HIGHER

6.11 Cumulative Frequency: 1-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The grouped frequency table shows the waiting time at a clinic (minutes) for 60 items.

$20 < x \leq 40$: 12

$40 < x \leq 60$: 12

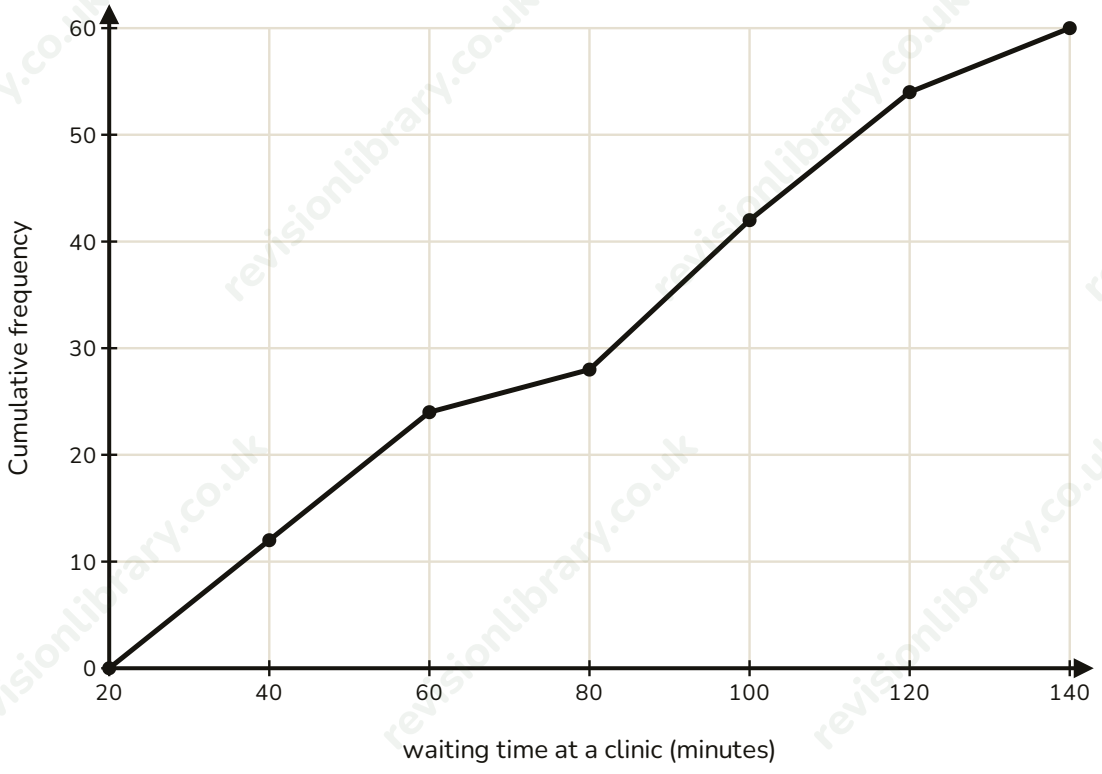
$60 < x \leq 80$: 4

$80 < x \leq 100$: 14

$100 < x \leq 120$: 12

$120 < x \leq 140$: 6

A cumulative frequency graph is drawn with straight lines joining the plotted points. Estimate the number of items with a value of 90 or less.



(Total for Question 1 is 3 marks)

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2 The grouped frequency table shows the time taken to finish a puzzle (minutes) for 80 items.

$20 < x \leq 25$: 10

$25 < x \leq 30$: 10

$30 < x \leq 35$: 18

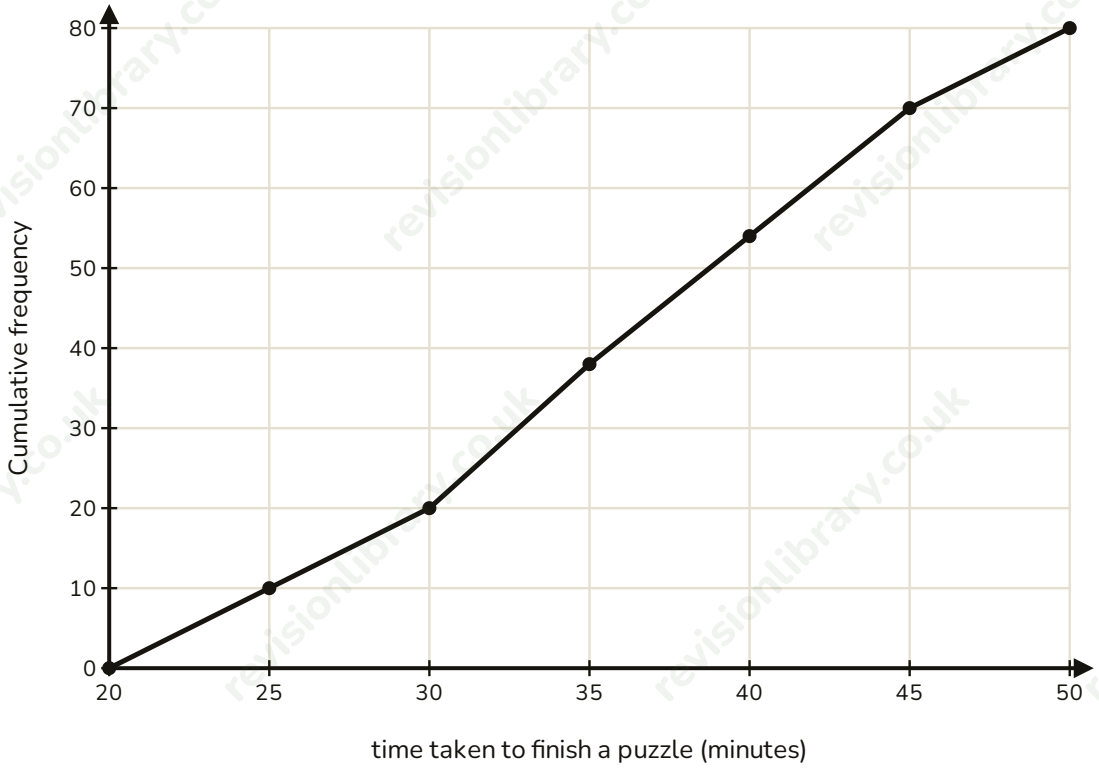
$35 < x \leq 40$: 16

$40 < x \leq 45$: 16

$45 < x \leq 50$: 10

Using linear interpolation on the cumulative frequency graph, estimate the interquartile range.

Give your answer to 1 decimal place.



(Total for Question 2 is 5 marks)

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3 The grouped frequency table shows the mass of a parcel (kg) for 120 items.

$40 < x \leq 60$: 29

$60 < x \leq 80$: 13

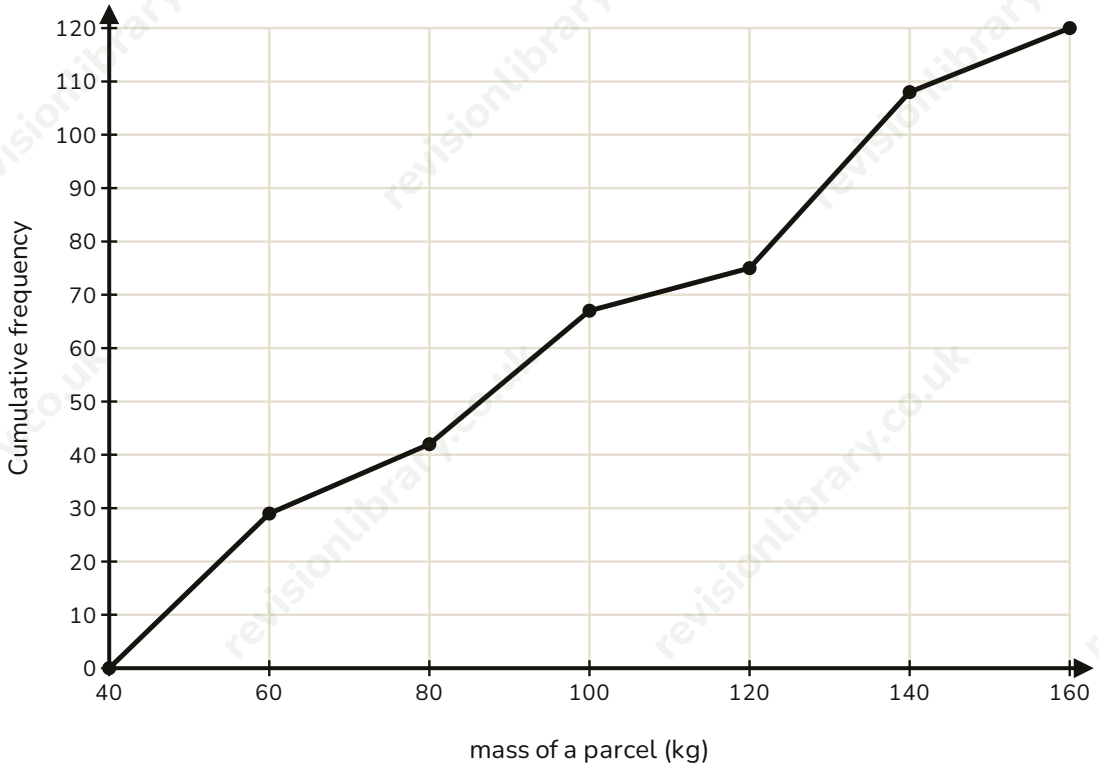
$80 < x \leq 100$: 25

$100 < x \leq 120$: 8

$120 < x \leq 140$: 33

$140 < x \leq 160$: 12

A cumulative frequency graph is drawn by plotting cumulative frequency against upper class boundary, joining the points with straight lines. Use linear interpolation to estimate the median. Give your answer to 1 decimal place.



(Total for Question 3 is 4 marks)

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4 The grouped frequency table shows the waiting time at a clinic (minutes) for 80 items.

$0 < x \leq 10$: 21

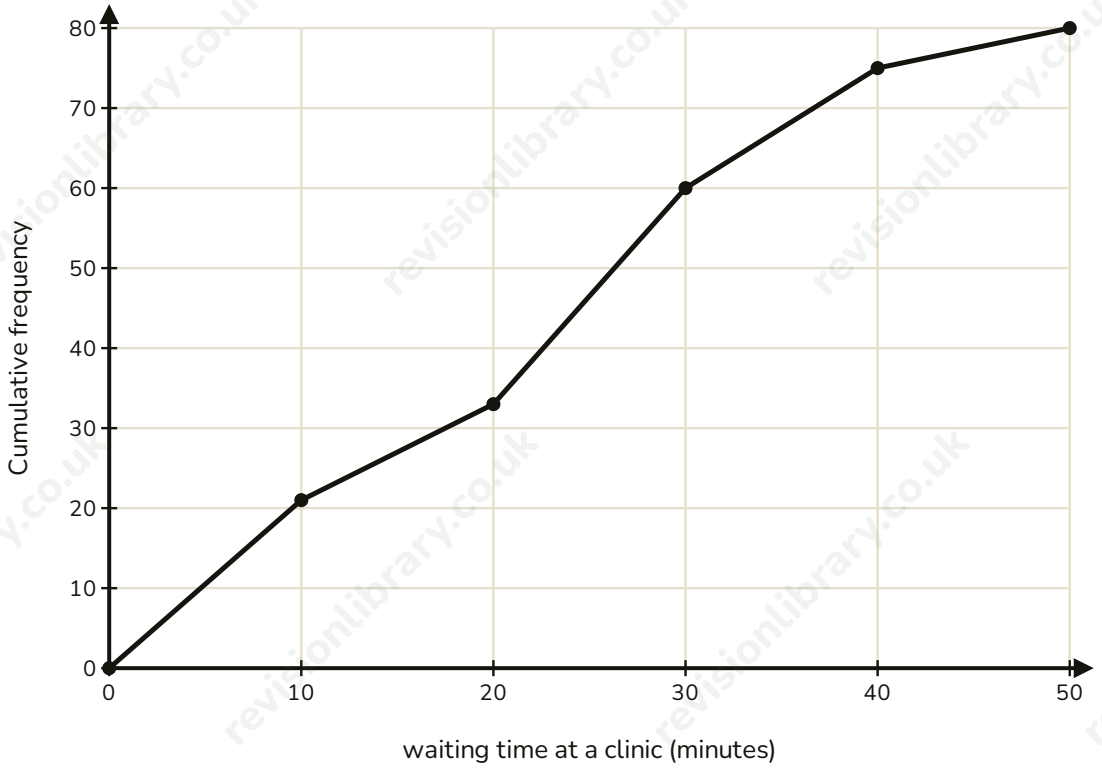
$10 < x \leq 20$: 12

$20 < x \leq 30$: 27

$30 < x \leq 40$: 15

$40 < x \leq 50$: 5

A cumulative frequency graph is drawn with straight lines joining the plotted points. Estimate the number of items with a value greater than 36.



(Total for Question 4 is 3 marks)

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5 The grouped frequency table shows the height of a plant (cm) for 40 items.

$20 < x \leq 30$: 6

$30 < x \leq 40$: 11

$40 < x \leq 50$: 3

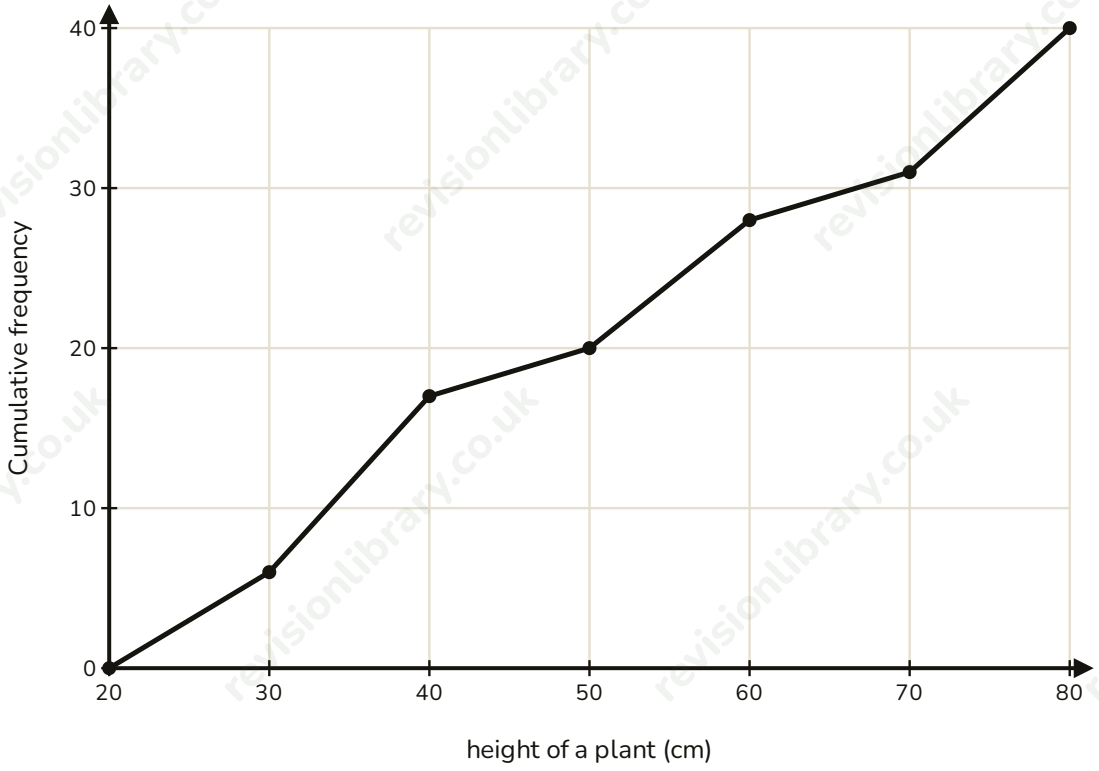
$50 < x \leq 60$: 8

$60 < x \leq 70$: 3

$70 < x \leq 80$: 9

Using linear interpolation on the cumulative frequency graph, estimate the interquartile range.

Give your answer to 1 decimal place.

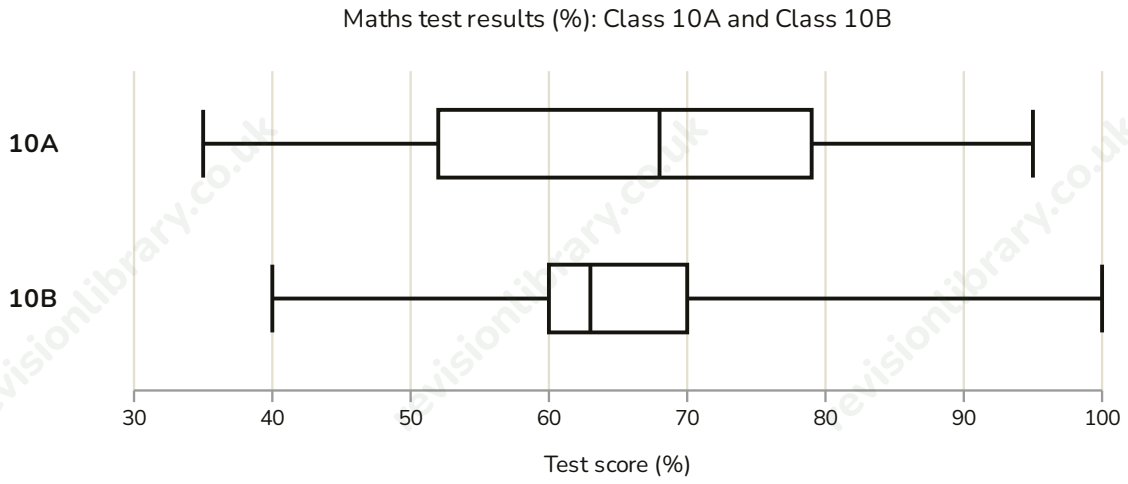


(Total for Question 5 is 5 marks)

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6 Two classes, 10A and 10B, sat the same maths test out of 100. Their results are summarised in the box plots below.

10A: minimum = 35, lower quartile = 52, median = 68, upper quartile = 79, maximum = 95
10B: minimum = 40, lower quartile = 60, median = 63, upper quartile = 70, maximum = 100



(a) Write down the range of test scores for each class. **(2)**

.....

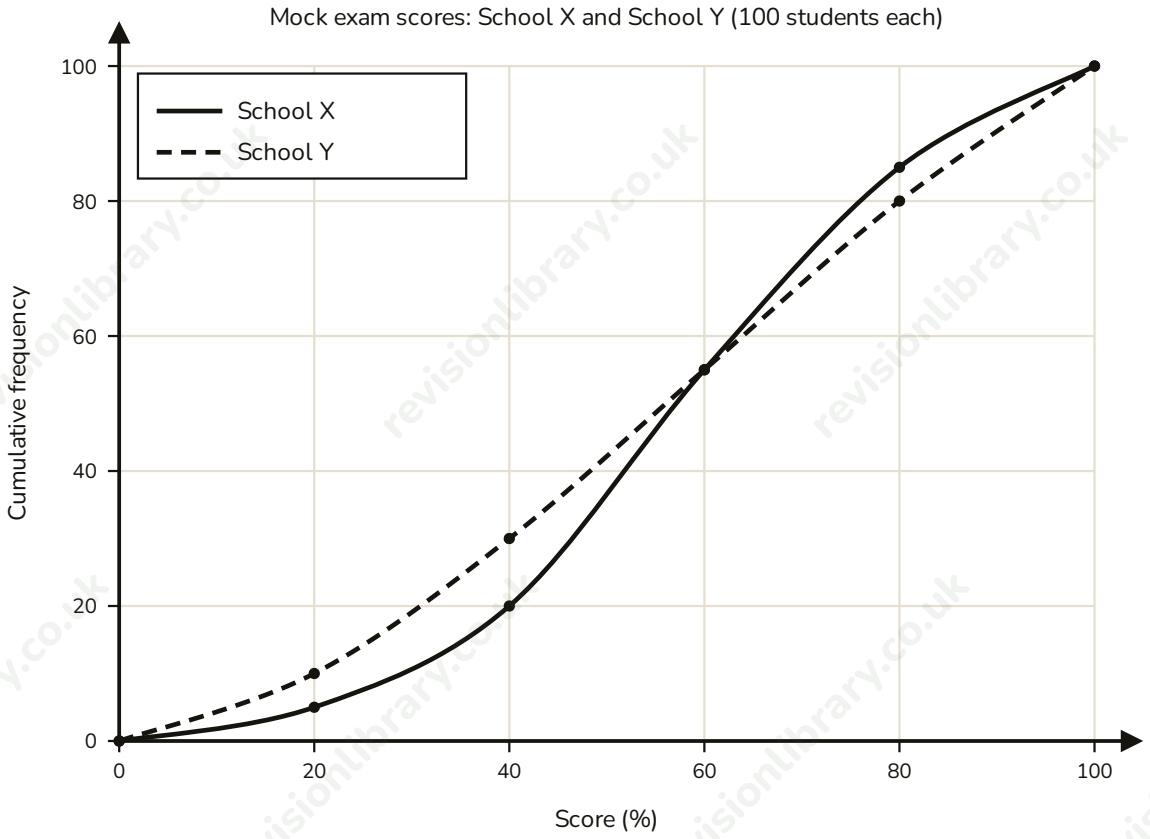
(b) Since the two classes have the same range, a student concludes that they must have the same spread of scores. Compare the distributions of test scores for the two classes to show whether this conclusion is correct. You must use appropriate statistics and refer to the context. **(3)**

(Total for Question 6 is 5 marks)

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7 Two schools, School X and School Y, each entered 100 students for the same mock exam. Cumulative frequency graphs have been drawn using the following points.

School X: (0,0), (20,5), (40,20), (60,55), (80,85), (100,100)
School Y: (0,0), (20,10), (40,30), (60,55), (80,80), (100,100)



(a) Use the graphs to find an estimate for the median score at each school. **(2)**

.....

(b) Use the graphs to find an estimate for the interquartile range of scores at each school. **(2)**

.....

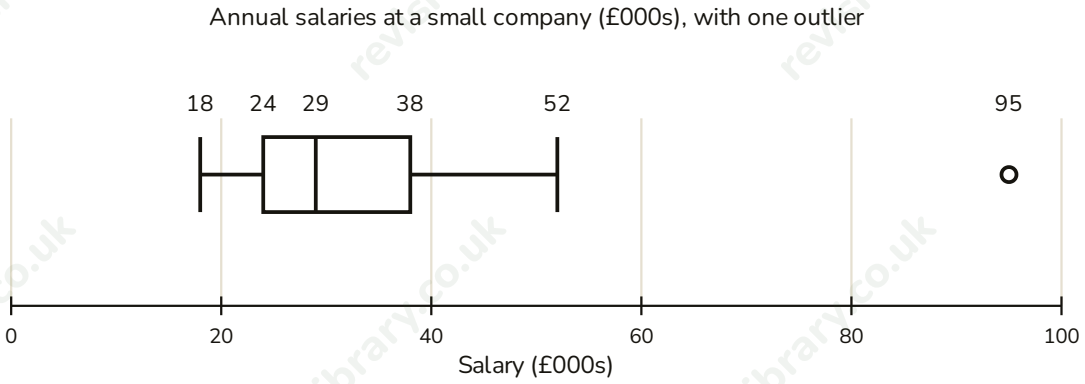
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(c) Using your answers to parts (a) and (b), compare the performance of the students at the two schools, and comment on which school's students performed more consistently. **(2)**

(Total for Question 7 is 6 marks)

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8 A box plot for the annual salaries, in £, of 40 employees at a small company has: minimum (excluding outliers) = £18,000, lower quartile = £24,000, median = £29,000, upper quartile = £38,000, maximum (excluding outliers) = £52,000, with one additional outlier plotted at £95,000.



(a) Using the rule that a value is an outlier if it is more than 1.5 x IQR above the upper quartile, show that £95,000 is an outlier. **(3)**

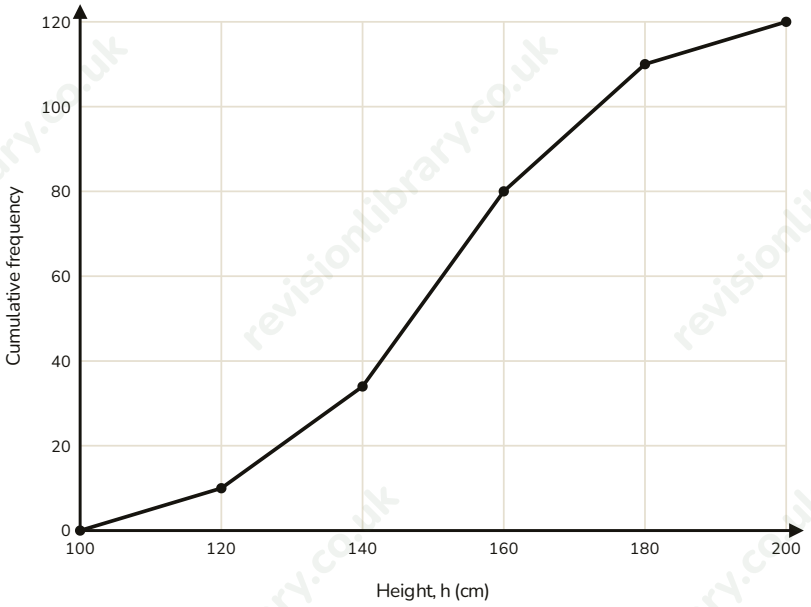
(b) Write down the range of the data, including the outlier. **(1)**

(Total for Question 8 is 4 marks)

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9 Kwame, a horticultural researcher, grew 120 sunflowers as part of a trial. The table shows their heights, h cm, at the end of the trial.

Height, h (cm)	Frequency
$100 < h \leq 120$	10
$120 < h \leq 140$	24
$140 < h \leq 160$	46
$160 < h \leq 180$	30
$180 < h \leq 200$	10



(a) Complete the cumulative frequency table below. **(2)**

Height, h (cm)	Cumulative frequency
$h \leq 120$	10
$h \leq 140$	...
$h \leq 160$	...
$h \leq 180$	...
$h \leq 200$	120

(b) Use the graph to estimate the median height. **(1)**

(c) Use the graph to estimate the interquartile range of the heights. **(2)**

(d) A sunflower is classed as exceptionally tall if its height is more than 1.5 x IQR above the upper quartile. Determine the height threshold for this, and state what this tells you about the sunflowers in this trial. **(1)**

(Total for Question 9 is 6 marks)

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10 Priya, a delivery analyst, believes that Courier A's delivery times are more consistent than Courier B's. Cumulative frequency graphs for 50 deliveries by each courier gave these estimates:

Courier A: lower quartile = 18 minutes, median = 25 minutes, upper quartile = 29 minutes
Courier B: lower quartile = 12 minutes, median = 24 minutes, upper quartile = 40 minutes

(a) Calculate the interquartile range for each courier. **(2)**

(b) Does the data support Priya's claim? Justify your answer with reference to the interquartile ranges. **(2)**

(c) State one limitation of using the interquartile range alone to compare the consistency of the two couriers. **(1)**

(Total for Question 10 is 5 marks)

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Mark scheme · 6.11 Cumulative Frequency: 1-hour Pack

Question 1

cumulative frequencies found	**M1**
interpolates within the correct class	**M1**
35 cao	**A1**

Answer: 35

Question 2

cumulative frequencies found	**M1**
lower quartile at 20th value	**M1**
upper quartile at 60th value	**M1**
both quartiles estimated by interpolation	**M1**
11.9 minutes (accept ±0.1)	**A1**

Answer: 11.9 minutes

Question 3

cumulative frequencies found	**M1**
median at 60th value	**M1**
linear interpolation within the correct class	**M1**
94.4 kg (accept ±0.1)	**A1**

Answer: 94.4 kg

Question 4

cumulative frequencies found	**M1**
cumulative frequency at 36 by interpolation	**M1**
11 cao	**A1**

Answer: 11

Question 5

cumulative frequencies found	**M1**
lower quartile at 10th value	**M1**
upper quartile at 30th value	**M1**
both quartiles estimated by interpolation	**M1**
33.0 cm (accept ±0.1)	**A1**

Answer: 33.0 cm

Question 6

(a) 10A range = 60 cao	**B1**
(a) 10B range = 60 cao	**B1**

(a) Answer: 10A: 60; 10B: 60 (the ranges are equal)

(b) IQR(10A) = 79 - 52 = 27 and IQR(10B) = 70 - 60 = 10, both correct	**B1**
(b) conclusion in context: 10A's IQR is much greater than 10B's, so 10A's scores (the middle 50%) were far more spread out/varied than 10B's, even though the ranges are equal	**B1**
(b) comparison of medians in context: 10A's median (68) is higher than 10B's (63), so 10A typically scored higher/better	**B1**

(b) Answer: The conclusion is wrong: although the ranges are equal, 10A's IQR (27) is much larger than 10B's (10), so 10A's scores were far more spread out/less consistent in the middle 50%; 10A also had the higher median (68 vs 63), so typically scored higher.

Question 7

(a) School X median = awrt 57 (accept 55-59)	**B1**
(a) School Y median = awrt 56 (accept 54-58)	**B1**

(a) Answer: School X: awrt 57; School Y: awrt 56

(b) School X IQR = awrt 30 (accept 27-34)	**B1**
(b) School Y IQR = awrt 41 (accept 37-45)	**B1**

(b) Answer: School X: awrt 30; School Y: awrt 41

(c) ft: the medians are similar (awrt 57 and awrt 56), so the overall level of performance at the two schools was about the same oe	**B1**
(c) ft: School X has the smaller IQR (awrt 30 compared with awrt 41), so School X's scores were less spread out/more consistent than School Y's oe	**B1**

(c) Answer: Similar median performance overall, but School X's students performed more consistently (smaller IQR).

Question 8

(a) IQR = 38,000 - 24,000 = 14,000	**M1**
(a) dep: upper boundary = 38,000 + 1.5 x 14,000 (= 59,000)	**M1**
(a) cso: 95,000 > 59,000, so £95,000 is an outlier	**A1**

(a) Answer: Upper boundary = £59,000; since £95,000 > £59,000, it is an outlier.

(b) £77,000 cao	**B1**

(b) Answer: £77,000

Question 9

(a) at least two of h ≤ 140 : 34, h ≤ 160 : 80, h ≤ 180 : 110 correct	**B1**
(a) all three values correct: h ≤ 140 : 34, h ≤ 160 : 80, h ≤ 180 : 110	**B1**

(a) Answer: h ≤ 140 : 34, h ≤ 160 : 80, h ≤ 180 : 110

(b) ft: awrt 151.3 cm (accept 150.8-151.8)	**B1**

(b) Answer: approx 151.3 cm

(c) ft: correct interpolation (or graph reading) for both the lower quartile (30th value, awrt 136.7 cm) and the upper quartile (90th value, awrt 166.7 cm)	**M1**
(c) ft: 30.0 cm cao (accept 29.0-31.0)	**A1**

(c) Answer: 30.0 cm

(d) ft: awrt 211.7 cm (accept 209-215), with the observation that since the tallest sunflower recorded was only 200 cm, no sunflower in this trial reached the exceptionally-tall threshold	**B1**

(d) Answer: approx 211.7 cm; since no sunflower in the trial was taller than 200 cm, none reached this threshold.

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Question 10

(a) Courier A: 11 minutes cao **B1**

(a) Courier B: 28 minutes cao **B1**

(a) Answer: Courier A: 11 minutes; Courier B: 28 minutes

(b) ft: recognising that a smaller IQR means the middle 50% of times are less spread out, i.e. more consistent **B1**

(b) ft: yes, the claim is supported, since Courier A's IQR (11) is much smaller than Courier B's (28), so Courier A's delivery times are more consistent **B1**

(b) Answer: Yes, the data supports the claim: Courier A's IQR (11 minutes) is much smaller than Courier B's (28 minutes), so Courier A's delivery times are more consistent.

(c) oe: the IQR ignores the top and bottom 25% of deliveries, so it does not account for any unusually early or late deliveries (outliers) in the full data set **B1**

(c) Answer: The IQR only describes the middle 50% of deliveries, so it ignores any very fast or very slow deliveries in the top and bottom 25%.

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