from correct working in the range 21(.25%) to 23.75(%) or 24(%)	B2	Working $\frac{17}{80} \times 100$ to $\frac{19}{80} \times 100$ B1 for sight of $\frac{17}{80}$ to $\frac{19}{80}$

7(a) Frequency density	B1	
7(b) 'No' OR 'You cannot tell' AND e.g. 'The heaviest player could have been 140 kg and the lightest player could have been 70 kg, but we cannot tell', 'It doesn't give you the mass of any player', 'You cannot tell exact weights because it is grouped data' OR No AND e.g. 'The lightest and heaviest players could not be 70kg and 140kg because of how groups are written'	E1	Do not accept reasons e.g. 'Because it is grouped data' without further explanation about how the data could be distributed in the groups, or 'The graph is not accurate enough'
7(c) $10\times0.8 + 10\times1.1 + 20\times0.1$ $= 21$	M1 A2	Allow for $x\times0.8 + 10\times1.1 + 20\times0.1$, where $6 \leq x < 10$ May be seen on the diagram CAO A1 for 17.8, possibly rounded to 17 or 18 If no marks, SC1 for sight of $10\times1.1 + 20\times0.1$, or $11 + 2$, or 13 May be seen on the diagram

7(d) (Mid-points) 80, 95, 105, 115, 130 (Frequencies of) 8, 5, 8, 11, 2	B1 B1	May be seen on the graph May be seen on the graph or in (c) FT 'their 8, 11, 2' from (c)
80×8 + 95×5 + 105×8 + 115×11 + 130×2 or equivalent (640 + 475 + 840 + 1265 + 260 = 3480)	M1	FT their frequencies (but not use of frequency densities 0.4, 0.5, 0.8, 1.1 and 0.1) AND FT their mid-points provided they are within the groups (inclusive of the boundaries)
÷ 34	m1	Allow FT for the sum of their frequencies
= 102.3(529…) or 102.4	A1	CAO Allow an answer of 102 from correct working

3(a) Whiskers at 3 m and 22 m Unambiguous values or box with LQ 5 m and UQ 20 m Median at 15 m	B1 B1 B1	Ignore if lines omitted from the ends of the whiskers Must be the least and greatest values shown May be seen in working, must be clearly LQ and UQ Check cumulative frequency diagram If not clearly labelled in working or on the graph, they must be no other values given between • the least and the LQ, and • the greatest and the UQ May be seen in working, must be clearly the median Check cumulative frequency diagram If not an unambiguous unique line or point, i.e. not clearly labelled in working or on the graph, allow for a line (or point) indicated that is not the least or greatest value shown Only if B1 B1 B1 awarded, <u>penalise -1</u> if a correct format for a box-and-whisker diagram is not shown
3(b)(i) 0.75 × 68 or equivalent 51 (yachts)	M1 A1	Answer space takes precedence If no marks, award SC1 for sight of 17 (from 0.25 × 68)
3(b)(ii) Conclusion 'Eog' with sight of (Eog IQR 20 – 5 =) 15 (m) AND (Clwyd IQR 18 – 10 =) 8 (m)	B2	FT 'their UQ – LQ' from (a) box-and–whisker diagram B1 for either IQR correct
3(b)(iii) Conclusion 'Can't tell' with reason, e.g. 'only know that 25% of yachts in Clwyd Marina are greater than 18m' 'we don't know if any of the yachts in Clwyd Marina are greater than 22(metres, the longest in Eog Marina)' 'we don't know if a yacht in Clwyd Marina is greater than 22(metres)' 'it doesn't say maximum length of Clwyd Marina's results'	E1	Ignore any additional incorrect or spurious statements Allow 'Can't tell' with a reason, e.g. 'no raw data' 'don't know this information' 'doesn't show anywhere the biggest yacht in Clwyd Marina' 'we are only given some of the lengths of the yachts in the marinas' 'doesn't show Clwyd Marina's results' 'not specified' 'not specific' 'range not given for the Clwyd Marina (so can't identify the longest yacht)' Do not accept, e.g. 'don't know how many yachts in the marinas' 'not mentioned for either marina'

4(a)(i) Entries 146 and 160 in the table and the cumulative frequency diagram completed correctly (correct plots (11, 146) and (13, 160) and all plots joined)	B2	B1 for any one of the following: • 146 and 160 in the table, correct plots but **not** joined • 146 and 160 in the table, with one correct plot and one incorrect plot in completing the **cumulative** frequency diagram with plots joined • one error in the table, including FT 'their 146' + 14 and these **cumulative** entries used correctly to complete the **cumulative** frequency diagram with plots joined • correct cumulative frequency diagram with plots joined, with incorrect, incomplete or not attempted entries in the table
4(a)(ii) 8.2 to 8.4 (minutes)	B1	Answer space takes precedence Allow 8 minutes 12 seconds to 8 minutes 24 seconds FT reading from the graph for 'their median', from ½ × 'their 160', provided 'their 160' ≥ 110, with a tolerance of ½ small square from 'their **cumulative** frequency graph', provided it is possible to read 'their median' from the vertical axis on the graph paper provided
4(a)(iii) 7.2 minutes	B1	Answer space in the statement takes precedence, if blank award for indication of '7.2' (circled) in the list Allow '7' in the answer space provided 7.2 indicated in the list Do not accept '8' in the answer space if 7.2 indicated in the list
4(a)(iv) $\frac{20}{160}$ (× 100) or $\frac{1}{2}$ × 25 (%) or equivalent 12.5 (%) or 12½ (%)	M1 A1	FT for (100 ×) 20/'their 160', provided 'their 160'> 106 On FT allow rounding or truncation to 1 decimal place
4(b) (Costs are 180 + 220) (£) 400 **AND** (Profit is 700 – 180 – 220) (£) 300 **OR** (Receipts / Costs =) $\frac{700}{400}$ (× 100) (Percentage profit is) $\frac{300}{400}$ (× 100) or $\frac{700}{400}$ (× 100) – 1 (× 100) 75 (%)	B1 M1 A1	May be embedded, e.g. 700 – 400 = 300 (= 1.75 or 175%) FT 'their 400' and 700 – 'their 400' provided their costs or profit are ≠ 180, ≠ 220 and ≠ 700 CAO Allow if all costs and the total are consistently multiplied by 3.
4(c) 8(.)40 ÷ 1(.)20 or 8(.)40 – 8(.)40 ÷ 6 or equivalent (£) 7 or 700 (p)	M1 A1	Accept a **complete** and **convincing** method of trial and improvement If units are given they must be correct Sight of 7 + 1.40 = 8.40 is awarded M1 A0 unless (£)7 is selected

Unit 1: Higher Tier	Mark	Comments
4(a)(i) 200 – 80 or 90 + 30 120 (customers)	M1 A1	
4(a)(ii) 32 seconds	B1	
4(a)(iii) $\frac{200-170}{200}$ or $\frac{30}{200}$ or $\frac{15}{100}$ $\frac{3}{20}$	M1 A1	Award M1 for 0.15 or 15% Only ignore further working if written as 0.15 or 15% If no marks, award SC1 for an answer of $\frac{17}{20}$ (from 40 seconds or less)
4(b)(i) 36	B1	
4(b)(ii) 46 – 20 26	M1 A1	Allow 20 – 46
4(c) 'No' unambiguously stated or implied AND a reason, e.g. 'upper quartile is higher this year' '75% reading higher this year' 'interval was 37 (or 38) to 50 seconds last year, this year it is 46 to 50 seconds'	E1	Do not ignore incorrect values for the upper quartiles given, E0 if 'upper quartile' or '75%' stated with incorrect upper quartile readings Allow 'No' with a reason, e.g. '(last year) 38, (this year) 46' '(last year) 37.(…), (this year) 46' Do not accept, e.g. 'range greater this year' 'lower quartile is lower this year' 'median higher this year' 'customers still waiting at 50 seconds'

4(a)(i) States 80 (and) 100 (seconds) AND indicates 'Yes'	B1	Allow written as 100 and 80 Answer space takes precedence
4(a)(ii)I. (80 – 75 =) 5 (seconds)	B1	Not from incorrect working Answer space takes precedence
4(a)(ii)II. Answer in the inclusive range 12 to 14 (seconds)	B2	Allow in this range only provided it not from incorrect working Answer space takes precedence B1 for sight of 92 – 60 (– 20) to 94 – 60 (– 20) or 32 (–20) to 34 (– 20)
4(b) 96 (seconds)	B3	Answer space takes precedence B2 for sight of or indication of 64 (squirrels), B1 any one of the following: • for sight of or indication of 16 (squirrels) • (use of 16 squirrels) answer of 52 (seconds) B0 for 64 seconds from incorrect working, 20% of 120 = 24, with time 64 seconds B0 for 96 seconds from incorrect working, 80% of 120 = 96, with time 96 seconds

4(c) (24 ÷ 21 500) × 1 000 000 (squirrels per km^2)	M2	Accept using estimation: (24 ÷ 20 000) × 1 000 000 M1 for any one of the following, including if embedded: • 24 ÷ 21500 (= 0.001116… squirrels per m^2) • (estimate) 24 ÷ 20 000 (= 0.0012 squirrels per m^2) • 1 000 000 ÷ 21 500 (= 46.5….) • (estimate) 1 000 000 ÷ 20 000 (= 50)
1116(.27...) (squirrels per km^2) AND Conclusion indicated or unambiguously implied 'Oak'	A1	Accept 1200 from estimating, i.e. (24 ÷ 20 000) × 1 000 000 =1200 (squirrels per km^2) If no marks, award SC1 for appropriate sight of a calculation of 24 ÷ 'a number with only non-zero digits 215', provided not embedded in further working apart from multiplication or division by powers of 10
4(c) Alternative method: *(If **oak**, number of squirrels likely in Maesgwyn Forest) 21 500 × 1200 ÷ 1 000 000*	*M2*	*Allow M2 for (If chestnut) 21 500 × 100 ÷ 1 000 000 (= 2.15)* *or (if pine) 21 500 × 45 ÷ 1 000 000 (= 0.9675)* *M1 for any one of the following, including if embedded:* • *(if oak) 21 500 × 1200 (= 25 800 000)* • *(If chestnut) 21 500 × 100 (= 2 150 000)* • *(if pine) 21 500 × 45 (= 967 500)* • *21 500 ÷ 1 000 000 (= 0.0215)* • *20 000 ÷ 1 000 000 (= 0.02)*
25.8 (squirrels) AND 'Oak' indicated as conclusion	*A1*	*Allow from correct working either* *2.15 (squirrels for Chestnut so must be) Oak, or* *0.9675 or 1 (squirrels for Pine so must be) Oak* *If no marks, award SC1 for appropriate sight of **any 1** of the following calculations:* • *'a number with only non-zero digits 215' ×1200* • *'a number with only non-zero digits 215' × 45* *provided not embedded in further working apart from multiplication or division by powers of 10*

8(d) Sight of base of triangle = 3h	B1	Any letter or word may be used for the height Needs to be convincing. May be seen on diagram
$\left(\frac{\pi \times h^2}{4} + 4h^2 + \frac{3h^2}{2}\right) \times 2 = 0.1$ or $\frac{2\pi \times h^2}{4} + 8h^2 + \frac{6h^2}{2} = 0.1$ or (12.57 to 12.571)h^2 = 0.1 or equivalent	M2	Ignore a place value error from an incorrect attempt to convert m^3 into cm^3 and/or m into cm for M and m marks only but A0 Allow omission of ×2 for M2 or M1 and possibly m1 M1 for: • the sum of appropriate terms equated to 0.1, with no more than 1 error in the terms • $\left(\frac{\pi \times h^2}{4} + 4h^2 + \frac{3h^2}{2}\right) \times 2$ or equivalent
$h^2 = \frac{0.1}{2(\frac{\pi}{4}+5.5)}$ or equivalent	m1	FT if possible from M1 provided h^2 in every term Note: $\pi/4 + 5.5 = 6.285$ to 6.2855 $\pi/2 + 11 = 12.57$ to 12.571
h = 0.089 to 0.0892 (m) or equivalent	A2	CAO Ignore an incorrect attempt to convert to cm or mm Accept 0.09 (m) from correct working A1 for h = $\sqrt{\frac{0.1}{2(\frac{\pi}{4}+5.5)}}$ or $\sqrt{\frac{1}{5\pi+110}}$ or h = $\sqrt{0.00795\ldots}$

End of solutions