Cumulative Frequency

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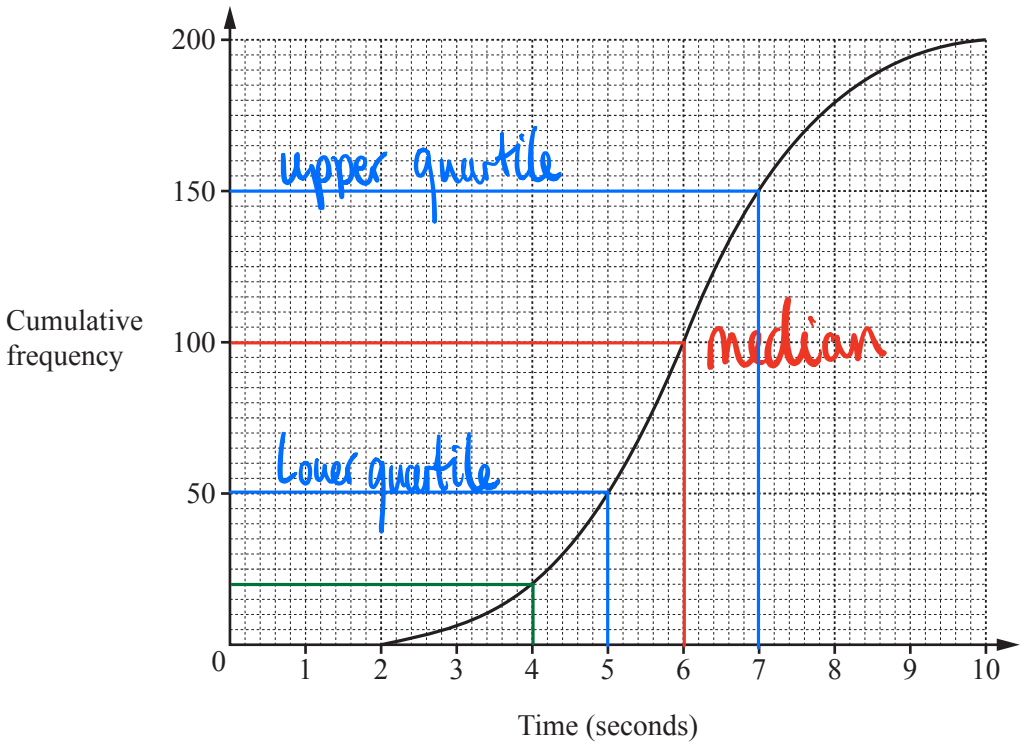
17



200 students take a reaction time test.
The cumulative frequency diagram shows the results.

Find

(a) the median,

Answer(a) 6 s [1]

(b) the inter-quartile range,

Upper quartile − Lower quartile
7 − 5

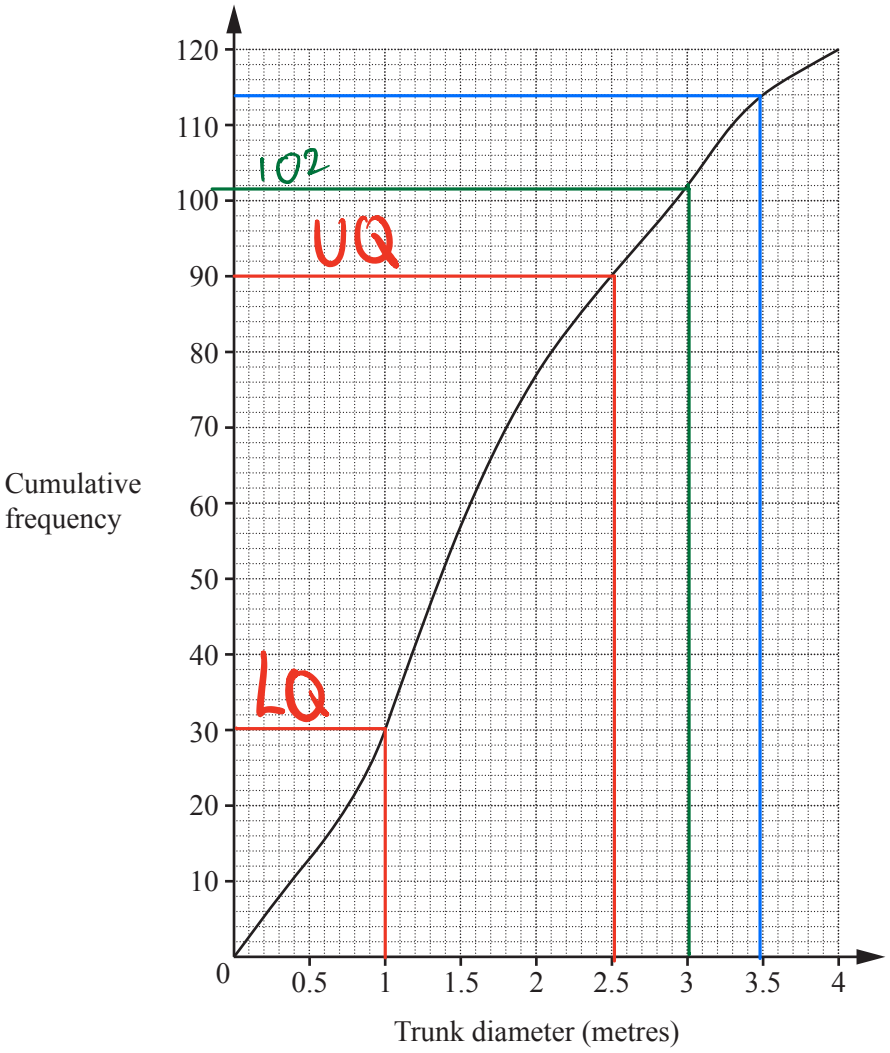
Answer(b) 2 s [2]

(c) the number of students with a reaction time of more than 4 seconds.

less than 4 seconds = 20
more than 4 seconds = 200 − 20 = 180

Answer(c) 180 [2]

22 The cumulative frequency diagram shows information about the trunk diameter, in metres, of 120 trees.



Find

(a) the inter-quartile range,

2.5 - 1 = 1.5

1.5 ..... m [2]

(b) the 95th percentile,

0.95 × 120 = 114

3.5 ..... m [2]

(c) the number of trees with a trunk diameter greater than 3 metres.

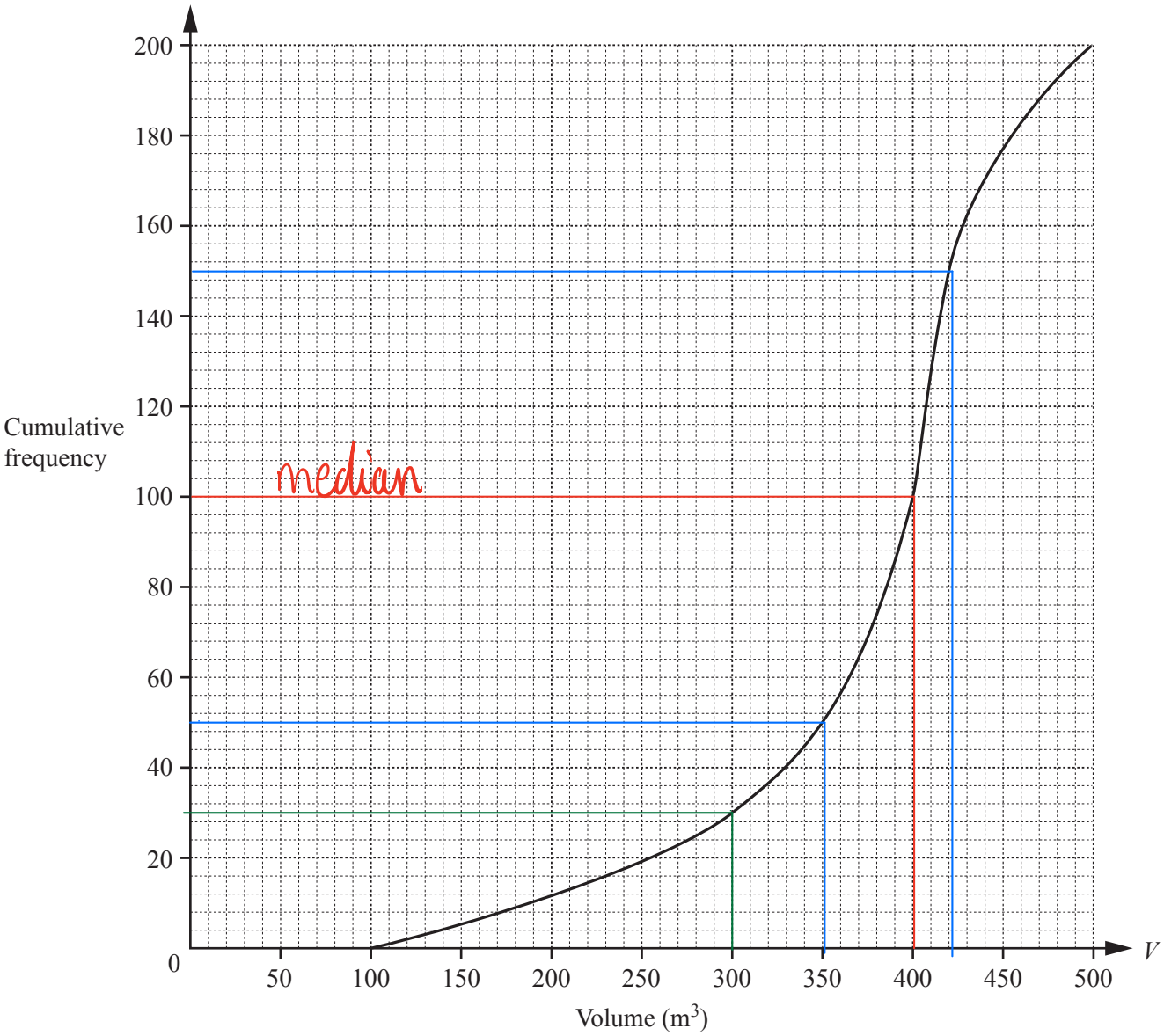
less than 3 metres = 102

more than 3 metres = 120 - 102 = 18

18 ..... [2]

Question 23 is printed on the next page.

3 **(a)** 200 students estimate the volume, $V\,m^3$, of a classroom.
The cumulative frequency diagram shows their results.



Find

(i) the median,

400 ..... m^3 [1]

(ii) the lower quartile,

350 ..... m^3 [1]

(iii) the inter-quartile range,

420 − 350 = 70

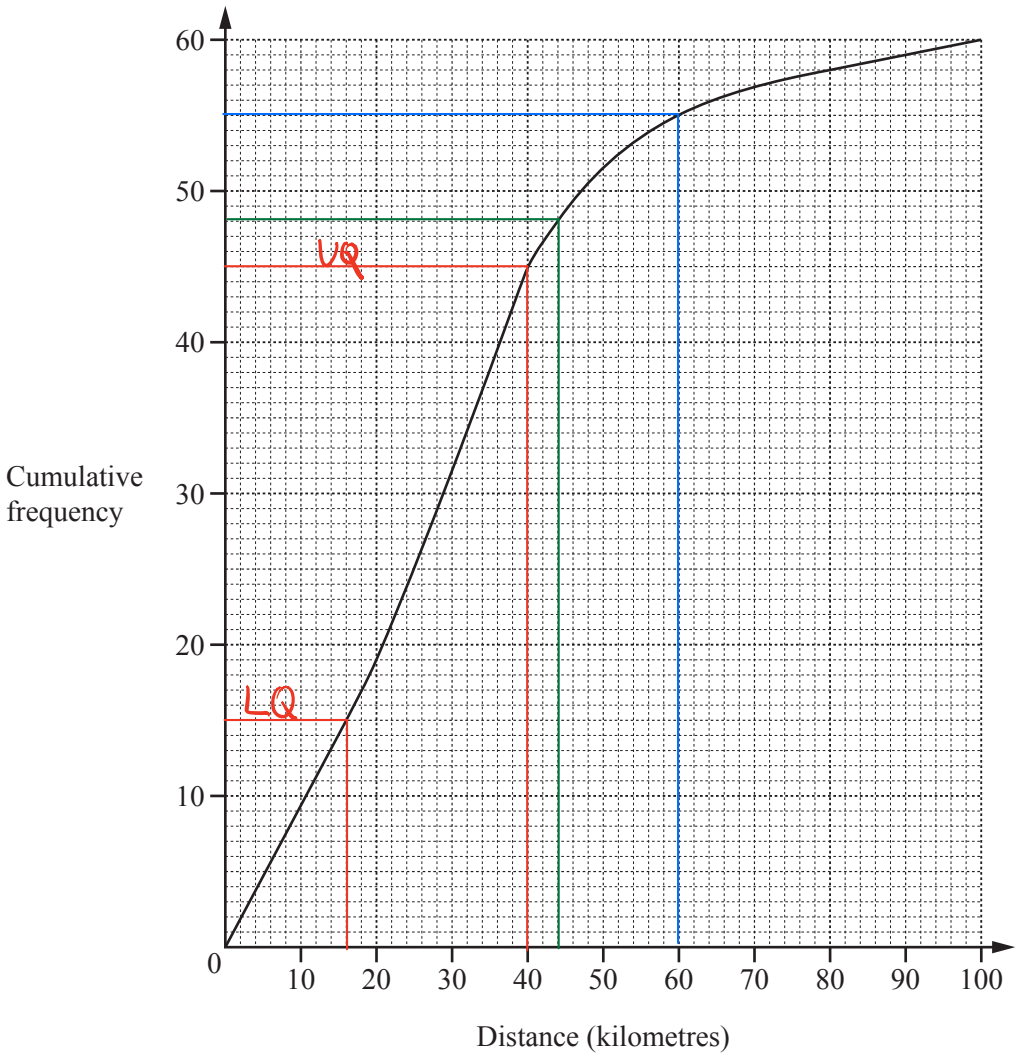
70 ..... m^3 [1]

(iv) the number of students who estimate that the volume is greater than 300 m^3.

200 − 30 = 170

170 ..... [2]

22 The cumulative frequency diagram shows information about the distances travelled, in kilometres, by 60 people.



Find

(a) the 80th percentile,

$0.8 \times 60 = 48$

Answer(a) 44 km [2]

(b) the inter-quartile range,

$40 - 18 = 22$

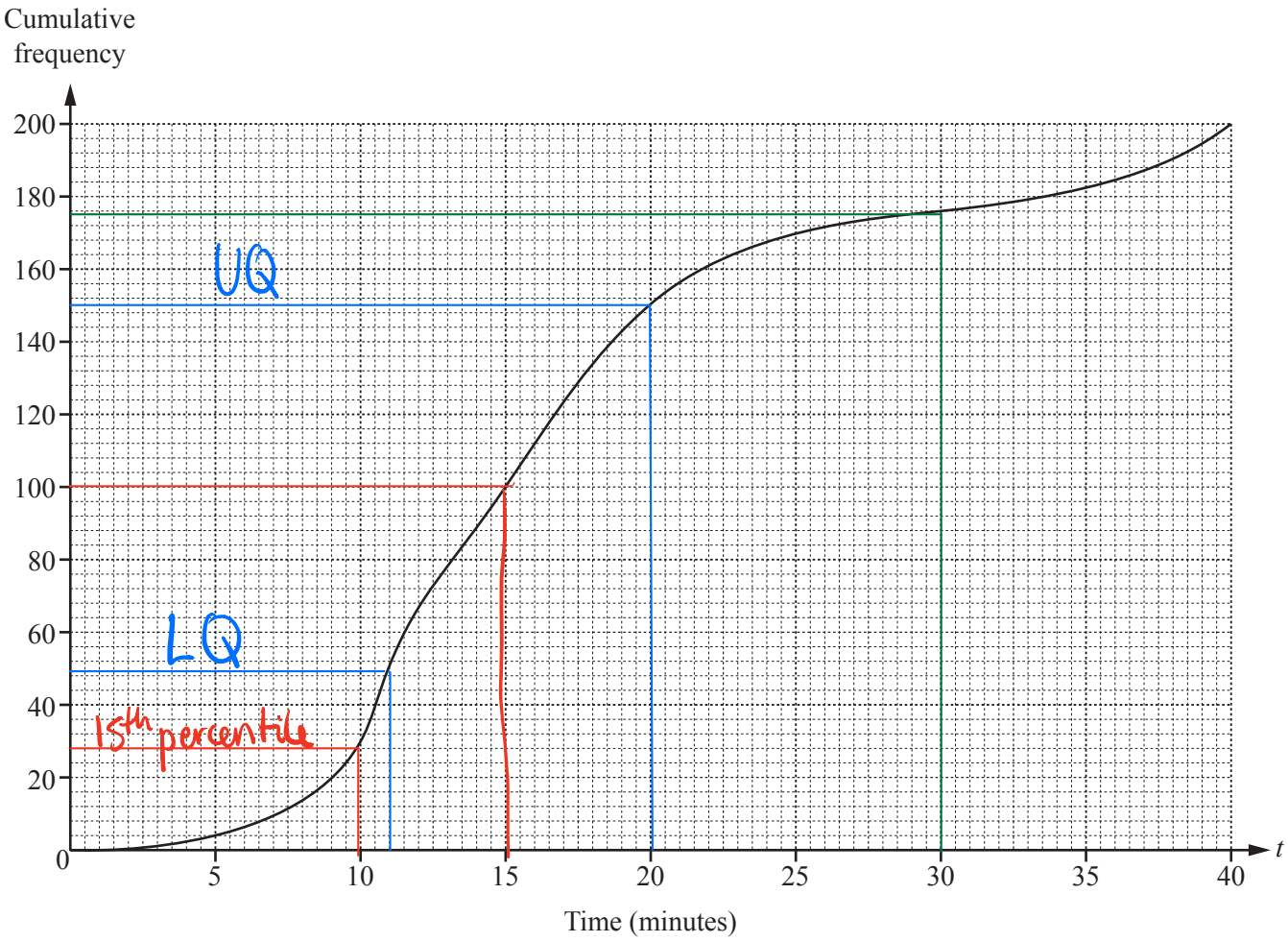
Answer(b) 22 km [2]

(c) the number of people who travelled more than 60 km.

$60 - 55 = 5$

Answer(c) 5 [2]

2 **(a)** 200 students record the time, t minutes, for their journey from home to school.
The cumulative frequency diagram shows the results.



Find

(i) the median,

15 ..... min [1]

(ii) the lower quartile,

11 ..... min [1]

(iii) the inter-quartile range,

20 - 11 = 9

9 ..... min [1]

(iv) the 15th percentile,

10 ..... min [1]

(v) the number of students whose journey time was more than 30 minutes.

200 - 168 = 32

32 ..... [2]

22 The table shows information about the numbers of pets owned by 24 students.

Number of pets	0	1	2	3	4	5	6	
Frequency	1	2	3	5	7	3	3	24
$F \times x$	0	2	6	15	28	15	18	84

(a) Calculate the mean number of pets.

$$\frac{\text{Total } Fx}{\text{Total } F} = \frac{84}{24} = 3.5$$

Answer(a) 3.5 [3]

(b) Jennifer joins the group of 24 students.
When the information for Jennifer is added to the table, the new mean is 3.44 .

Calculate the number of pets that Jennifer has.

$$\frac{x}{25} = 3.44$$

$$x = 3.44 \times 25 = 86$$

Answer(b) 86 [3]

6 The table shows the time, t minutes, that 400 people take to complete a test.

Time taken (t mins)	$0 < t \leqslant 10$	$10 < t \leqslant 24$	$24 < t \leqslant 30$	$30 < t \leqslant 40$	$40 < t \leqslant 60$	$60 < t \leqslant 70$
Frequency	10	90	135	85	70	10
Fx	50	1530	3240	2975	3500	650

(a) (i) Write down the modal time interval.

Answer(a)(i) $20 < t \leqslant 30$ min [1]

(ii) Calculate an estimate of the mean time taken to complete the test.

$$\frac{\text{Total } Fx}{\text{Total } F} = \frac{11945}{400} = 29.8625$$

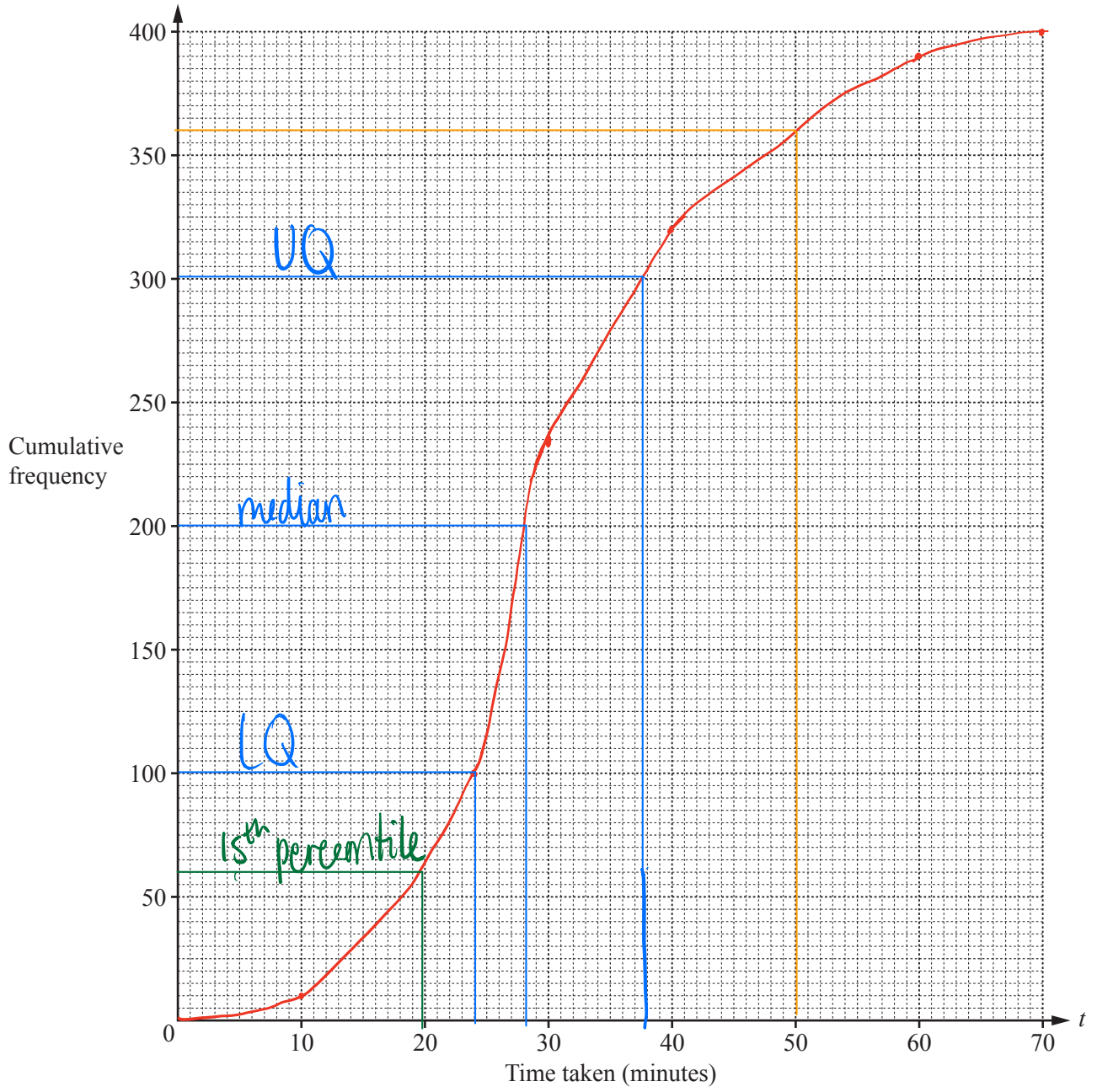
Answer(a)(ii) 29.9 min [4]

(b) (i) Complete the table of cumulative frequencies.

Time taken (t mins)	$t \leqslant 10$	$t \leqslant 24$	$t \leqslant 30$	$t \leqslant 40$	$t \leqslant 60$	$t \leqslant 70$
Cumulative frequency	10	100	235	320	390	400

[2]

(ii) On the grid opposite, draw a cumulative frequency diagram to show this information.



[3]

(c) Use your graph to estimate

(i) the median time,

Answer(c)(i) 28 min [1]

(ii) the inter-quartile range,

38 − 24 = 14

Answer(c)(ii) 14 min [2]

(iii) the 15th percentile,

0.15 × 400 = 60

Answer(c)(iii) 20 min [2]

(iv) the number of people who took more than 50 minutes.

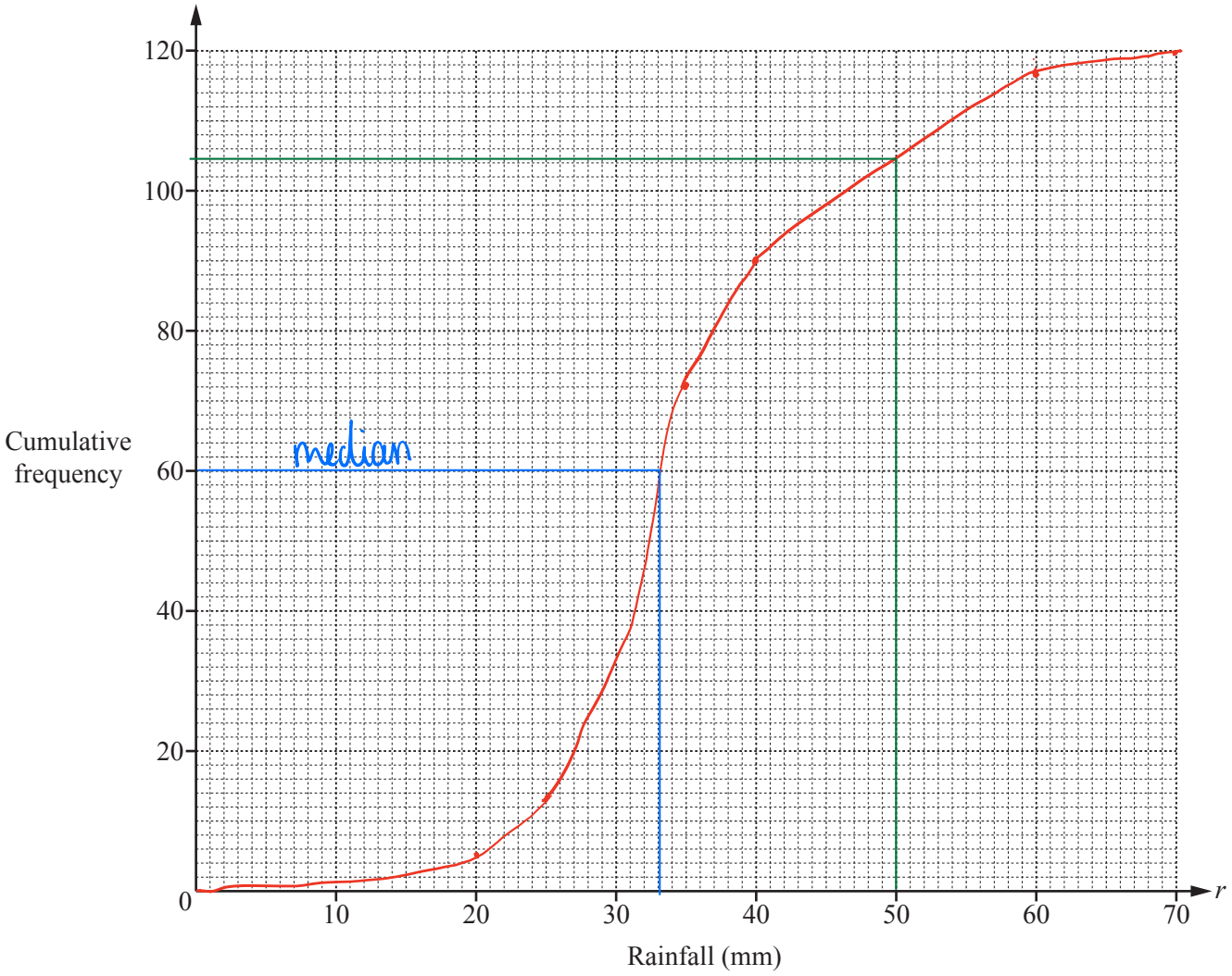
400 − 360 = 40

Answer(c)(iv) 40 [2]

3 Leo measured the rainfall each day, in millimetres, for 120 days.
The cumulative frequency table shows the results.

Rainfall (r mm)	$r \leqslant 20$	$r \leqslant 25$	$r \leqslant 35$	$r \leqslant 40$	$r \leqslant 60$	$r \leqslant 70$
Cumulative frequency	5	13	72	90	117	120

(a) On the grid below, draw a cumulative frequency diagram to show these results.



[3]

(b) **(i)** Find the median.

Answer(b)(i) 33 mm [1]

(ii) Use your diagram to find the number of days when the rainfall was more than 50 mm.

Answer(b)(ii) 104 [2]

6 120 students take a mathematics examination.

(a) The time taken, m minutes, for each student to answer question 1 is shown in this table.

x

	0.5	1.5	2.5	3.5	4.5	5.5
Time (m minutes)	$0 < m \leqslant 1$	$1 < m \leqslant 2$	$2 < m \leqslant 3$	$3 < m \leqslant 4$	$4 < m \leqslant 5$	$5 < m \leqslant 6$
Frequency	72	21	9	11	5	2
F x x	36	31.5	22.5	38.5	22.5	11

Calculate an estimate of the mean time taken.

$$\frac{\text{Total } Fx}{\text{Total } F} = \frac{162}{120} = 1.35$$

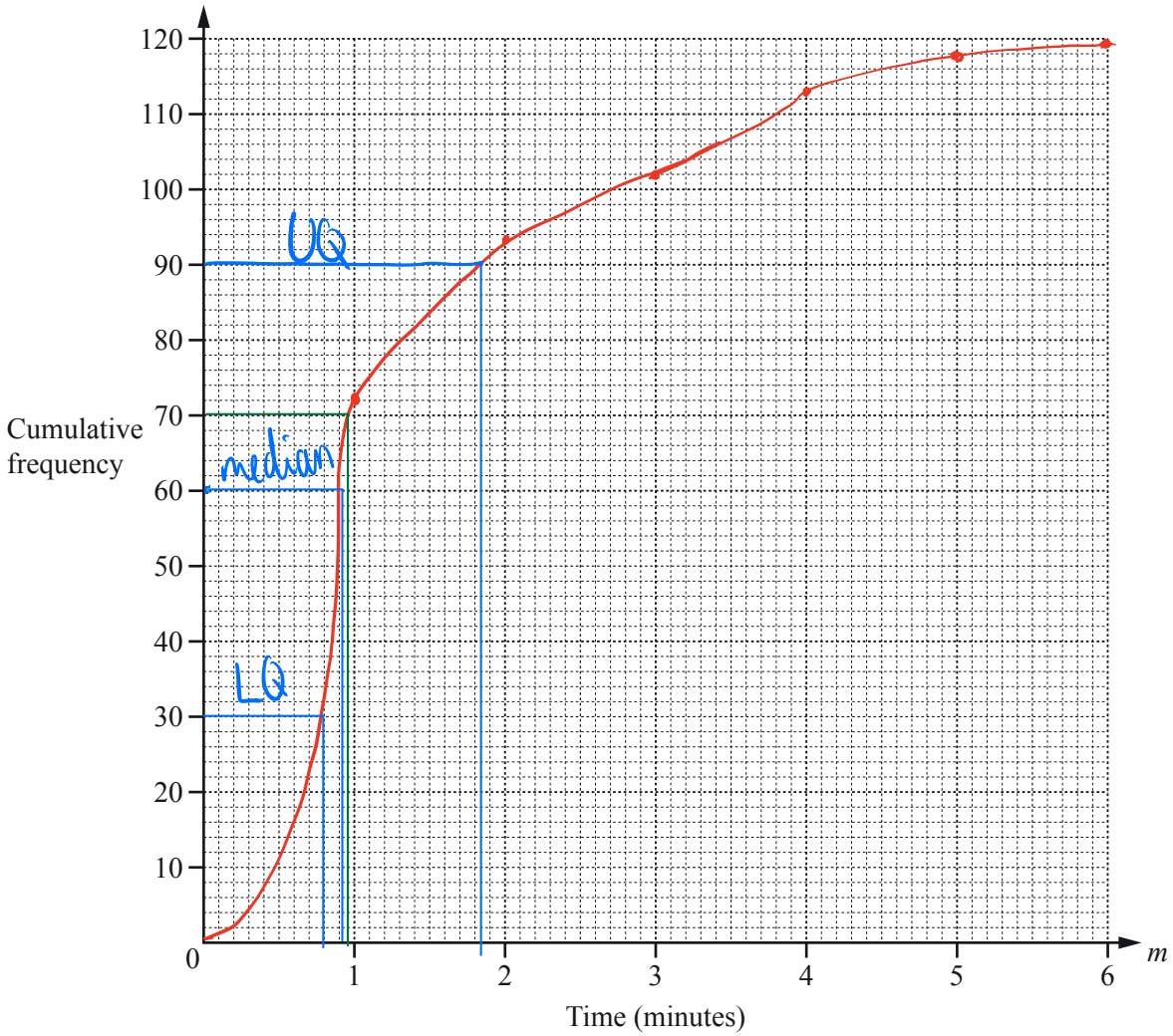
Answer(a) 1.35 min [4]

(b) **(i)** Using the table in **part (a)**, complete this cumulative frequency table.

Time (m minutes)	$m \leqslant 1$	$m \leqslant 2$	$m \leqslant 3$	$m \leqslant 4$	$m \leqslant 5$	$m \leqslant 6$
Cumulative frequency	72	93	102	113	118	120

[2]

(ii) Draw a cumulative frequency diagram to show the time taken.



[3]

(iii) Use your cumulative frequency diagram to find

(a) the median,

Answer(b)(iii)(a) 0.9 min [1]

(b) the inter-quartile range,

1.85 − 0.8 = 1.05

Answer(b)(iii)(b) 1.05 min [2]

(c) the 35th percentile.

0.35 × 200 = 70

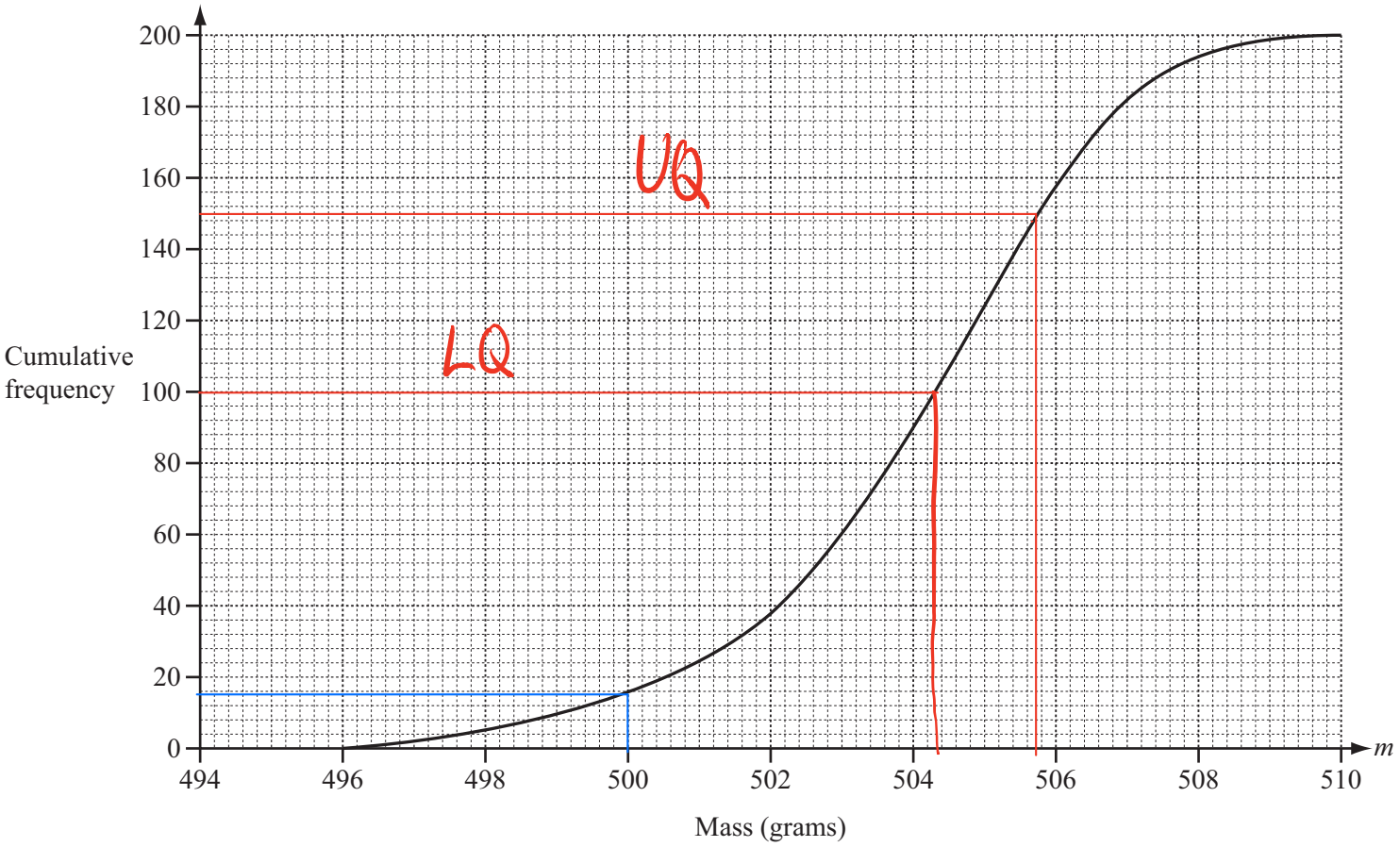
Answer(b)(iii)(c) 1.95 min [2]

(c) A new frequency table is made from the table shown in **part (a)**.

Time (m minutes)	$0 < m \leqslant 1$	$1 < m \leqslant 3$	$3 < m \leqslant 6$
Frequency	72	195	351

(i) Complete the table above. [2]

17 The mass, m grams, of cornflakes in each of 200 boxes is recorded.
The cumulative frequency diagram shows the results.



(a) Use the diagram to estimate the inter-quartile range.

505.7 - 504.3

Answer(a) 51.4 g [2]

(b) Find the probability that a box chosen at random has a mass of 500 grams or less.

Answer(b) 16 [2]

(c)

Mass (m grams)	$496 < m \leqslant 500$	$500 < m \leqslant 504$	$504 < m \leqslant 508$	$508 < m \leqslant 510$
Frequency	16	74	104	6

The data in this frequency table is to be shown in a histogram.

Complete the frequency density table below.

Mass (m grams)	$496 < m \leqslant 500$	$500 < m \leqslant 504$	$504 < m \leqslant 508$	$508 < m \leqslant 510$
Frequency density	4	18.5	26	3

[2]

6 A company tested 200 light bulbs to find the lifetime, T hours, of each bulb.
The results are shown in the table.

x	Lifetime (T hours)	Number of bulbs	$f \times x$
500	$0 < T \leqslant 1000$	10	5000
1250	$1000 < T \leqslant 1500$	30	37500
1750	$1500 < T \leqslant 2000$	55	96250
2250	$2000 < T \leqslant 2500$	72	162000
2750	$2500 < T \leqslant 3500$	33	90750
			391500

(a) Calculate an estimate of the mean lifetime for the 200 light bulbs.

$$\frac{391500}{200} = 1957.5$$

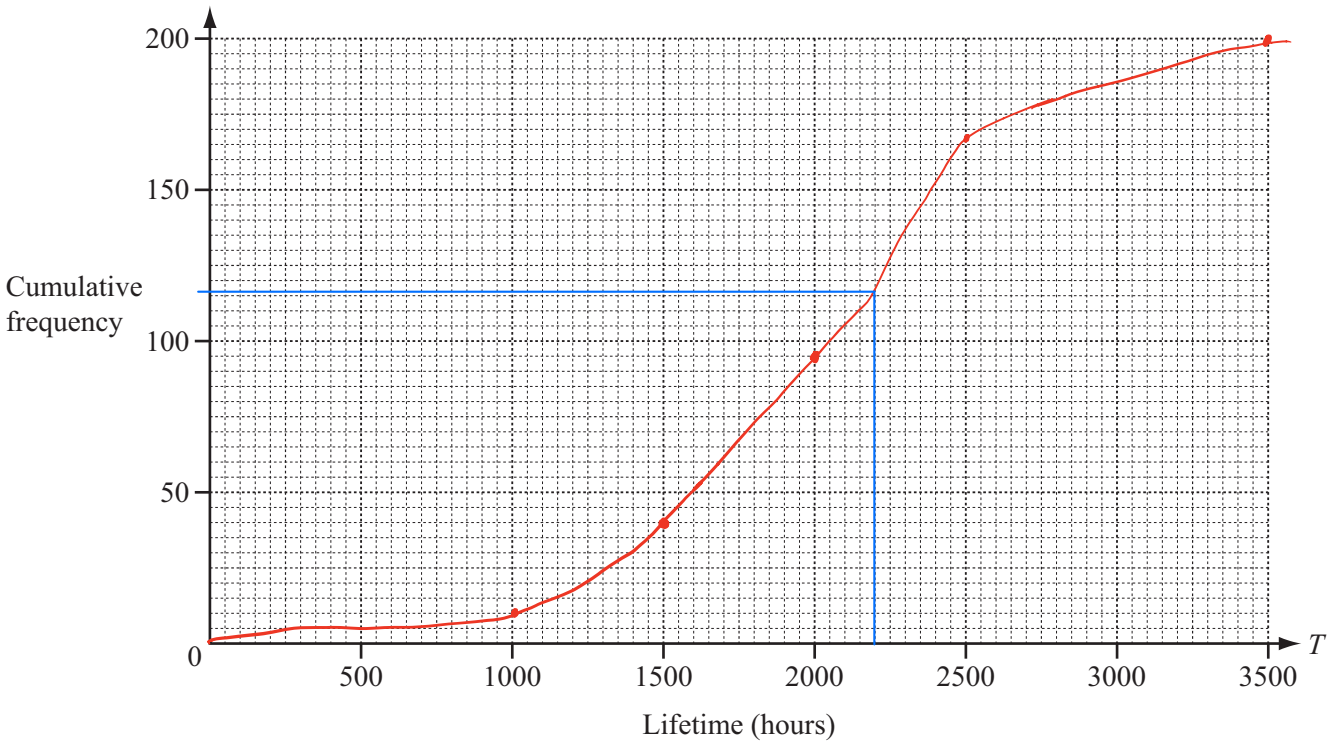
Answer(a) 1957.5 hours [4]

(b) **(i)** Complete the cumulative frequency table.

Lifetime (T hours)	$T \leqslant 1000$	$T \leqslant 1500$	$T \leqslant 2000$	$T \leqslant 2500$	$T \leqslant 3500$
Number of bulbs	10	40	95	167	200

[2]

(ii) On the grid, draw a cumulative frequency diagram to show this information.



[3]

(iii) The company says that the average lifetime of a bulb is 2200 hours.

Estimate the number of bulbs that lasted longer than 2200 hours.

Answer(b)(iii) 117.5 [2]

(c) Robert buys one energy saving bulb and one halogen bulb.

The probability that the energy saving bulb lasts longer than 3500 hours is $\frac{9}{10}$.

The probability that the halogen bulb lasts longer than 3500 hours is $\frac{3}{5}$.

Work out the probability that exactly one of the bulbs will last longer than 3500 hours.

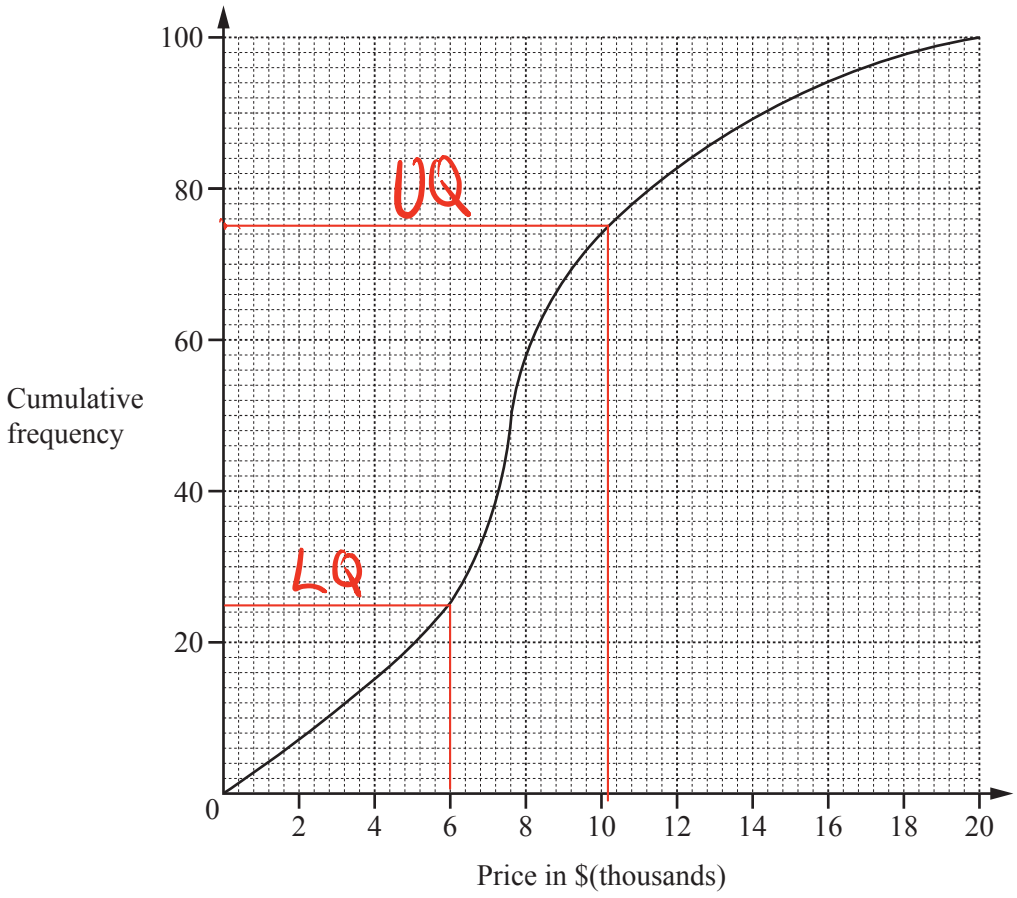
energy bulb x halogen bulb $= \frac{9}{10} \times \frac{2}{5}$ + = 0.42

or

halogen Bulb x energy bulb $= \frac{1}{10} \times \frac{3}{5}$

Answer(c) 0.42 [4]

7 **(a)** **(i)**



The cumulative frequency diagram shows information about the prices of 100 cars on Website A.
Use the information to complete this table.

Lower quartile	Median	Upper quartile	Inter-quartile range
$ 6000	$7600	$ 10200	$ 4200

[2]

(ii) This table shows information about the prices of cars on Website B.

Lower quartile	Median	Upper quartile	Inter-quartile range
$7600	$10 800	$13 600	$6000

Here are two statements comparing the distributions of the prices of cars on Website A and Website B.

For each statement write True or False.
Give a reason for each answer, stating clearly which statistic you use to make your decision.

(a) The prices of cars on Website A are lower than the prices of cars on Website B.

True because The lower quartile and upper quartile are lower on website A than B. [1]

(b) A greater percentage of cars have a price more than \$13 600 on Website A compared to Website B.

False because The Upper quartile is less than 13606 [1]

(b) The table shows the prices of cars on Website B.

x	Price (\$$P$)	Number of cars	F x x
3000	$0 < P \leqslant 6000$	9	27000
7000	$6000 < P \leqslant 8000$	29	203000
9000	$8000 < P \leqslant 10000$	20	180000
11000	$10000 < P \leqslant 12000$	14	154000
13000	$12000 < P \leqslant 14000$	21	273000
18000	$14000 < P \leqslant 22000$	27	486000
			1323000

Calculate an estimate of the mean price of the 120 cars.

$\frac{1323}{120} = 11025$

\$ 11025 . [4]

(c) The price of a car is \$8760.
Bryan pays a deposit of 25% of this price and then 24 equal monthly payments.
After 24 months, he will have paid a total of \$9948.

Calculate the cost of one monthly payment.

$8760 \times 0.25 = 2190$

$8760 - 2190 = 6570$

$9948 - 6570 = 3378$

$\frac{3378}{24} = 140.75$

\$ 140.75 . [3]