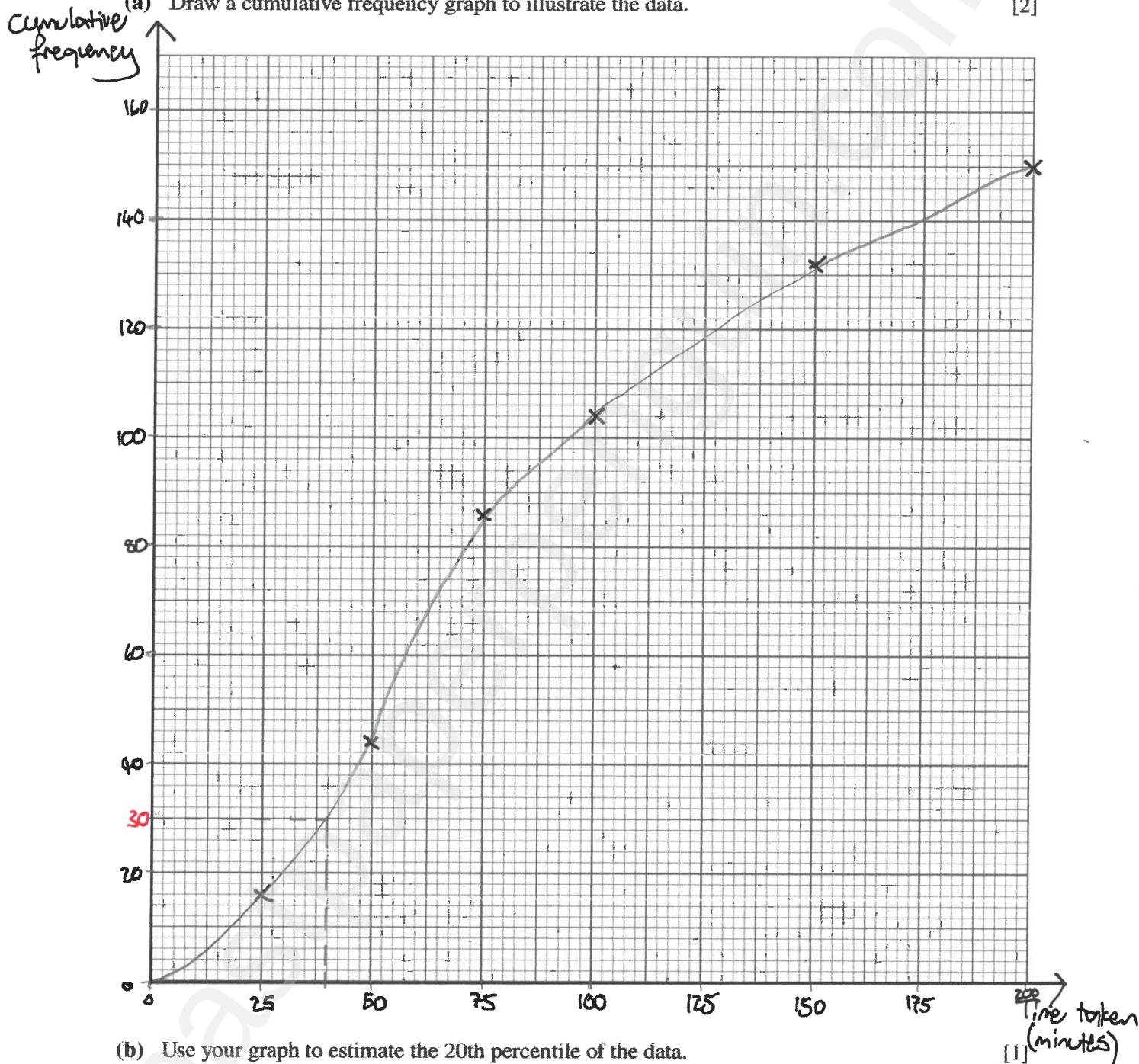


- 1 The time taken, t minutes, to complete a puzzle was recorded for each of 150 students. These times are summarised in the table.

Time taken (t minutes)	$t \leq 25$	$t \leq 50$	$t \leq 75$	$t \leq 100$	$t \leq 150$	$t \leq 200$
Cumulative frequency	16	44	86	104	132	150

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]

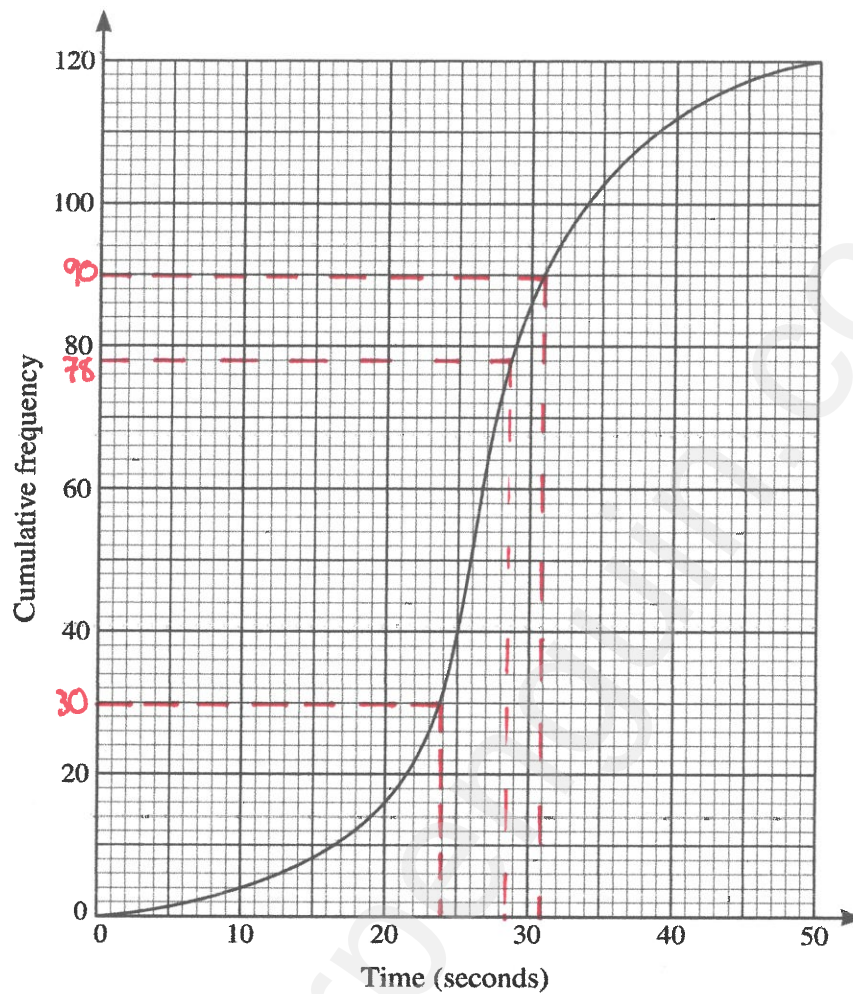


- (b) Use your graph to estimate the 20th percentile of the data.

$$0.2 \times 150 = 30$$

$$20^{\text{th}} \text{ percentile} = \underline{40}$$

1



The times taken by 120 children to complete a particular puzzle are represented in the cumulative frequency graph.

- (a) Use the graph to estimate the interquartile range of the data.

[2]

$$Q_1: 0.25 \times 120 = 30 \quad Q_3: 0.75 \times 120 = 90$$

$$Q_1 = 24$$

$$Q_3 = 31$$

$$IQR = 31 - 24 = \underline{7}$$

35% of the children took longer than T seconds to complete the puzzle.

- (b) Use the graph to estimate the value of T .

[2]

35% took longer than T , so 65% took less than T .

$$0.65 \times 120 = 78$$

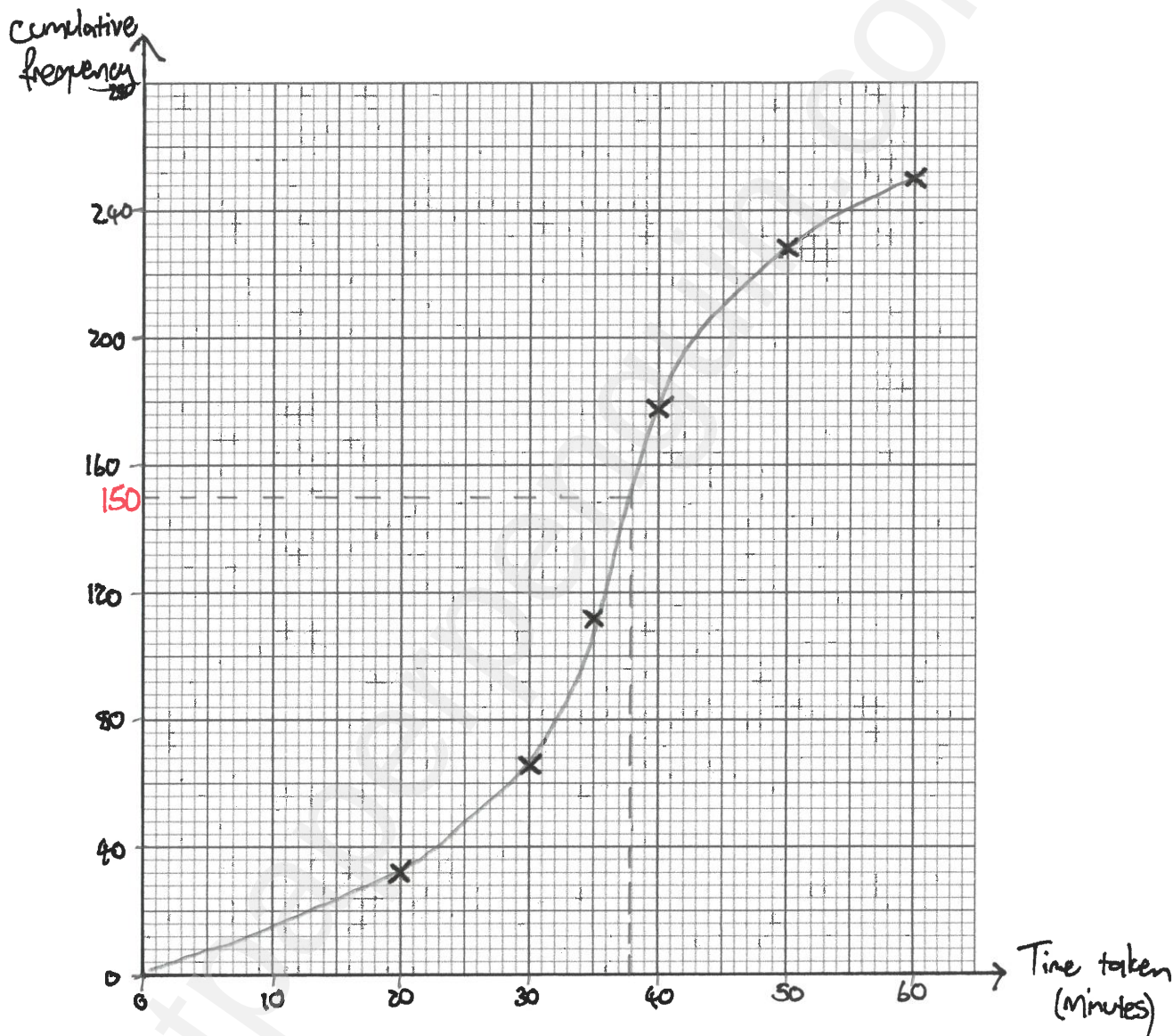
$$T \approx \underline{28.5s}$$

- 3 The times, t minutes, taken to complete a walking challenge by 250 members of a club are summarised in the table.

Time taken (t minutes)	$t \leq 20$	$t \leq 30$	$t \leq 35$	$t \leq 40$	$t \leq 50$	$t \leq 60$
Cumulative frequency	32	66	112	178	228	250

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]



- (b) Use your graph to estimate the 60th percentile of the data.

[1]

$$0.6 \times 250 = 150$$

60th percentile $\approx$ 38 mins

It is given that an estimate for the mean time taken to complete the challenge by these 250 members is 34.4 minutes.

- (c) Calculate an estimate for the standard deviation of the times taken to complete the challenge by these 250 members. [4]

Mid-point (t)	Frequency (f)
10	32
25	34
32.5	46
37.5	66
45	50
55	22
	$\Sigma f = 250$

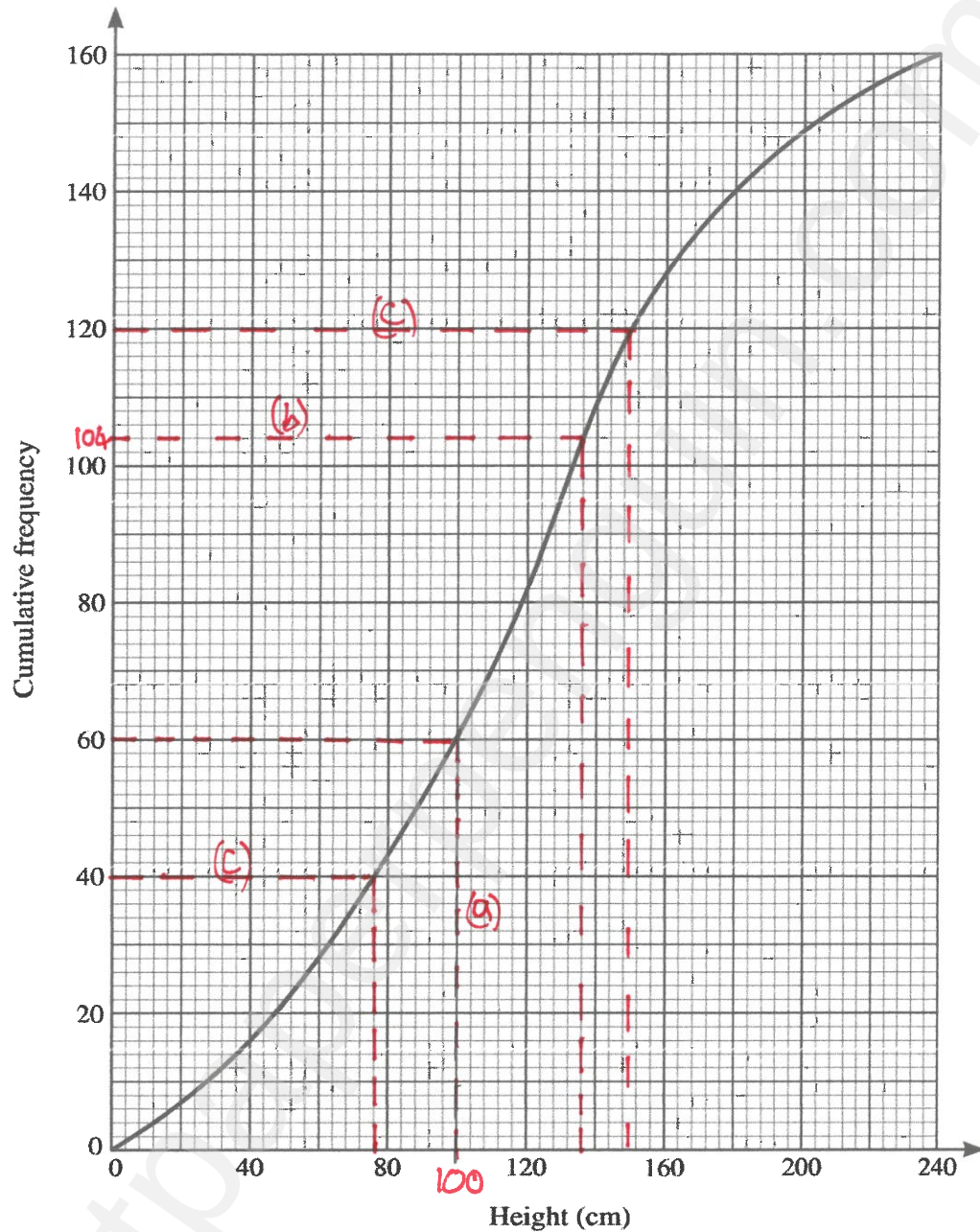
$$\text{Var} = \frac{10^2 \times 32 + 25^2 \times 34 + 32.5^2 \times 46 + 37.5^2 \times 66 + 45^2 \times 50 + 55^2 \times 22}{250} - 34.4^2$$

$$= 151.24$$

$$\sigma = \sqrt{151.24}$$

$$= \underline{12.3}$$

- 1 The heights in cm of 160 sunflower plants were measured. The results are summarised on the following cumulative frequency curve.



- (a) Use the graph to estimate the number of plants with heights less than 100 cm.

[1]

60

- (b) Use the graph to estimate the 65th percentile of the distribution.

[2]

$$0.65 \times 160 = 104$$

$$65^{\text{th}} \text{ percentile} = \underline{136 \text{ cm}}$$

- (c) Use the graph to estimate the interquartile range of the heights of these plants.

[2]

$$Q_1: 0.25 \times 160 = 40$$

$$Q_1 = 76$$

$$Q_3: 0.75 \times 160 = 120$$

$$Q_3 = 150$$

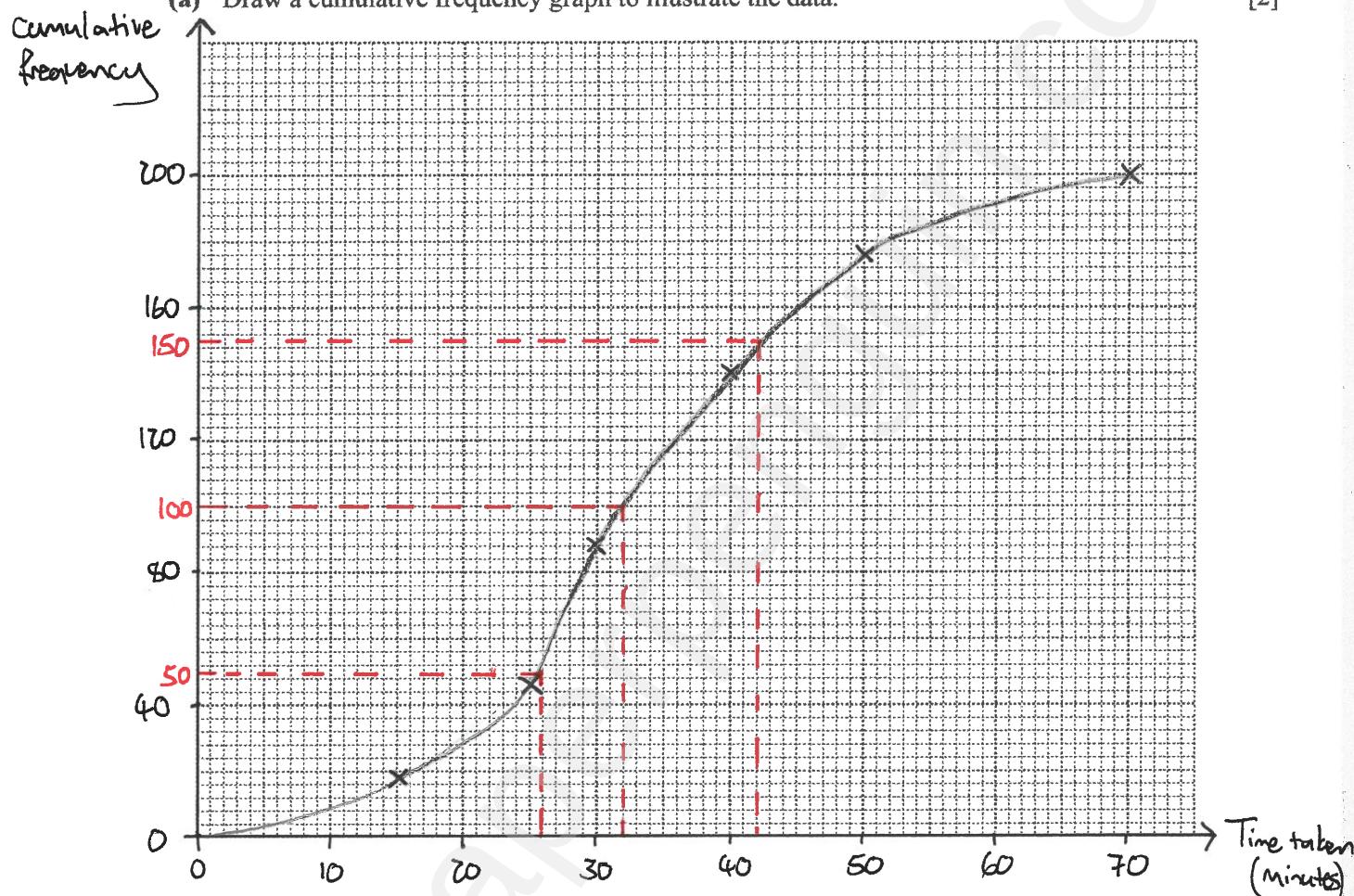
$$\begin{aligned} \text{IQR} &= 150 - 76 \\ &= \underline{74 \text{ cm}} \end{aligned}$$

- 3 The time taken, in minutes, to walk to school was recorded for 200 pupils at a certain school. These times are summarised in the following table.

Time taken (t minutes)	$t \leq 15$	$t \leq 25$	$t \leq 30$	$t \leq 40$	$t \leq 50$	$t \leq 70$
Cumulative frequency	18	46	88	140	176	200

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]



- (b) Use your graph to estimate the median and the interquartile range of the data.

[3]

Median: $0.5 \times 200 = 100$ $\rightarrow$ $Q_2: 0.75 \times 200 = 150$

Median = 32

$Q_3 = 42$

$Q_1: 0.25 \times 200 = 50$

$Q_1 = 26$

$IQR = 42 - 26$

$= 16$



- (c) Calculate an estimate for the mean value of the times taken by the 200 pupils to walk to school. [3]

Mid-point (t)	Frequency (f)	$f \times x$
7.5	18	135
20	28	560
27.5	42	1155
35	52	1820
45	36	1620
60	24	1440
	$\Sigma f = 200$	$\Sigma fx = 6730$

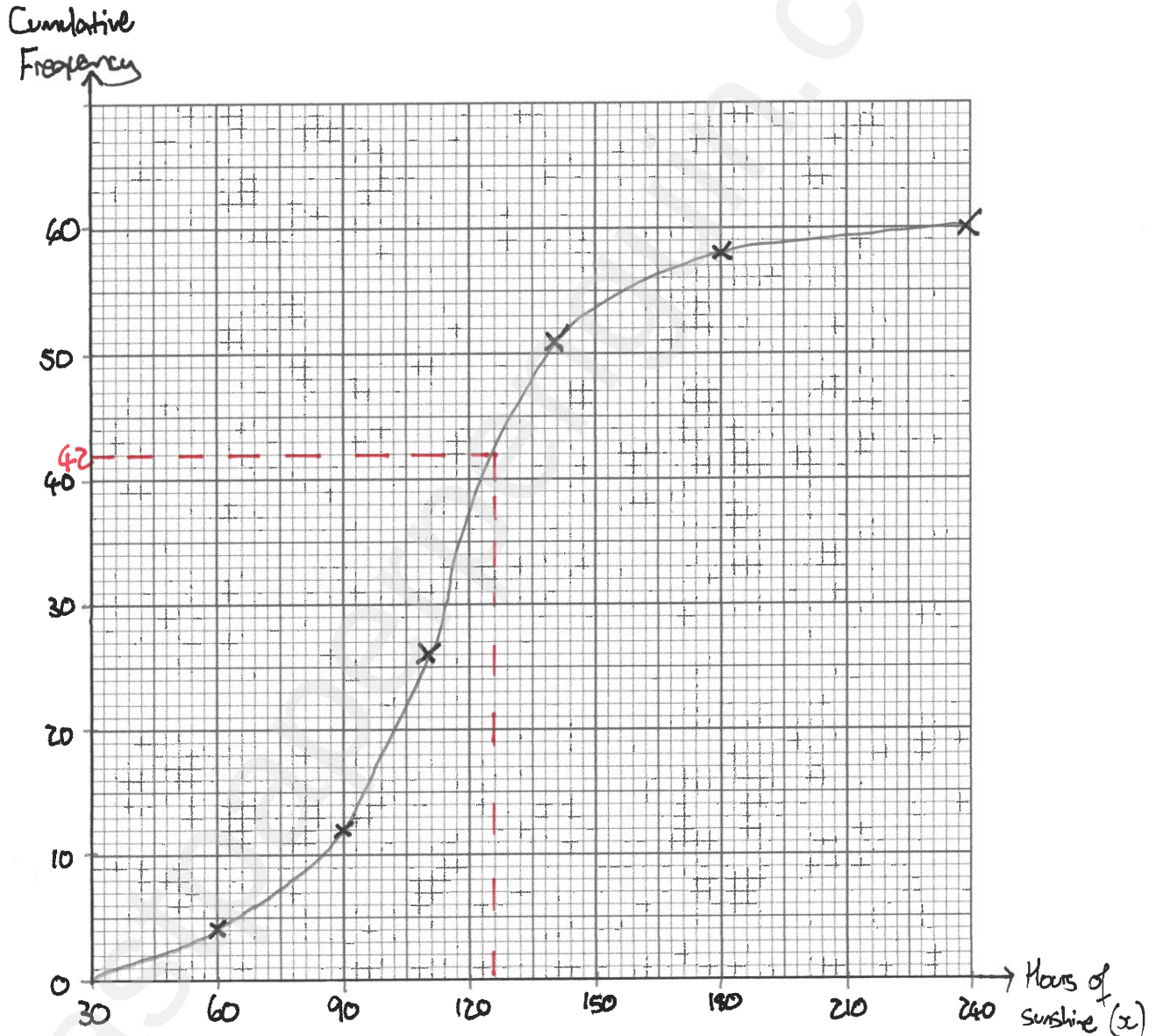
$$\bar{t} = \frac{6730}{200}$$

$$= \underline{\underline{33.65 \text{ minutes}}}$$

- 1 Each year the total number of hours, x , of sunshine in Kintoo is recorded during the month of June. The results for the last 60 years are summarised in the table.

x	$30 \leq x < 60$	$60 \leq x < 90$	$90 \leq x < 110$	$110 \leq x < 140$	$140 \leq x < 180$	$180 \leq x \leq 240$
Number of years	4	8	14	25	7	2

- (a) Draw a cumulative frequency graph to illustrate the data. [3]



- (b) Use your graph to estimate the 70th percentile of the data.

[2]

$$0.7 \times 60 = 42$$

$$70^{\text{th}} \text{ percentile} = \underline{126 \text{ hours}}$$

- (c) Calculate an estimate for the mean number of hours of sunshine in Kintoo during June over the last 60 years.

[3]

Mid-point (x)	Frequency (f)	$f \times x$
45	4	180
75	8	600
100	14	1400
125	25	3125
160	7	1120
210	2	420
	$\Sigma f = 60$	$\Sigma fx = 6845$

$$\bar{x} = \frac{6845}{60}$$

$$= \underline{114 \text{ hours}}$$

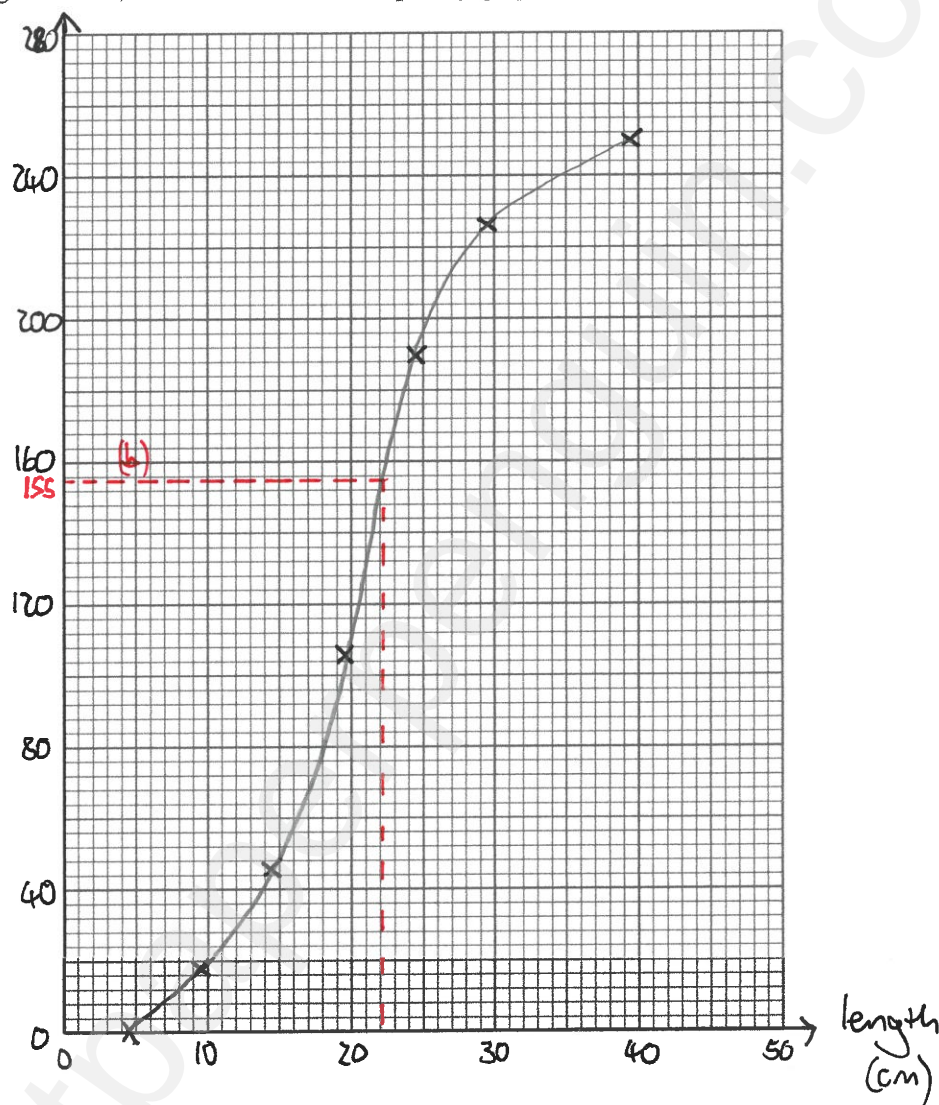
- 3 The lengths of 250 leaves of a certain type of plant are measured, correct to the nearest centimetre. The results are summarised in the table below.

	4.5	9.5	14.5	19.5	24.5	29.5	34.5
Length (cm)	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 39	
Frequency	18	28	60	72	48	24	
c.f.	18	46	106	178	226	250	

- (a) On the grid below, draw a cumulative frequency graph to illustrate this information.

[4]

Cumulative frequency





- (b) 38% of these leaves are of length k cm or more.

Use your graph to find an estimate for k .

[2]

38% are more than k , so 62% are less than k .

$$0.62 \times 250 = 155$$

$$\underline{k \approx 22 \text{ cm}}$$

- (c) Calculate an estimate for the mean length of these 250 leaves.

[3]

Mid-point (x)	Frequency (f)	$f \times x$
7	18	126
12	28	336
17	60	1020
22	72	1584
27	48	1296
34.5	24	828
$\Sigma f = 250$		$\Sigma fx = 5190$

$$\begin{aligned} \bar{x} &= \frac{\Sigma fx}{\Sigma f} \\ &= \frac{5190}{250} \\ &= \underline{20.76} \end{aligned}$$

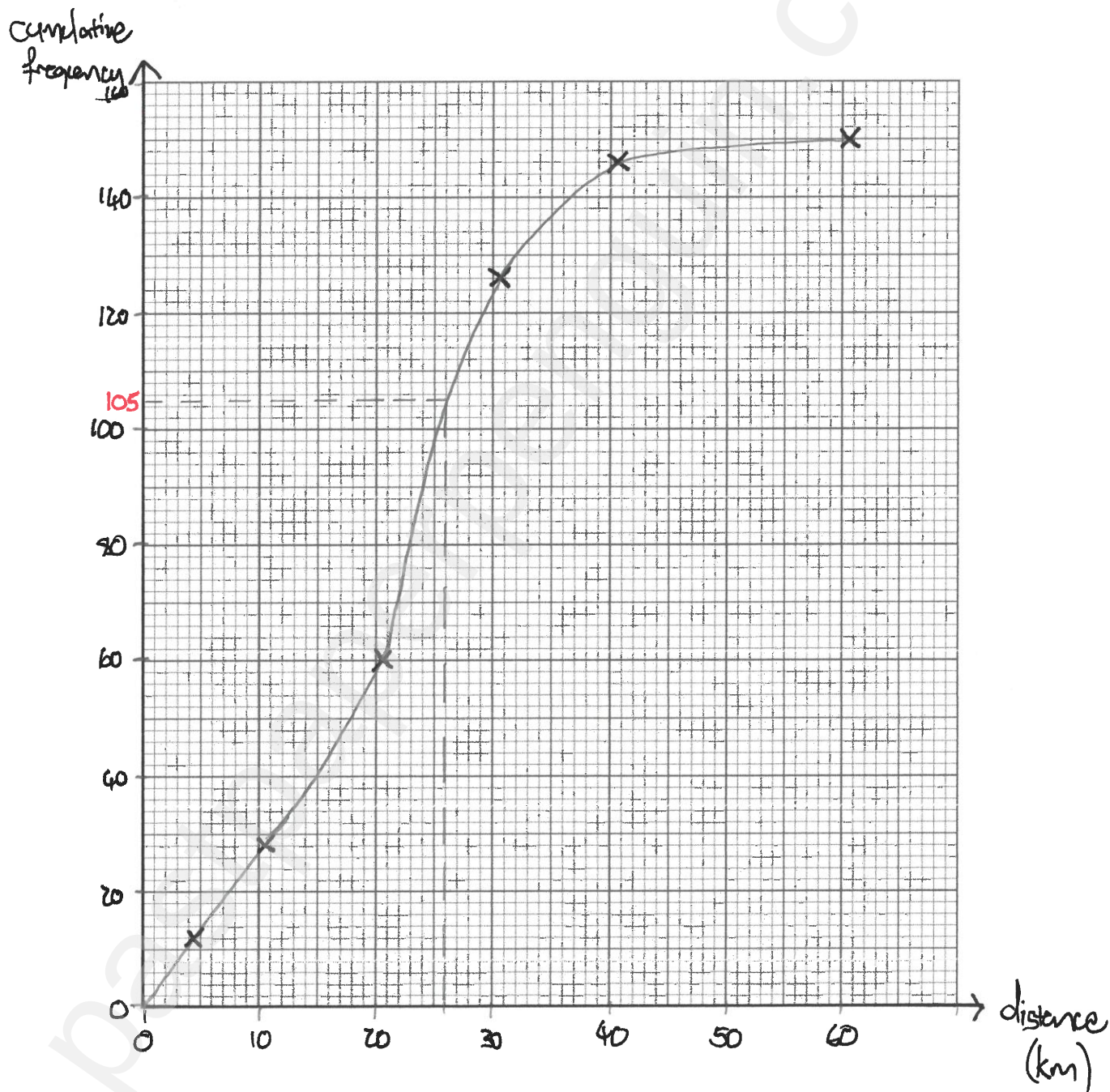


- 5 A driver records the distance travelled in each of 150 journeys. These distances, correct to the nearest km, are summarised in the following table.

Distance (km)	0 – 4	5 – 10	11 – 20	21 – 30	31 – 40	41 – 60
Frequency	12	16	32	66	20	4

- (a) Draw a cumulative frequency graph to illustrate the data.

[4]



- (b) For 30% of these journeys the distance travelled is d km or more.

Use your graph to estimate the value of d .

[2]

30% are d km or more, so 70% are less than d .

$$0.7 \times 150 = 105$$

$$d \approx \underline{26 \text{ km}}$$

- (c) Calculate an estimate of the mean distance travelled for the 150 journeys.

[3]

Mid-point (x)	Frequency (f)	$f \times x$
2.5	12	27
7.5	16	120
15.5	32	496
25.5	66	1683
35.5	20	710
50.5	4	202
	$\Sigma f = 150$	$\Sigma fx = 3238$

$$\bar{x} = \frac{3238}{150}$$

$$= \underline{21.6 \text{ km}}$$



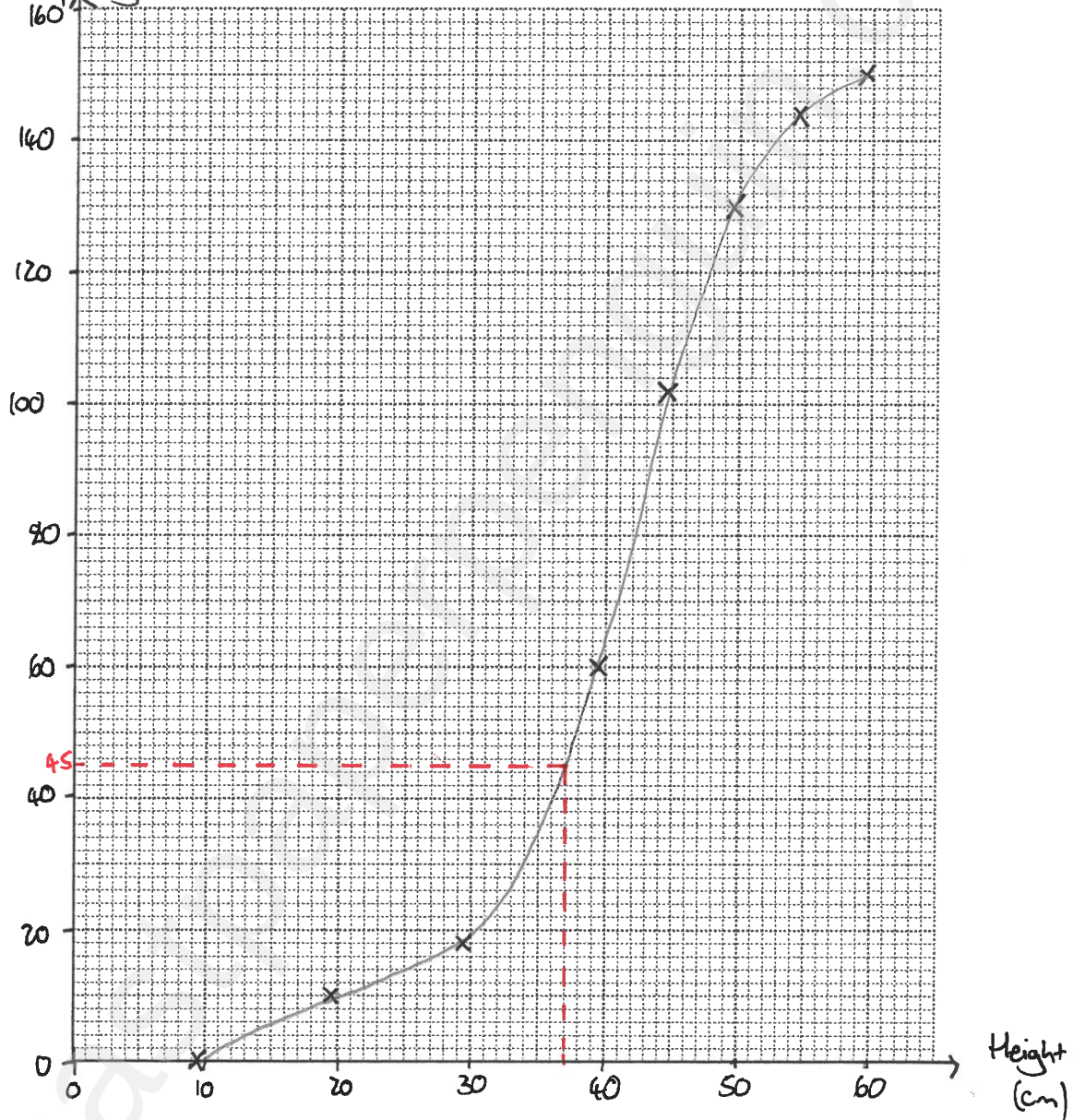
- 4 On a certain day, the heights of 150 sunflower plants grown by children at a local school are measured, correct to the nearest cm. These heights are summarised in the following table.

Height (cm)	10-19	20-29	30-39	40-44	45-49	50-54	55-59
Frequency	10	18	32	42	28	14	6

- (a) Draw a cumulative frequency graph to illustrate the data.

[4]

Cumulative
Frequency



- (b) Use your graph to estimate the 30th percentile of the heights of the sunflower plants.

[2]

$$0.3 \times 150 = 45$$

$$45^{\text{th}} \text{ percentile} = \underline{37 \text{ cm}}$$



- (c) Calculate estimates for the mean and the standard deviation of the heights of the 150 sunflower plants. [5]

Mid-point (x)	Frequency (f)	$f \times x$
14.5	10	145
24.5	18	441
34.5	32	1104
42	42	1764
47	28	1316
52	14	728
57	6	342

$$\Sigma f = 150$$

$$\Sigma fx = 5840$$

$$\bar{x} = \frac{\Sigma fx}{\Sigma f}$$

$$= \frac{5840}{150}$$

$$= 38.933... \text{ ST0}$$

$$= \underline{\underline{38.9 \text{ cm}}}$$

$$\text{Var} = \frac{14.5^2 \times 10 + 24.5^2 \times 18 + 34.5^2 \times 32 + 42^2 \times 42 + 47^2 \times 28 + 52^2 \times 14 + 57^2 \times 6}{150} - (38.933...)^2$$

$$= \frac{244285}{150} - 38.933...^2$$

$$= 112.76...$$

$$\sigma = \sqrt{\text{Var}}$$

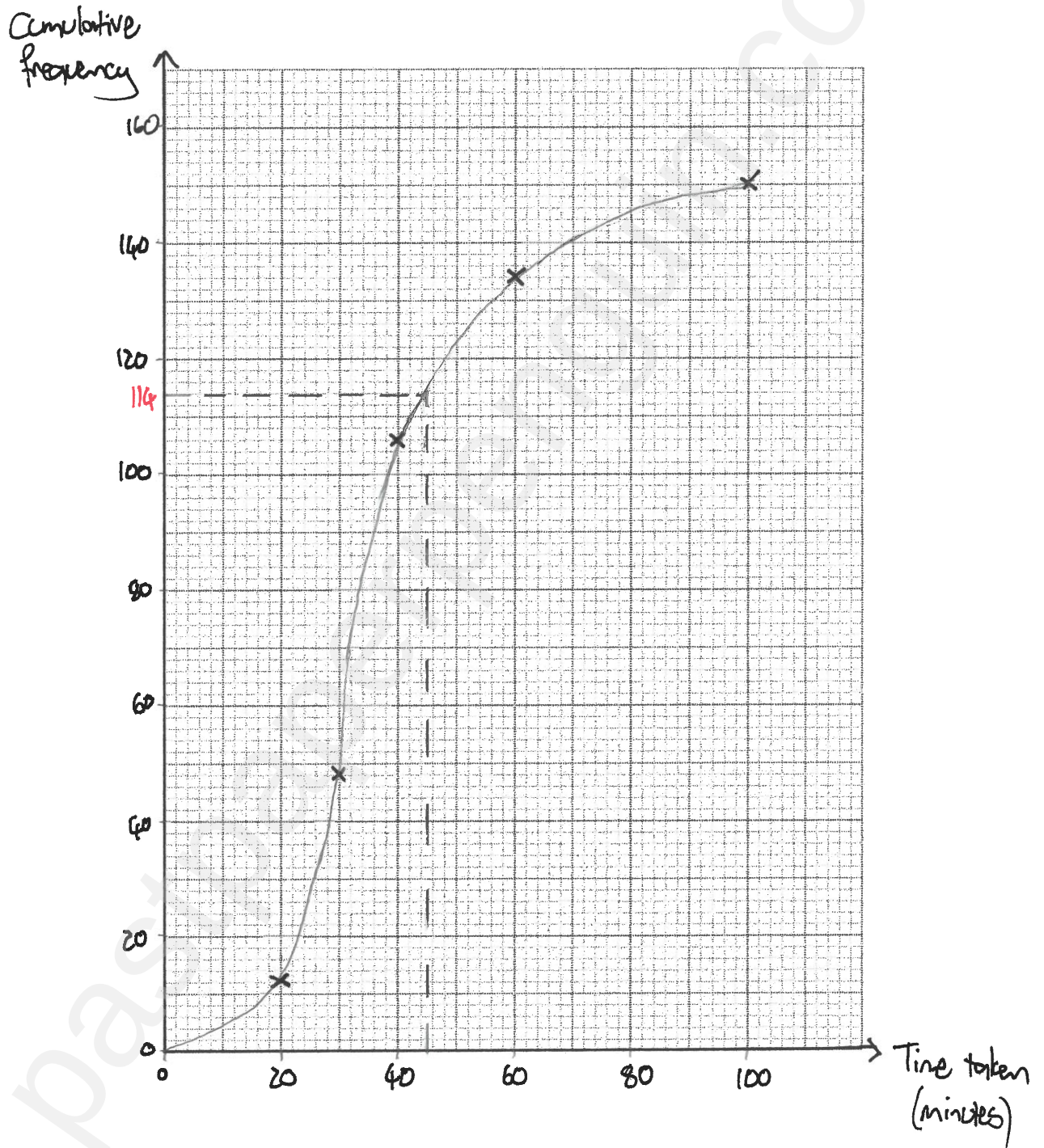
$$= \underline{\underline{10.6}}$$

- 6 The times, t minutes, taken by 150 students to complete a particular challenge are summarised in the following cumulative frequency table.

Time taken (t minutes)	$t \leq 20$	$t \leq 30$	$t \leq 40$	$t \leq 60$	$t \leq 100$
Cumulative frequency	12	48	106	134	150

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]



- (b) 24% of the students take k minutes or longer to complete the challenge. Use your graph to estimate the value of k . [2]

24% take k mins or longer, so 76% take less than k mins.

$$0.76 \times 150 = 114$$

$$\underline{k = 45 \text{ mins}}$$

- (c) Calculate estimates of the mean and the standard deviation of the time taken to complete the challenge. [6]

Mid-point (t)	Frequency (f)	$f \times t$
10	12	120
25	36	900
35	58	2030
50	28	1400
80	16	1280
	$\Sigma f = 150$	$\Sigma ft = 5730$

$$\bar{t} = \frac{5730}{150} = \underline{38.2}$$

$$\text{Var} = \frac{10^2 \times 12 + 25^2 \times 36 + 35^2 \times 58 + 50^2 \times 28 + 80^2 \times 16}{150} - 38.2^2$$

$$= 321.76$$

$$\sigma = \sqrt{\text{Var}}$$

$$= \underline{17.9}$$

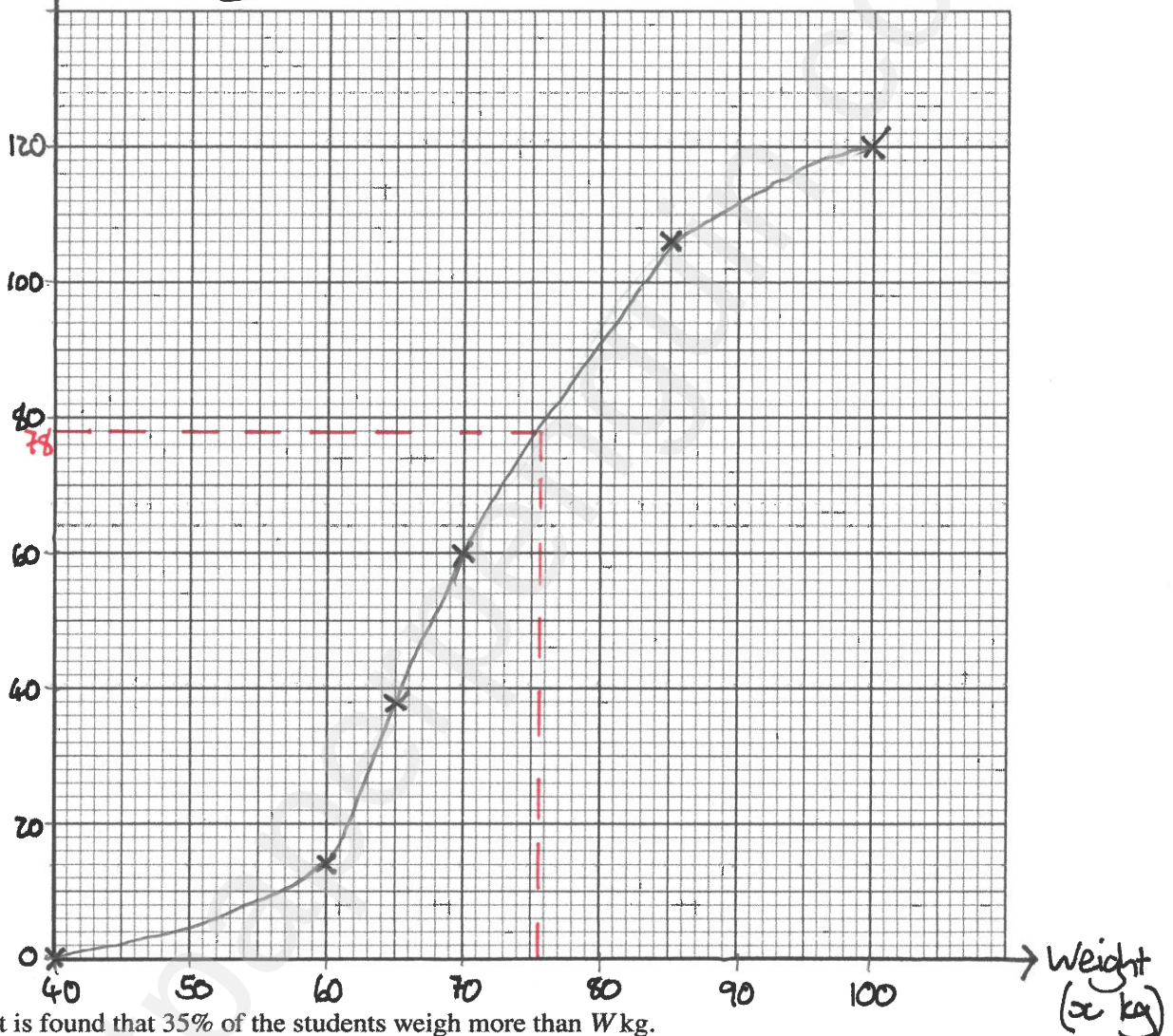
- 4 The weights, x kg, of 120 students in a sports college are recorded. The results are summarised in the following table.

Weight (x kg)	$x \leq 40$	$x \leq 60$	$x \leq 65$	$x \leq 70$	$x \leq 85$	$x \leq 100$
Cumulative frequency	0	14	38	60	106	120

- (a) Draw a cumulative frequency graph to represent this information.

[2]

Cumulative frequency



- (b) It is found that 35% of the students weigh more than W kg.

Use your graph to estimate the value of W .

[2]

35% are more than W , so 65% are less than W .

$$0.65 \times 120 = 78$$

$$W \approx 75.5 \text{ kg}$$

- (c) Calculate estimates for the mean and standard deviation of the weights of the 120 students. [6]

Mid-point (x)	Frequency (f)	$f \times x$
20	0	0
50	14	700
62.5	24	1500
67.5	22	1485
77.5	46	3565
92.5	14	1295
	$\Sigma f = 120$	$\Sigma fx = 8545$

$$\bar{x} = \frac{8545}{120}$$

$$= \underline{71.2 \text{ kg}} \text{ STO}$$

$$\text{Var} = \frac{50^2 \times 14 + 62.5^2 \times 24 + 67.5^2 \times 22 + 77.5^2 \times 46 + 92.5^2 \times 14}{120} - 71.2^2$$

$$\text{Var} = 138.23$$

$$\sigma = \sqrt{\text{Var}}$$

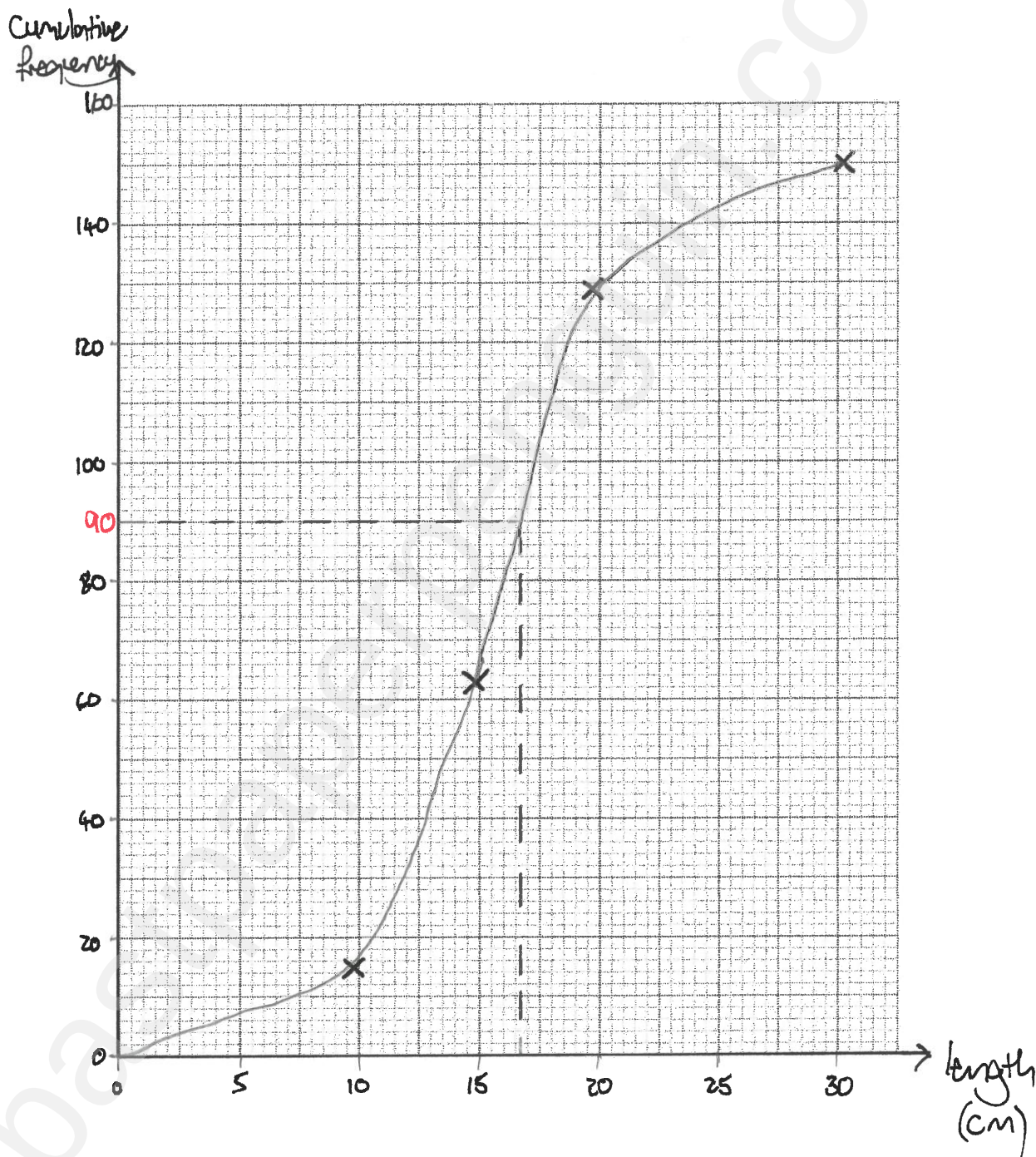
$$= \underline{11.8}$$

- 7 Helen measures the lengths of 150 fish of a certain species in a large pond. These lengths, correct to the nearest centimetre, are summarised in the following table.

Length (cm)	0 – 9	10 – 14	15 – 19	20 – 30
Frequency	15	48	66	21

- (a) Draw a cumulative frequency graph to illustrate the data.

[4]



- (b) 40% of these fish have a length of d cm or more. Use your graph to estimate the value of d . [2]

40% are d cm or more, so 60% are less than d .

$$0.6 \times 150 = 90$$

$$\underline{\underline{d \approx 16.5 \text{ cm}}}$$

The mean length of these 150 fish is 15.295 cm.

- (c) Calculate an estimate for the variance of the lengths of the fish. [3]

Mid-point (x)	Frequency (f)
4.75	15
12	48
17	66
25	21
	$\Sigma f = 150$

$$\text{Var} = \frac{4.75^2 \times 15 + 12^2 \times 48 + 17^2 \times 66 + 25^2 \times 21}{150} - 15.295^2$$

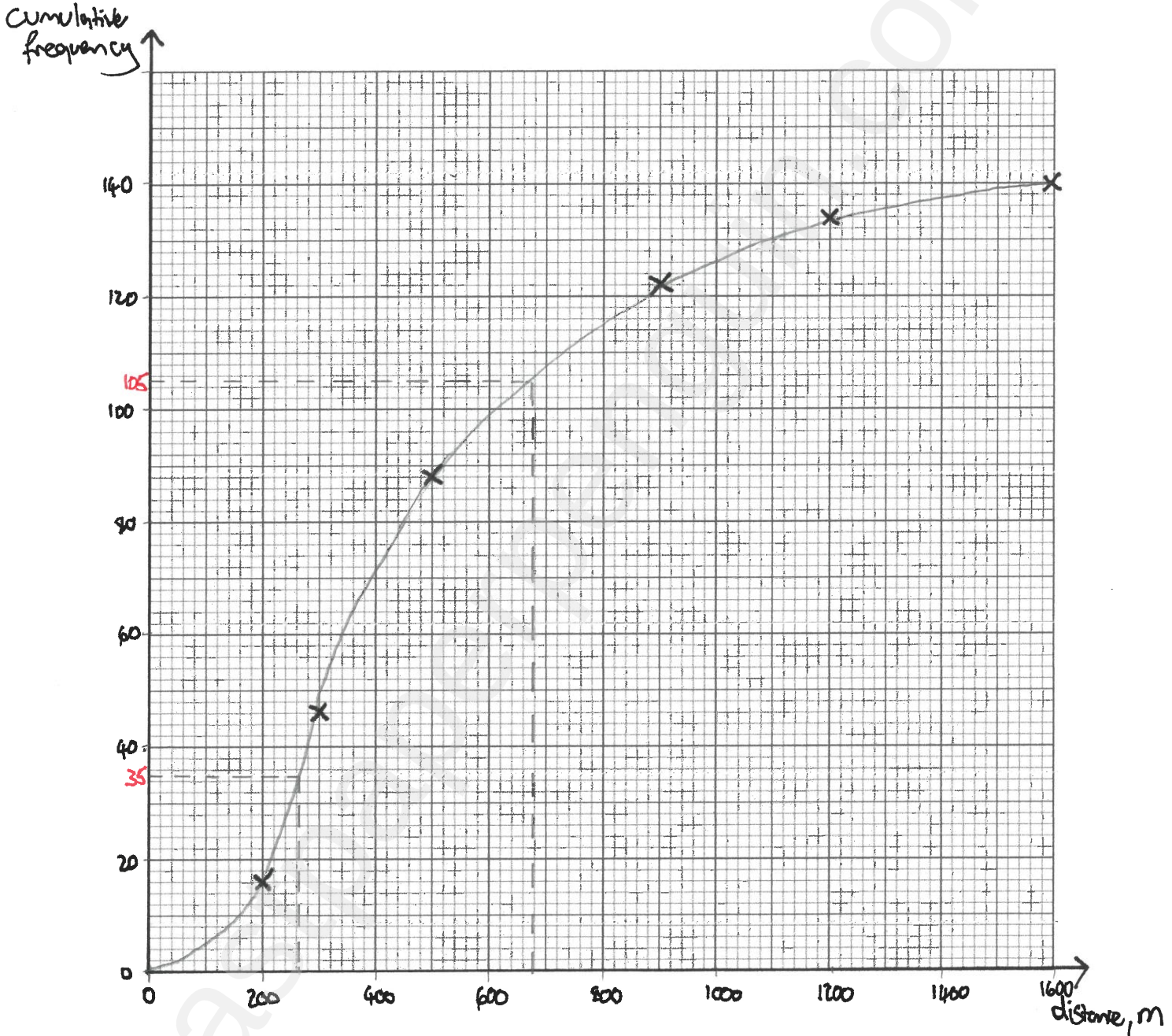
$$= \underline{\underline{29.1}}$$

- 7 The distances, x m, travelled to school by 140 children were recorded. The results are summarised in the table below.

Distance, x m	$x \leq 200$	$x \leq 300$	$x \leq 500$	$x \leq 900$	$x \leq 1200$	$x \leq 1600$
Cumulative frequency	16	46	88	122	134	140

- (a) On the grid, draw a cumulative frequency graph to represent these results.

[2]



- (b) Use your graph to estimate the interquartile range of the distances.

[2]

$$Q_1: 0.25 \times 140 = 35$$

$$Q_1 = 260$$

$$Q_3: 0.75 \times 140 = 105$$

$$Q_3 = 680$$

$$IQR = 680 - 260$$

$$= \underline{420}$$

- (c) Calculate estimates of the mean and standard deviation of the distances.

[6]

Mid-point (x)	Frequency (f)	$f \times x$
100	16	1600
250	30	7500
400	42	16800
700	34	23800
1050	12	12600
1400	6	8400
$\Sigma f = 140$		$\Sigma fx = 70700$

$$\bar{x} = \frac{70700}{140} = \underline{505}$$

$$\text{Var} = \frac{100^2 \times 16 + 250^2 \times 30 + 400^2 \times 42 + 700^2 \times 34 + 1050^2 \times 12 + 1400^2 \times 6}{140} - 505^2$$

$$= 105010$$

$$\sigma = \sqrt{\text{Var}}$$

$$= \underline{324}$$