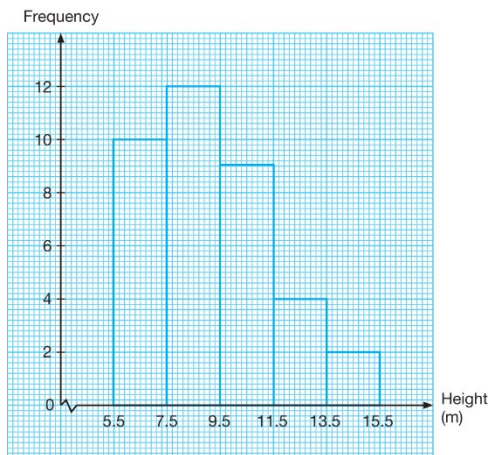


Form 5 Chapter 7
Measures of Dispersion of Grouped Data
Fully-Worked Solutions

UPSKILL 7.1

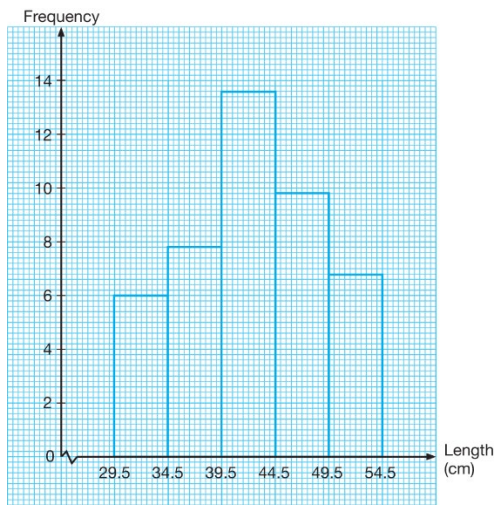
1

Height (m)	Upper boundary	Frequency
6 – 7	5.5 – 7.5	10
8 – 9	7.5 – 9.5	12
10 – 11	9.5 – 11.5	9
12 – 13	11.5 – 13.5	4
14 – 15	13.5 – 15.5	2



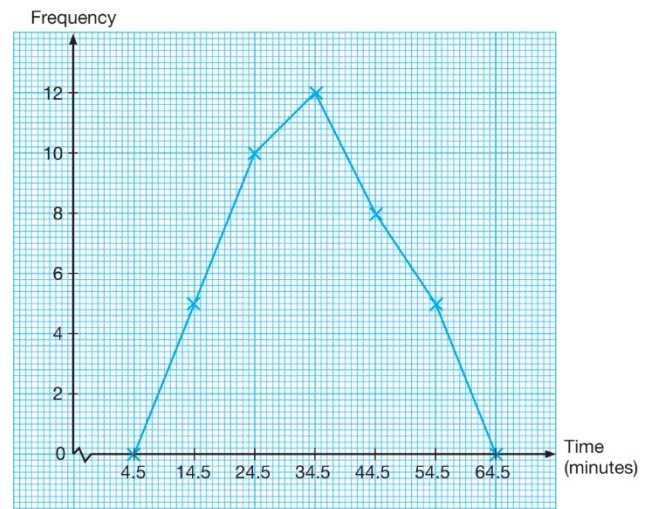
2

Length(cm)	Class boundaries	Frequency
30 – 34	29.5 – 34.5	6
35 – 39	34.5 – 39.5	8
40 – 44	39.5 – 44.5	14
45 – 49	44.5 – 49.5	10
50 – 54	49.5 – 54.5	7



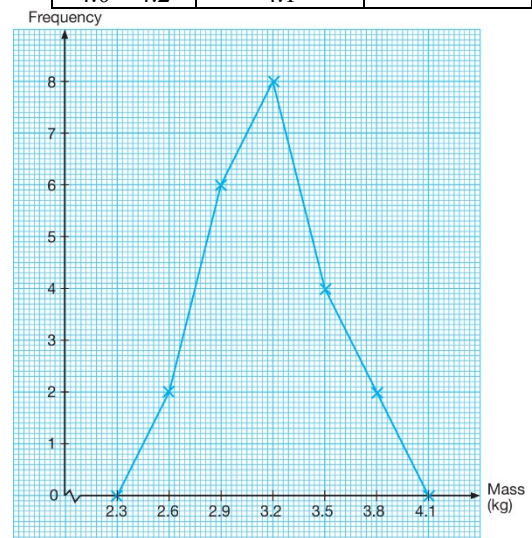
3

Time (minutes)	Midpoint	Frequency
0 – 9	4.5	0
10 – 19	14.5	5
20 – 29	24.5	10
30 – 39	34.5	12
40 – 49	44.5	8
50 – 59	54.5	5
60 – 69	64.5	0



4

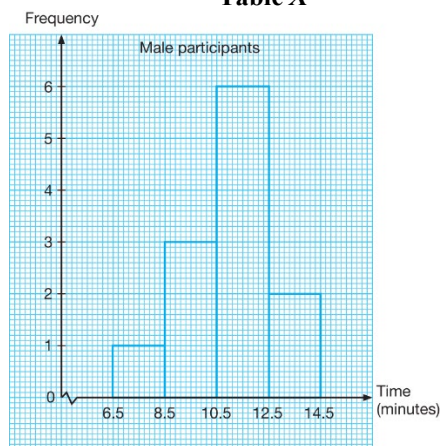
Mass (kg)	Midpoint	Frequency
2.2 – 2.4	2.3	0
2.5 – 2.7	2.6	2
2.8 – 3.0	2.9	6
3.1 – 3.3	3.2	8
3.4 – 3.6	3.5	4
3.7 – 3.9	3.8	2
4.0 – 4.2	4.1	0



5

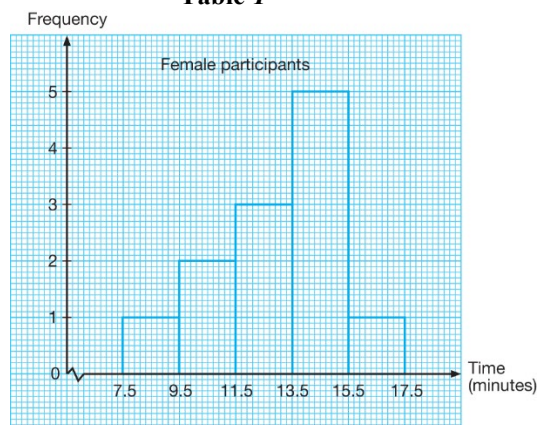
Time (minutes)	Class boundaries	Frequency
7 – 8	6.5 – 8.5	1
9 – 10	8.5 – 10.5	3
11 – 12	10.5 – 12.5	6
13 – 14	12.5 – 14.5	2

Table X



Time (minutes)	Class boundaries	Frequency
8 – 9	7.5 – 9.5	1
10 – 11	9.5 – 11.5	5
12 – 13	11.5 – 13.5	3
14 – 15	13.5 – 15.5	2
16 – 17	15.5 – 17.5	1

Table Y



(b) *Interpretation:*

The times taken by the men's participants dispersed from 7 to 14 minutes and the modal class is (11 – 12) minutes.

The times taken by the women's participants dispersed from 8 to 17 minutes and the modal class is (14 – 15) minutes.

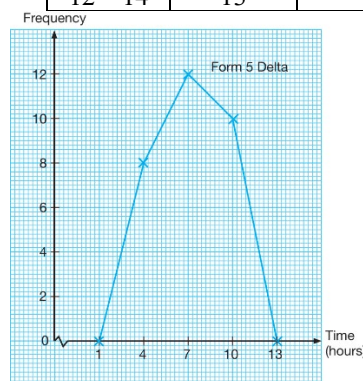
Conclusion:

The times taken by the women's participants are more widely dispersed compared to the men's participants. The average time of the men's participants is shorter than that of the women.

6 (a) (i)

Table H

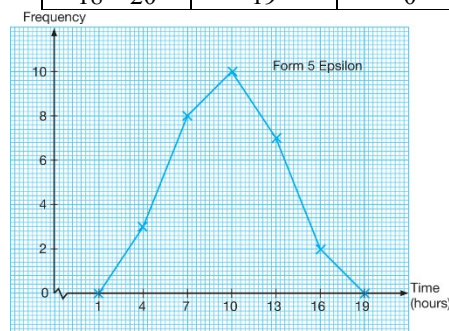
Time (hours)	Midpoint	Frequency
0 – 2	1	0
3 – 5	4	8
6 – 8	7	12
9 – 11	10	10
12 – 14	13	0



(ii)

Table K

Time (hours)	Midpoint	Frequency
0 – 2	1	0
3 – 5	4	3
6 – 8	7	8
9 – 11	10	10
12 – 14	13	7
15 – 17	16	2
18 – 20	19	0



The distribution of times taken by the students of Form 5 Delta to attend tuition classes dispersed from 3 to 11 hours a week and the modal class is (6 – 8) hours. The distribution of times taken by the students of Form 5 Epsilon to attend tuition classes dispersed from 3 to 17 hours a week and the modal class is (9 – 11) hours.

Conclusion:

The distribution of times taken by the students of Form 5 Epsilon is more widely dispersed compared to that of the students of 5 Delta. The average time to attend tuition classes for the students of Form 5 Epsilon is longer compared to that of the students of 5 Delta.

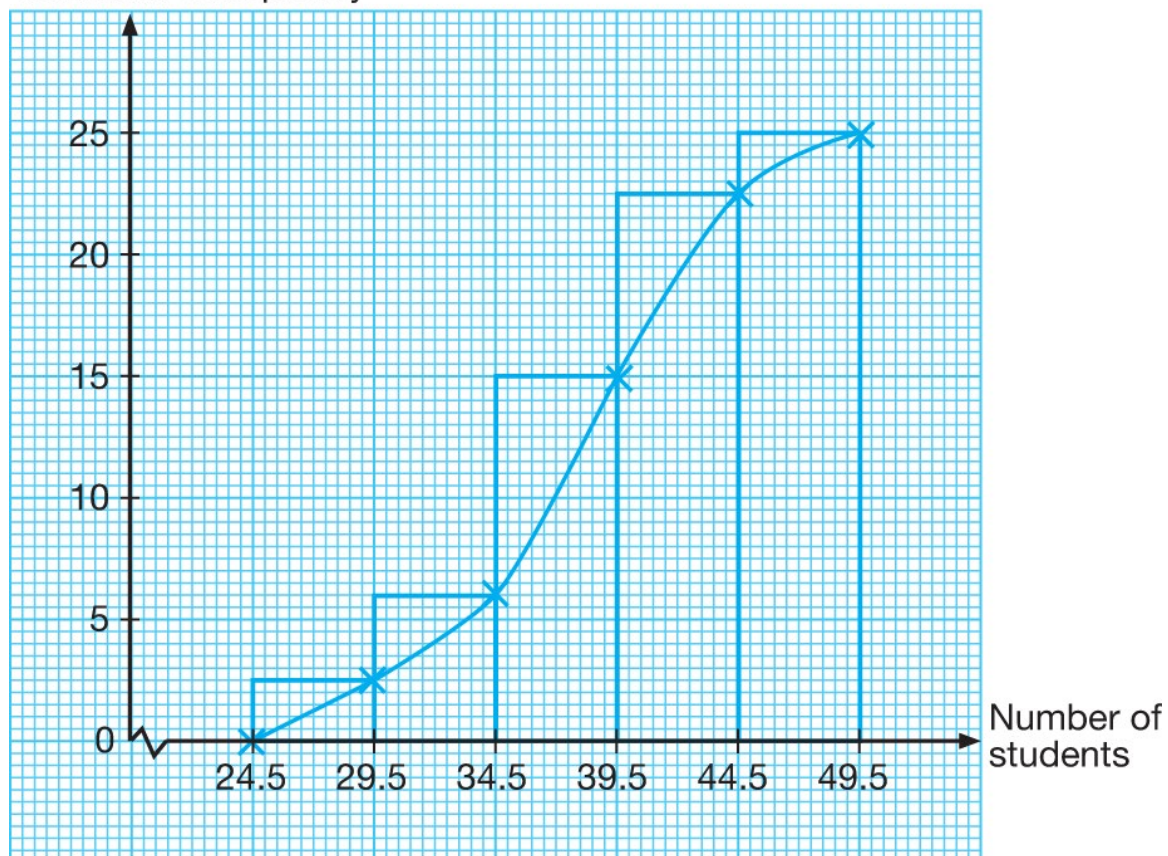
7

<i>Diameter (mm)</i>	<i>Frequency</i>	<i>Cumulative frequency</i>
1 – 2	4	4
3 – 4	8	12
5 – 6	9	21
7 – 8	13	34
9 – 10	6	40
11 – 12	4	44

8 (a)

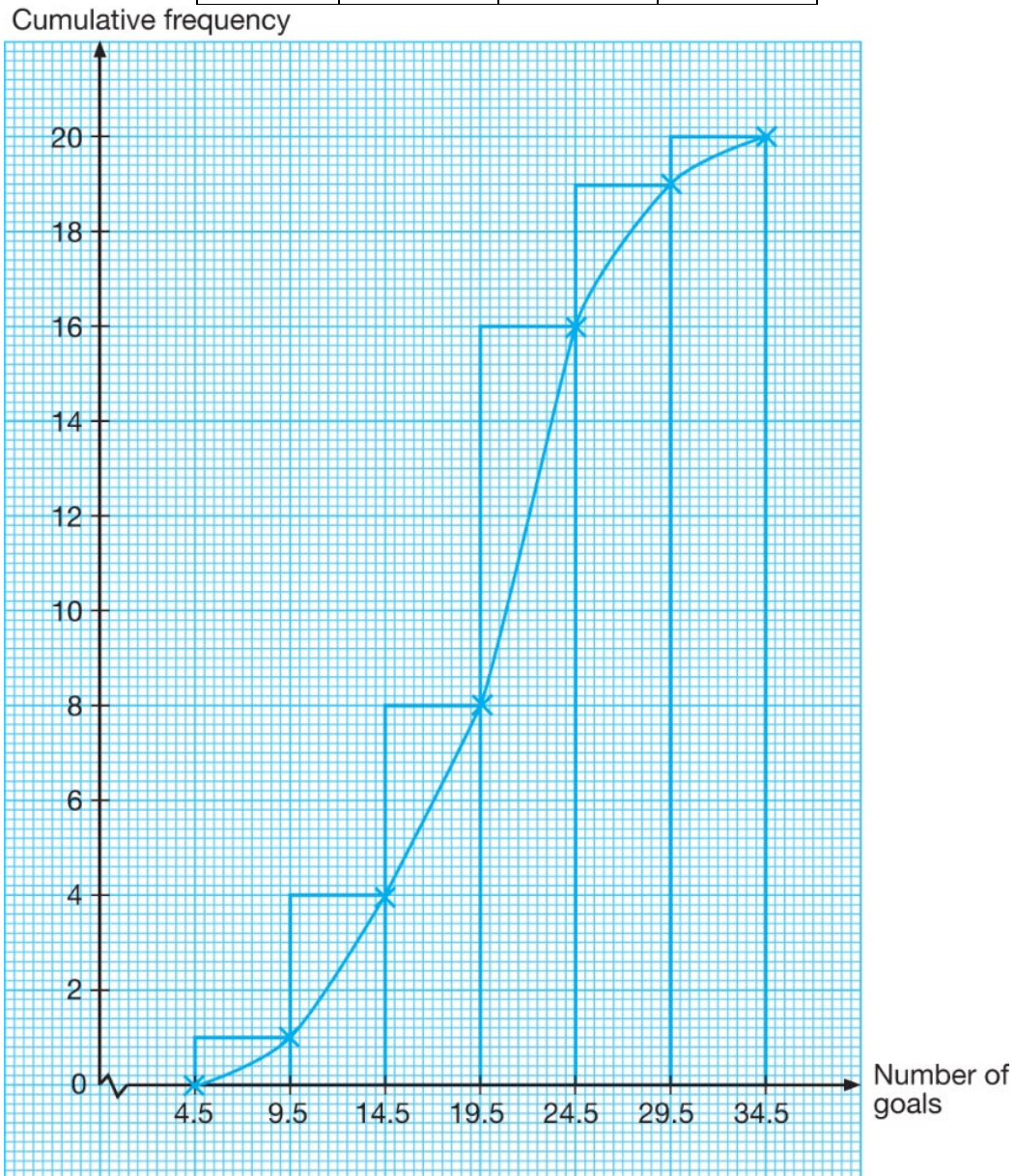
<i>Number of students</i>	<i>Upper boundary</i>	<i>Frequency</i>	<i>Cumulative frequency</i>
20 – 24	24.5	0	0
25 – 29	29.5	2	2
30 – 34	34.5	4	6
35 – 39	39.5	9	15
40 – 44	44.4	7	22
45 – 49	49.5	3	28

Cumulative frequency



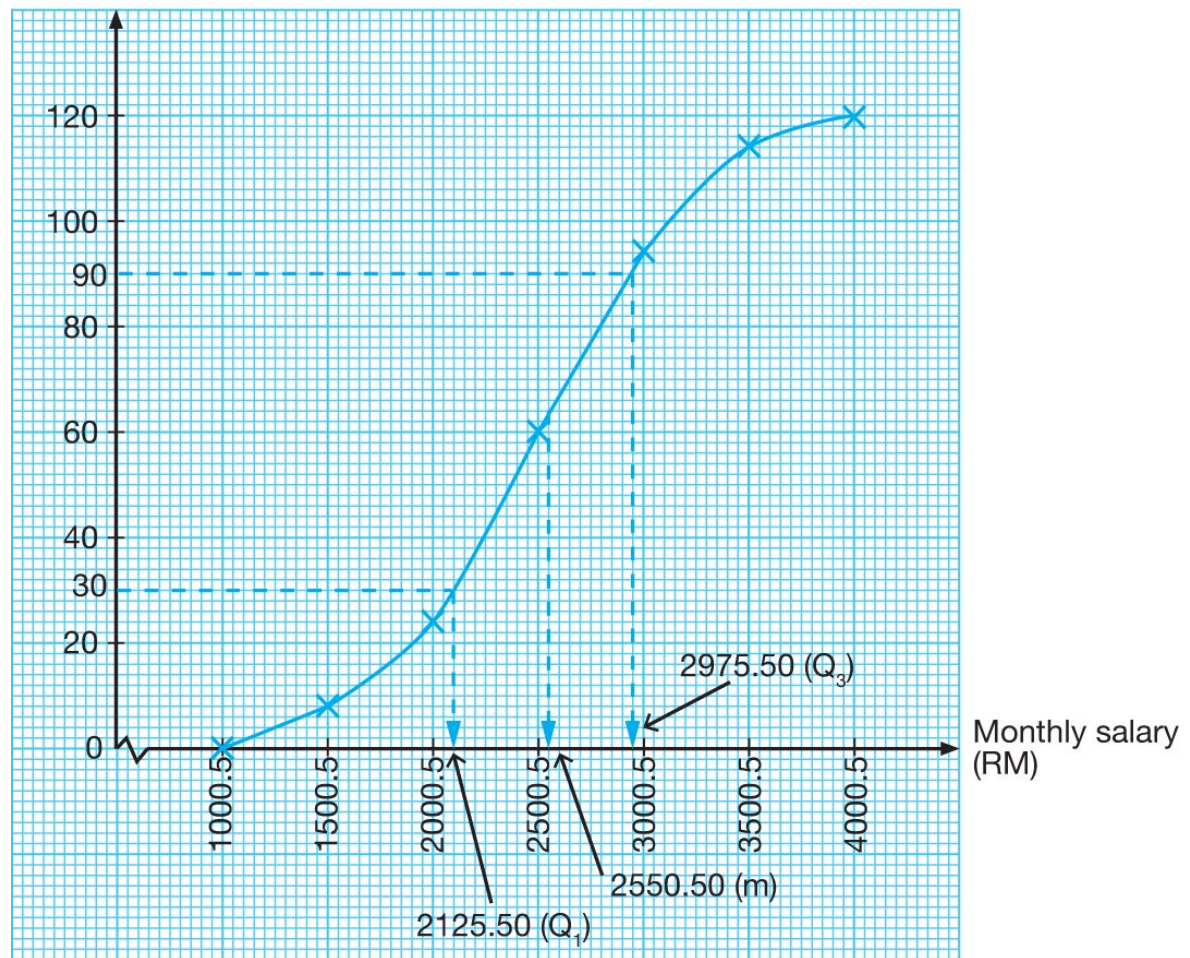
(b)

<i>Number of goals</i>	<i>Frequency</i>	<i>Upper boundary</i>	<i>Cumulative frequency</i>
0 – 4	0	4.5	0
5 – 9	1	9.5	1
10 – 14	3	14.5	4
15 – 19	4	19.5	8
20 – 24	8	24.5	16
25 – 29	3	29.5	19
30 – 34	1	34.5	20



9

Cumulative frequency

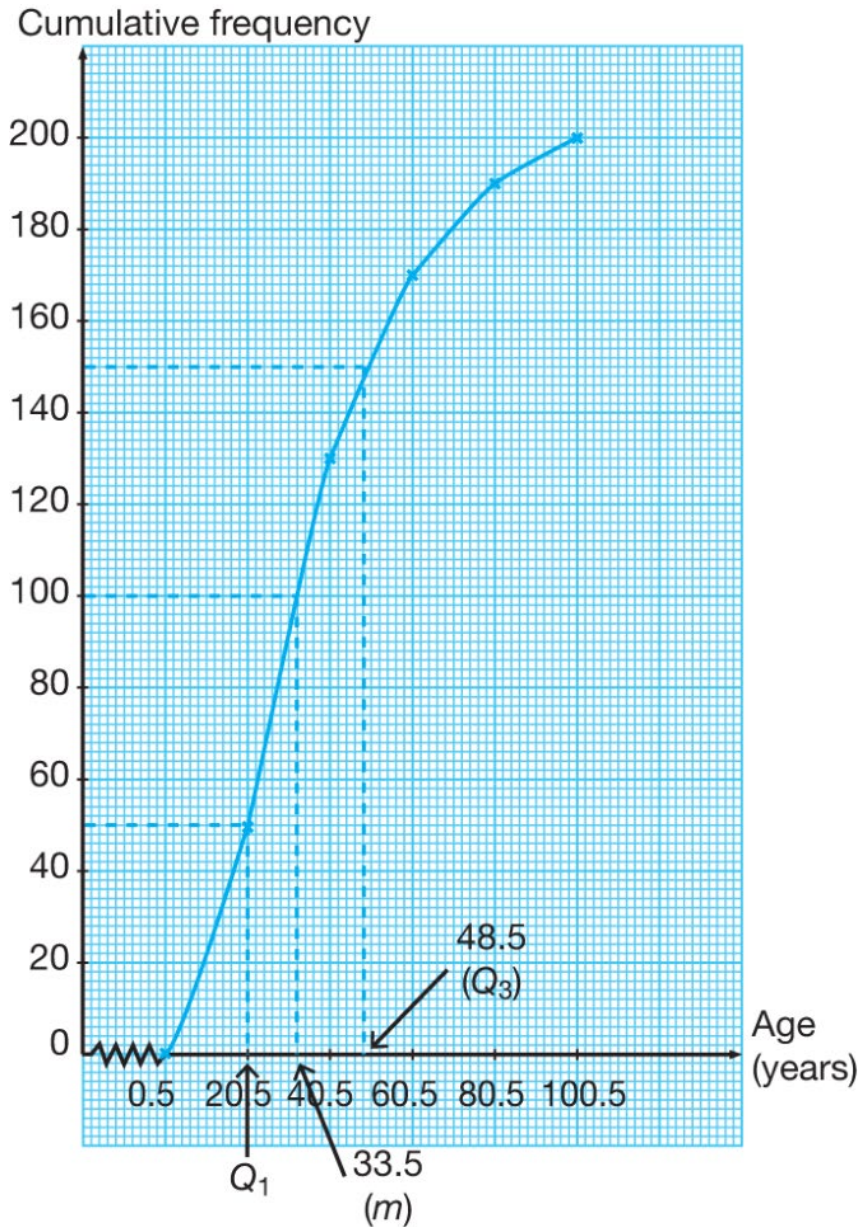


- (a) $m = \text{RM}2\ 550.50$
- (b) $Q_1 = \text{RM}2\ 125.50$
- (c) $Q_3 = \text{RM}2\ 975.50$
- (d) Interquartile range
 $= Q_3 - Q_1$
 $= \text{RM}2\ 975.50 - \text{RM}2\ 125.50$
 $= \text{RM}850.00$

10 (a)

Age (years)	Frequency	Upper boundary	Cumulative frequency
	0	0.5	0
1 – 20	50	20.5	50
21 – 40	80	40.5	130
41 – 60	40	60.5	170
61 – 80	20	80.5	190
81 – 100	10	100.5	200

(b)



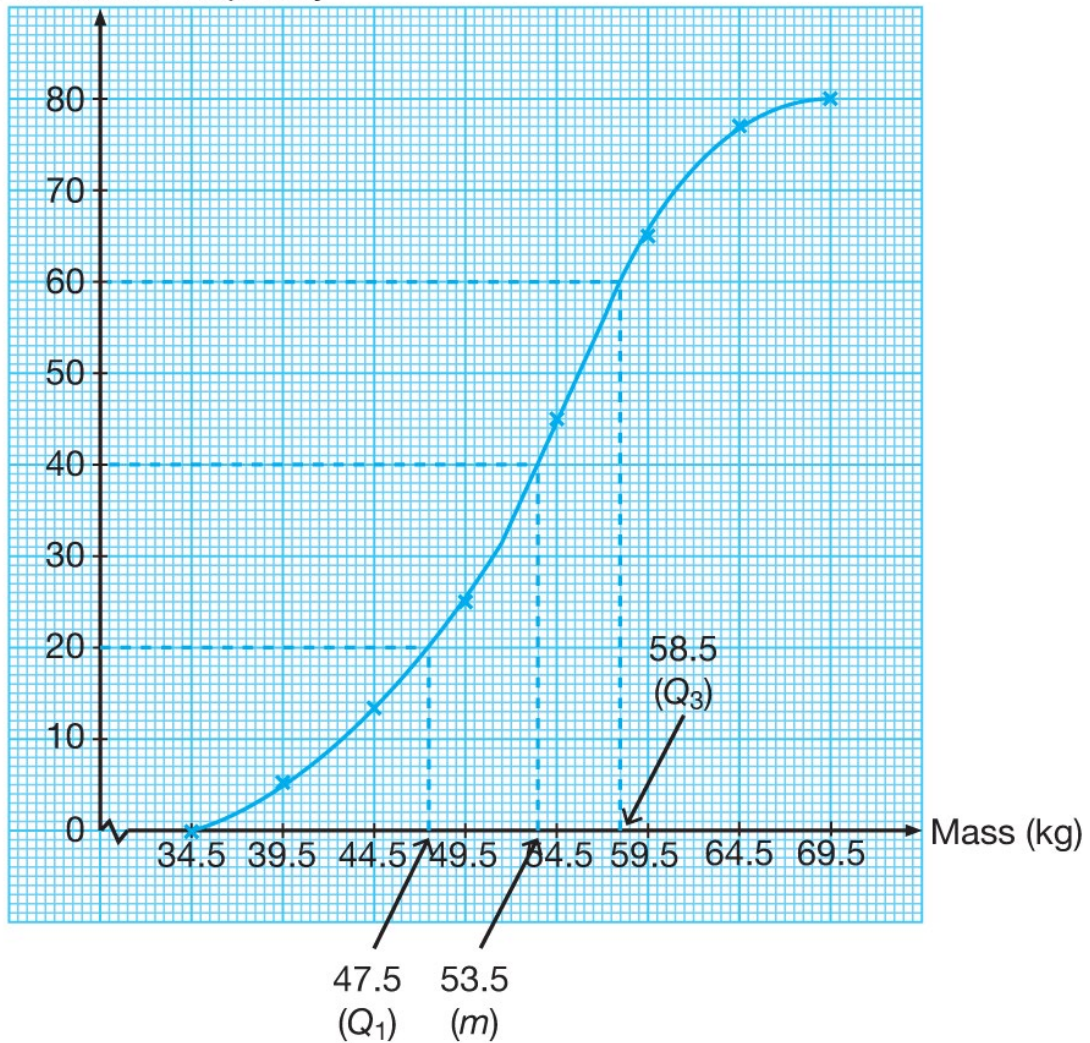
- (c) (i) $m = 33.5$
(ii) $Q_1 = 20.5$
(iii) $Q_3 = 48.5$
(iv) Interquartile range = $Q_3 - Q_1 = 28.0$

UPSKILL 7.2

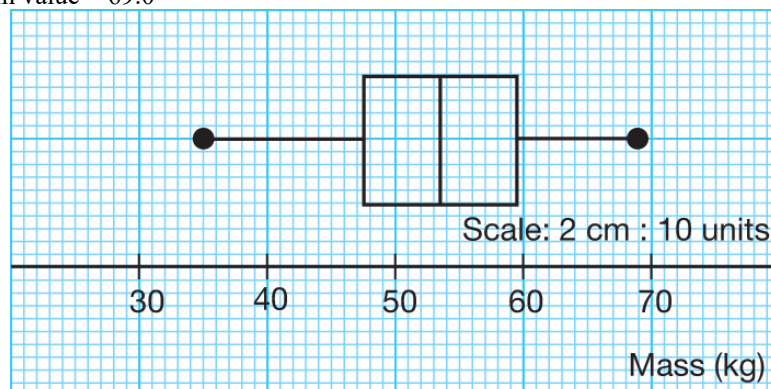
1 (a) Range = $67 - 37 = 30$ kg

(b)

Cumulative frequency



(c) $Q_1 = 47.5$,
 $m = 53.5$,
 $Q_3 = 58.5$,
 Minimum value = 35.0,
 Maximum value = 69.0

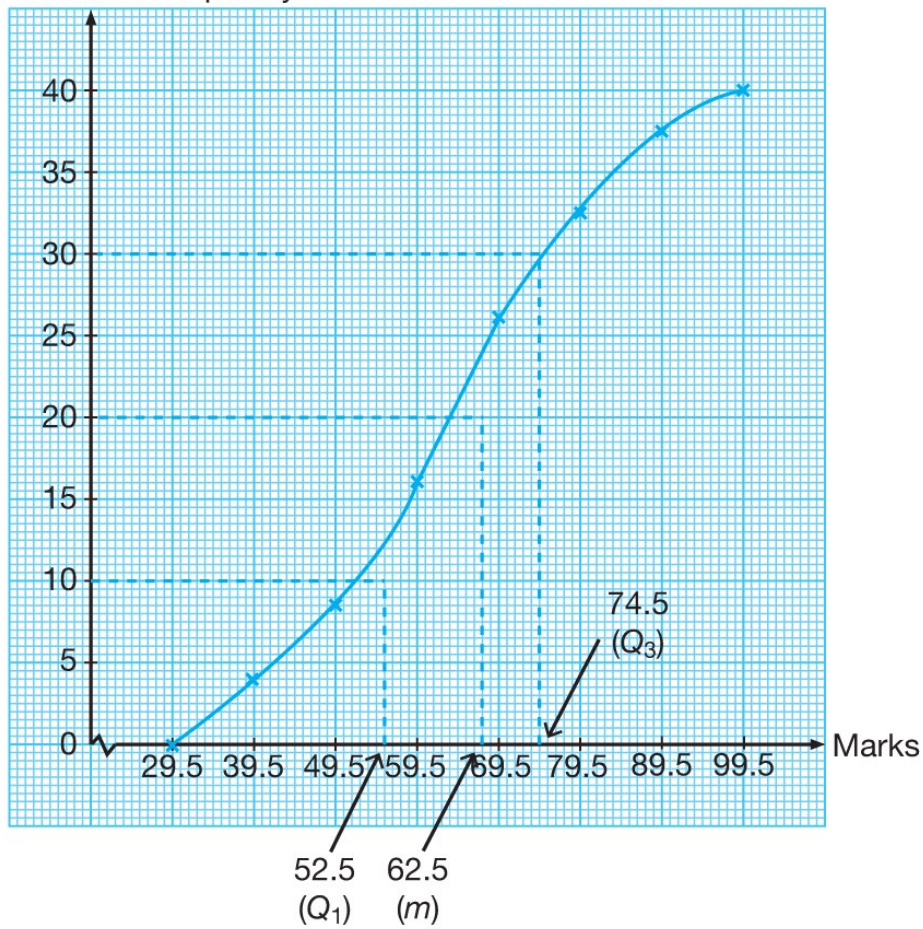


The distribution of mass is skewed to the left because the left box and whisker are longer compared to that of the right.

2 (a) Range = $94.5 - 34.5 = 60$

(b)

Cumulative frequency



(c) $Q_1 = 52.5,$

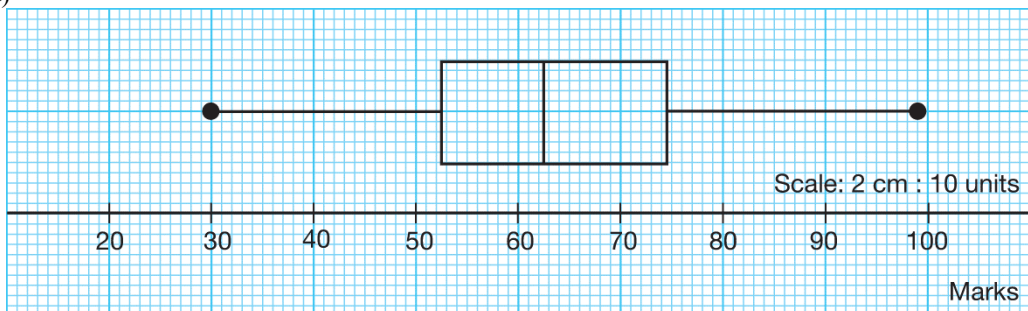
$m = 62.5,$

$Q_3 = 74.5,$

Minimum value = 30.0,

Maximum value 99.0

(d)



The distribution of marks is skewed to the right because the right box and whisker are longer compared to that of the left.

3 (a)

Time (s)	Frequency (f)	Midpoint (x)	fx	fx ²
151 – 165	6	158	948	149 784
166 – 180	15	173	2 595	448 935
181 – 195	20	188	3 760	706 882
196 – 210	13	203	2 639	535 717
211 – 225	5	218	1 090	237 620
226 – 240	1	233	233	54 289
	60		11 265	2 133 225

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{11\,265}{60} = 187.75 \text{ s}$$

$$(b) \sigma = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2} = \sqrt{\frac{2\,133\,225}{60} - 187.75^2} = 17.43 \text{ s}$$

$$(c) \sigma^2 = 303.6875 \text{ s}^2$$

4 (a)

Marks	Frequency (f)	Midpoint (x)	fx	fx ²
50 – 59	14	54.5	763	41 583.5
60 – 69	16	64.5	1 032	66 564
70 – 79	10	74.5	745	55 502.5
80 – 89	6	84.5	507	42 841.5
90 – 99	4	94.5	378	35 751
	50		3 425	242 212.5

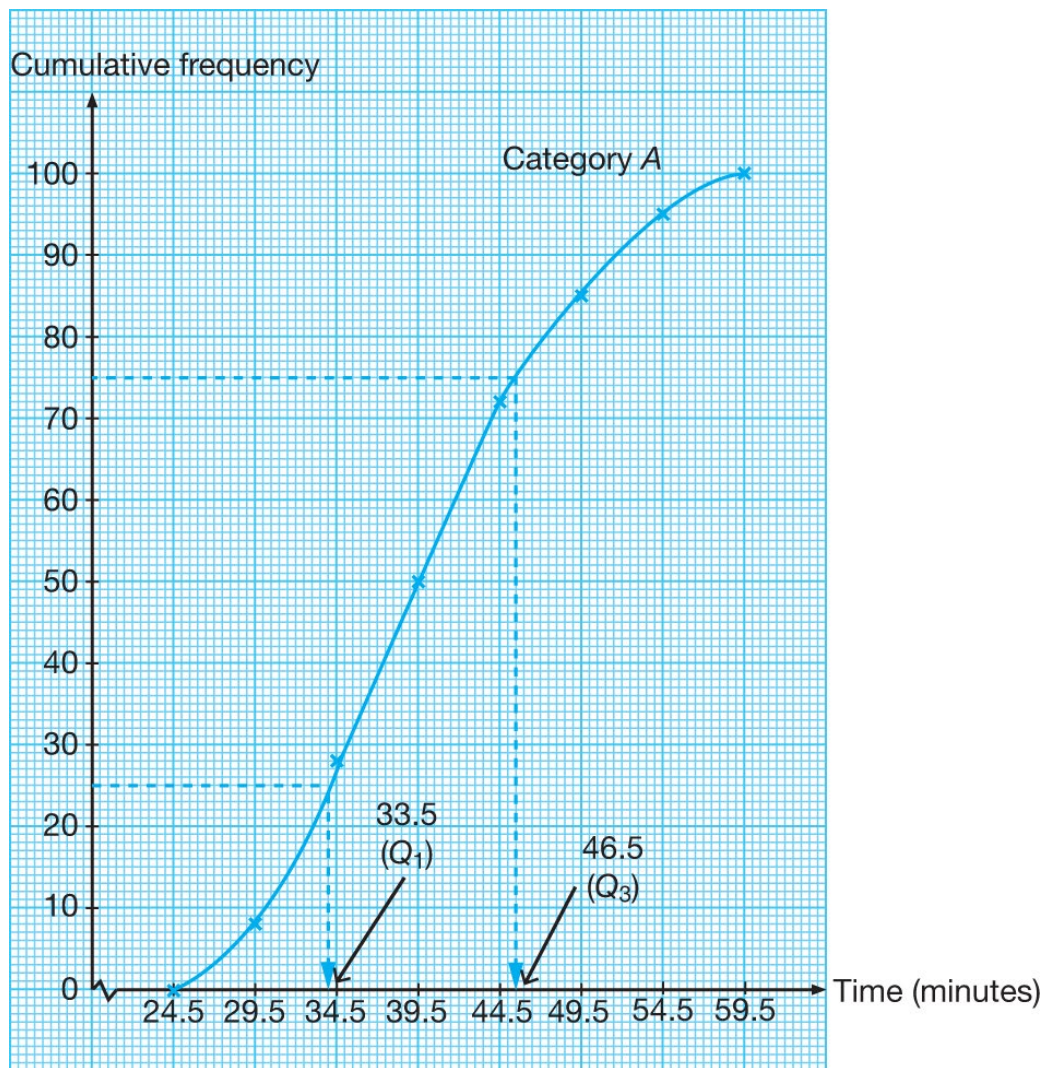
$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{3\,425}{50} = 68.5$$

$$(b) \sigma = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2} = \sqrt{\frac{242\,212.5}{50} - 68.5^2} = 12.33$$

$$(c) \sigma^2 = 152$$

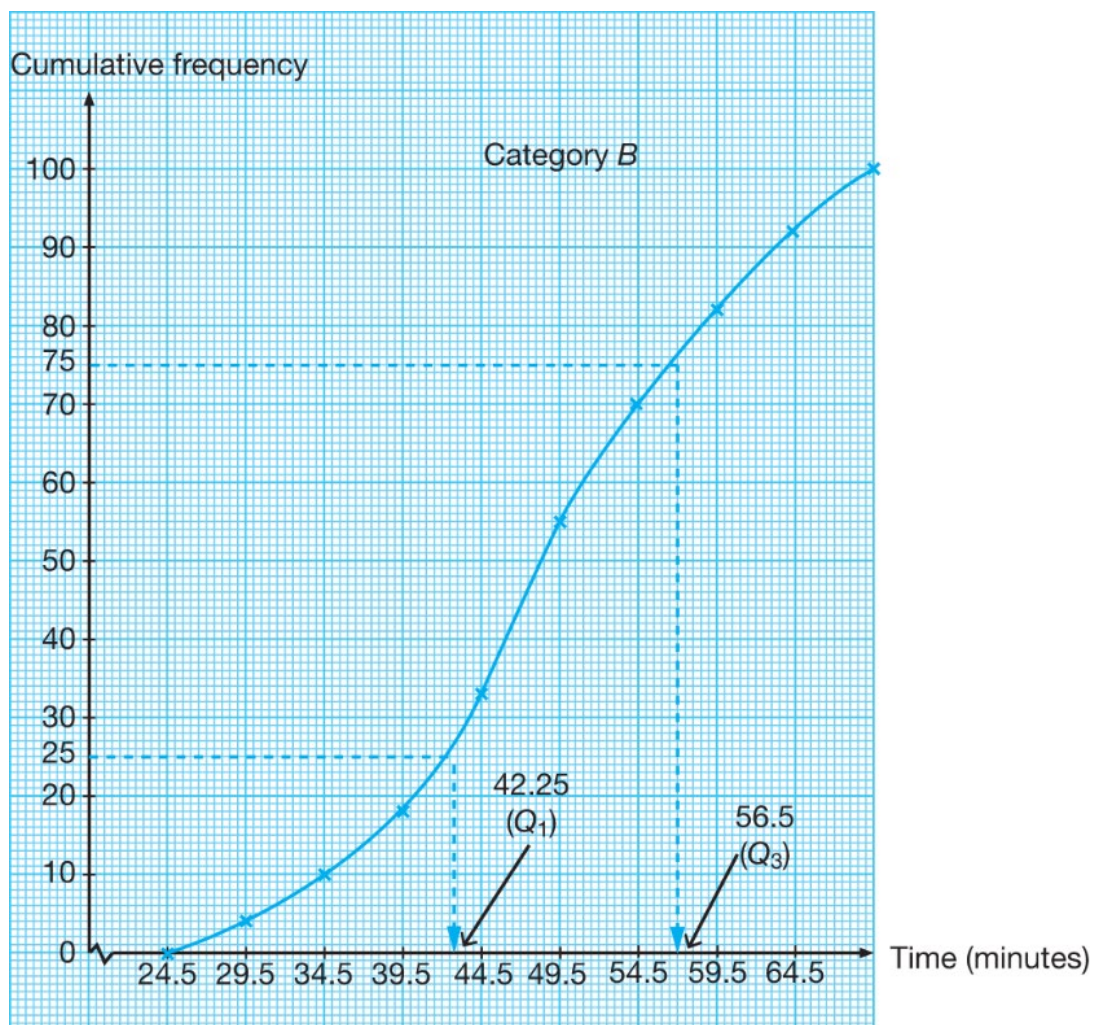
5 (a) (i)

Time (minutes)	Frequency (f)	Cumulative frequency	Midpoint (x)	fx	fx ²
20 – 24	0	0			
25 – 29	8	8	27	216	5 832
30 – 34	20	28	32	640	20 480
35 – 39	22	50	37	814	30 118
40 – 44	22	72	42	924	38 808
45 – 49	14	86	47	658	30 926
50 – 54	8	94	52	416	21 632
55 – 59	6	100	57	342	19 949
Sum	100			4 010	167 290



(ii)

Time (minutes)	Frequency (f)	Cumulative frequency	Midpoint (x)	fx	fx^2
	0	0			
25 – 29	4	4	27	108	2 916
30 – 34	6	10	32	192	6 144
35 – 39	8	18	37	296	10 952
40 – 44	15	33	42	630	26 460
45 – 49	22	55	47	1 034	48 598
50 – 54	15	70	52	780	40 560
55 – 59	12	82	57	684	38 988
60 – 64	10	92	62	620	38 440
65 – 69	8	100	67	536	35 912
Sum	100			4 010	248 970



- (b) (i) Interquartile range = $46.5 - 33.5 = 13$ minutes
(ii) Interquartile range = $56.5 - 42.25 = 14.25$ minutes

(c) (i) Standard deviation =
$$\sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2} =$$

$$= \sqrt{\frac{167\,290}{100} - (4\,010)^2} =$$

$$= 8.055 \text{ minutes}$$

(ii) Standard deviation =
$$\sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2} =$$

$$= \sqrt{\frac{248\,970}{100} - \left(\frac{4\,880}{100}\right)^2} =$$

$$= 10.40 \text{ minutes}$$

(d) *Interpretation:*

Both interquartile range and standard deviation of the walking times of the students of category *B* are greater than the walking times of the students of category *A*.

Conclusion:

The walking times of students of category *B* are more widely dispersed compared to the walking times of the students of category *A*.

6 (a) (i) *Quartet of school R*

Time (s)	Frequency (f)	Midpoint (x)	fx	fx ²
201 – 210	2	205.5	411	84 460.5
211 – 220	3	215.5	646.5	139 320.75
221 – 230	6	225.5	1353	305 101.5
231 – 240	3	235.5	706.5	166 380.75
241 – 250	2	245.5	491	120 540.5
Sum	16		3 608	815 804

$$\text{Min} = \frac{\sum fx}{\sum f} = \frac{3\,608}{16} = 225.5 \text{ s}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2} = \sqrt{\frac{815\,804}{16} - 225.5^2} = 11.73 \text{ s}$$

(ii) *Quartet of school S:*

Time (s)	Frequency (f)	Midpoint (x)	fx	fx ²
191 – 200	1	195.5	195.5	38 220.25
201 – 210	2	205.5	411	84 460.5
211 – 220	3	215.5	646.5	139 320.75
221 – 230	4	225.5	902	203 401
231 – 240	3	235.5	706.5	166 380.75
241 – 250	2	245.5	491	120 540.5
251 – 260	1	255.5	255.5	65 280.25
Sum			3 608	817 604

$$\text{Min} = \frac{3\,608}{16} = 225.5 \text{ s}$$

$$\text{Standard deviation} = \sqrt{\frac{817\,604}{16} - 225.5^2} = 15.81 \text{ s}$$

- (b) Although the mean times for both quartets are the same, but the standard deviation of the quartet from school R is smaller than the quartet from school S. Hence, the performance of the quartet from school R is more consistent.

Summative Practice 7

Multiple-Choice Questions

1

<i>Number of reference book</i>	1 – 2	3 – 4	5 – 6	7 – 8	9 – 10
<i>Frequency</i>	3	7	8	10	8
<i>Cumulative frequency</i>	3	10	18	28	36

The modal class is 7 – 8.

Answer: C

2

<i>Score</i>	61 – 65	66 – 70	71 – 75	76 – 80	81 – 85	<i>Sum</i>
<i>Midpoint (x)</i>	63	68	73	78	83	
<i>Frequency (f)</i>	5	4	6	3	2	20
<i>fx</i>	315	272	438	234	166	1 425
<i>fx²</i>	19 845	18 496	31 976	18 252	13 778	102 345
<i>Cumulative</i>	5	9	15	18	20	

$$\sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

$$\sigma = \sqrt{\frac{102\,345}{20} - \left(\frac{1\,425}{20}\right)^2}$$

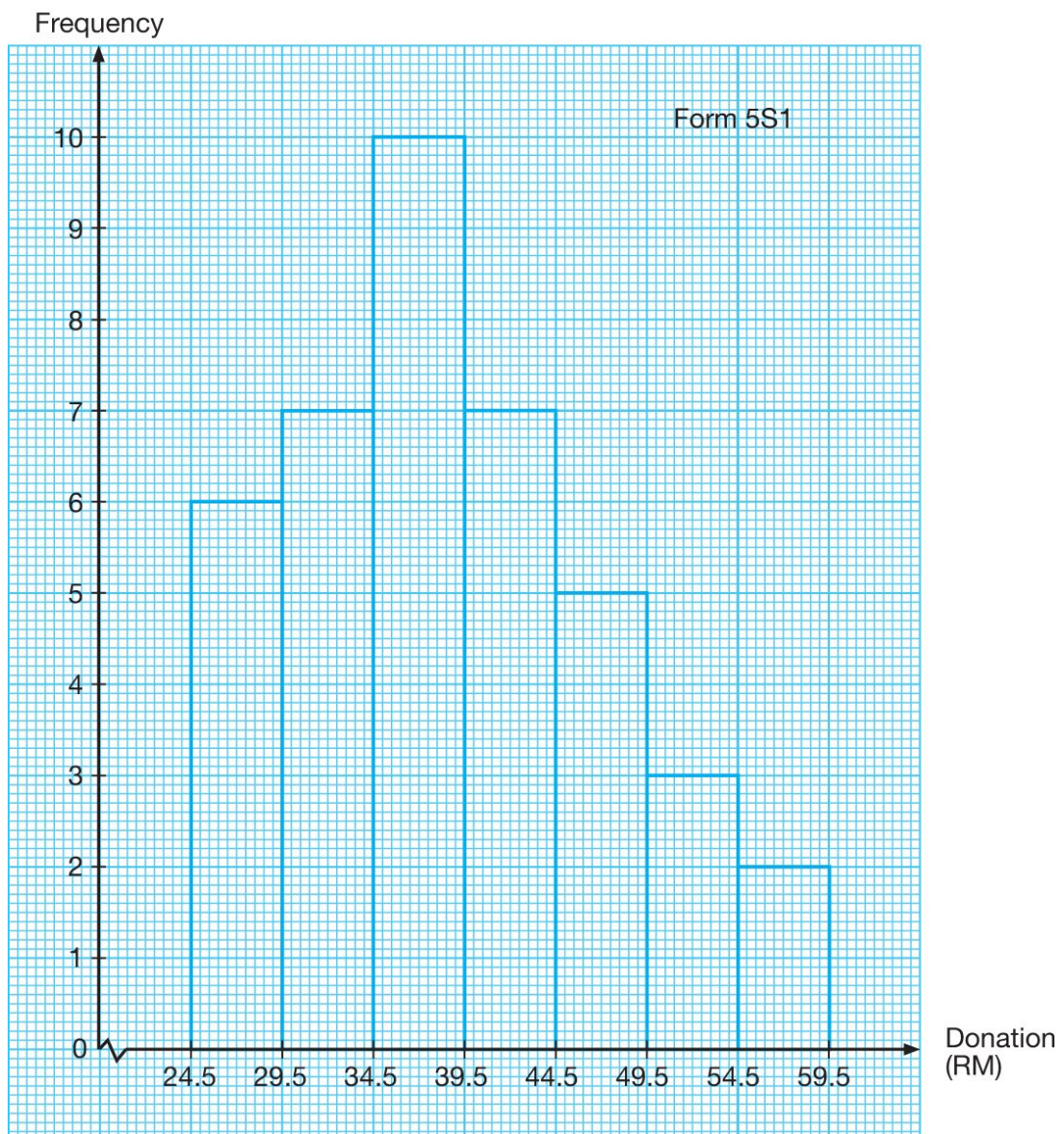
$$\sigma = 6.379$$

Answer: B

Structured Questions

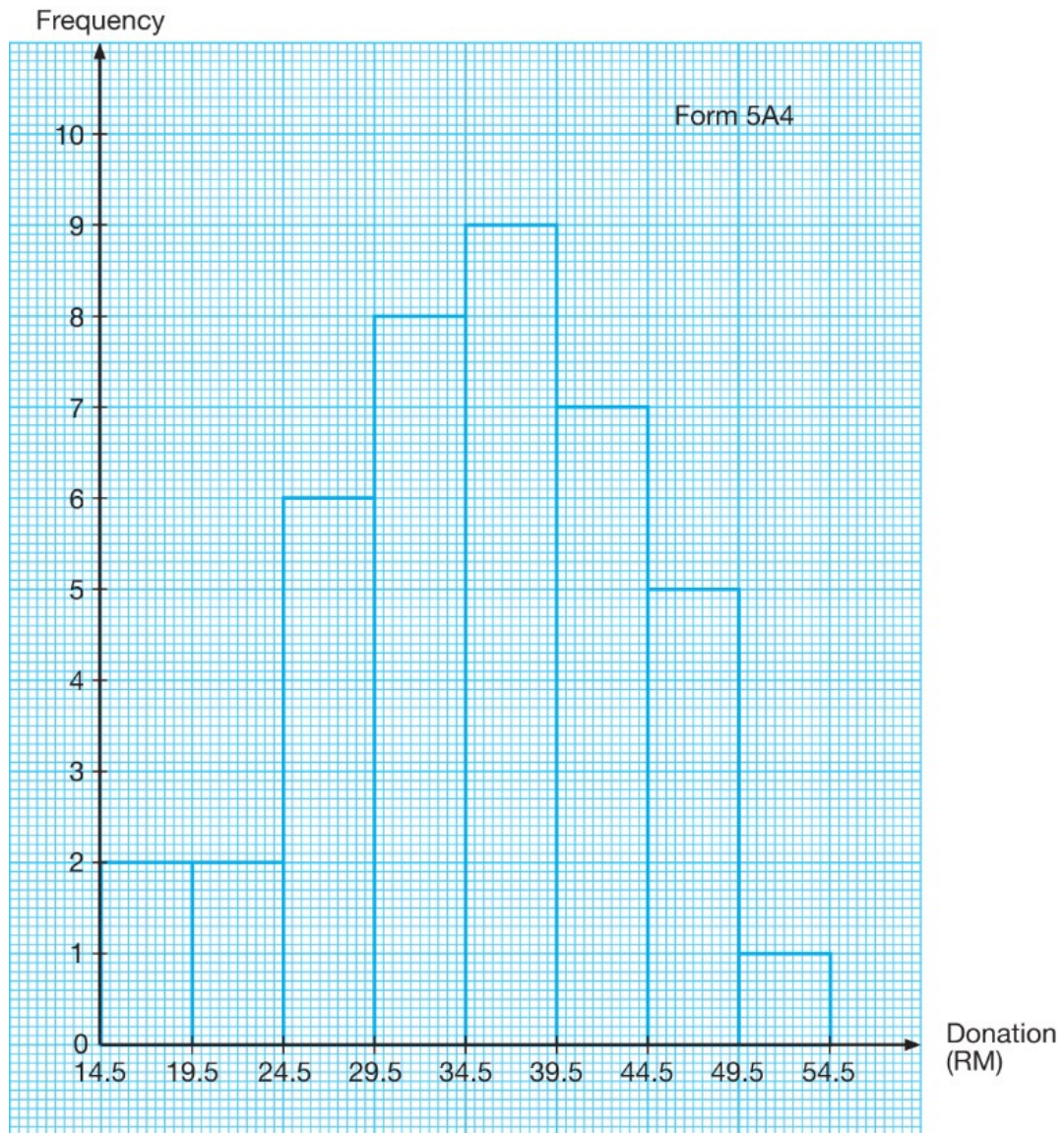
1 (a)

<i>Donation (RM)</i>	<i>Class boundaries</i>	<i>Frequency</i>
25 – 29	24.5 – 29.5	6
30 – 34	29.5 – 34.5	7
35 – 39	34.5 – 39.5	10
40 – 44	39.5 – 44.5	7
45 – 49	44.5 – 49.5	5
50 – 54	49.5 – 54.5	3
55 – 59	54.5 – 59.5	2



(b)

<i>Donation (RM)</i>	<i>Class boundaries</i>	<i>Frequency</i>
15 – 19	14.5 – 19.5	2
20 – 24	19.5 – 24.5	2
25 – 29	24.5 – 29.5	6
30 – 34	29.5 – 34.5	8
35 – 39	34.5 – 39.5	9
40 – 44	39.5 – 44.5	7
45 – 49	44.5 – 49.5	5
50 – 54	49.5 – 54.5	1



(c) (i) **5S1**

<i>Donation (RM)</i>	<i>Midpoint</i>	<i>Frequency (f)</i>	<i>fx</i>
25 – 29	27	6	162
30 – 34	32	7	224
35 – 39	37	10	370
40 – 44	42	7	294
45 – 49	47	5	235
50 – 54	52	3	156
55 – 59	57	2	114
		$\sum f = 40$	$\sum fx^2 = 1\ 555$

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{1\ 555}{40} = 38.88$$

(ii) **5A4**

<i>Donation (RM)</i>	<i>Midpoint</i>	<i>Frequency (f)</i>	<i>fx</i>
15 – 19	17	2	34
20 – 24	22	2	44
25 – 29	27	6	162
30 – 34	32	8	256
35 – 39	37	9	333
40 – 44	42	7	294
45 – 49	47	5	235
50 – 54	53	1	53
		$\sum f = 40$	$\sum fx^2 = 1\ 411$

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{1\ 411}{40} = 35.28$$

(d) **Histogram of Form 5S1**

Interpretation:

The donations collected distributes from RM25 to RM59. The mean is RM38.88.

Histogram of Form 5A4

Interpretation:

The donations collected distributes from RM15 to RM54. The mean is RM35.28.

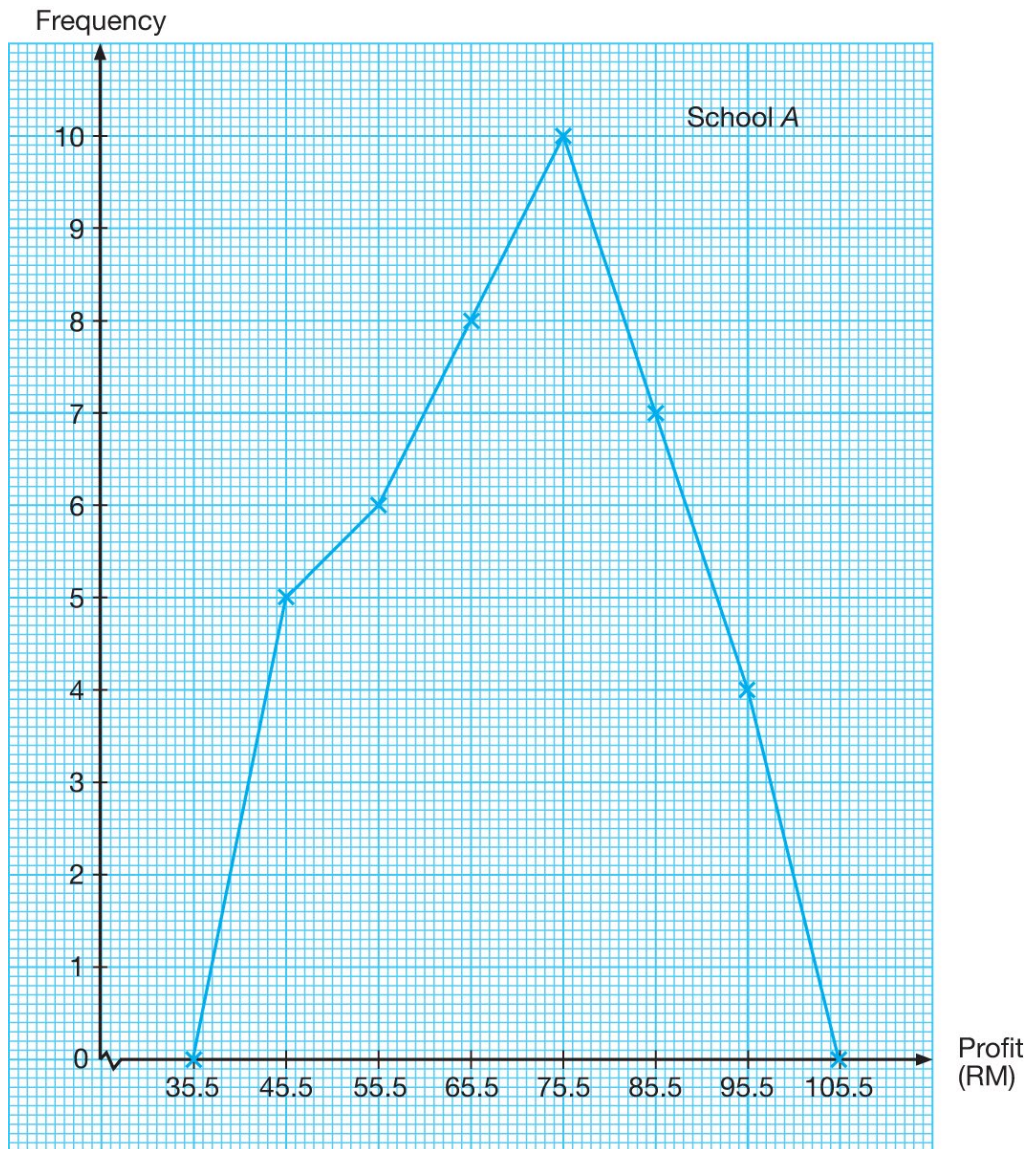
Conclusion:

The donations collected by the students of 5S1 are more than the donations collected by the students of Form 5A4.

The distribution of donations collected by the students of 5A4 is more widely dispersed compared to the donations collected by the students of 5S1.

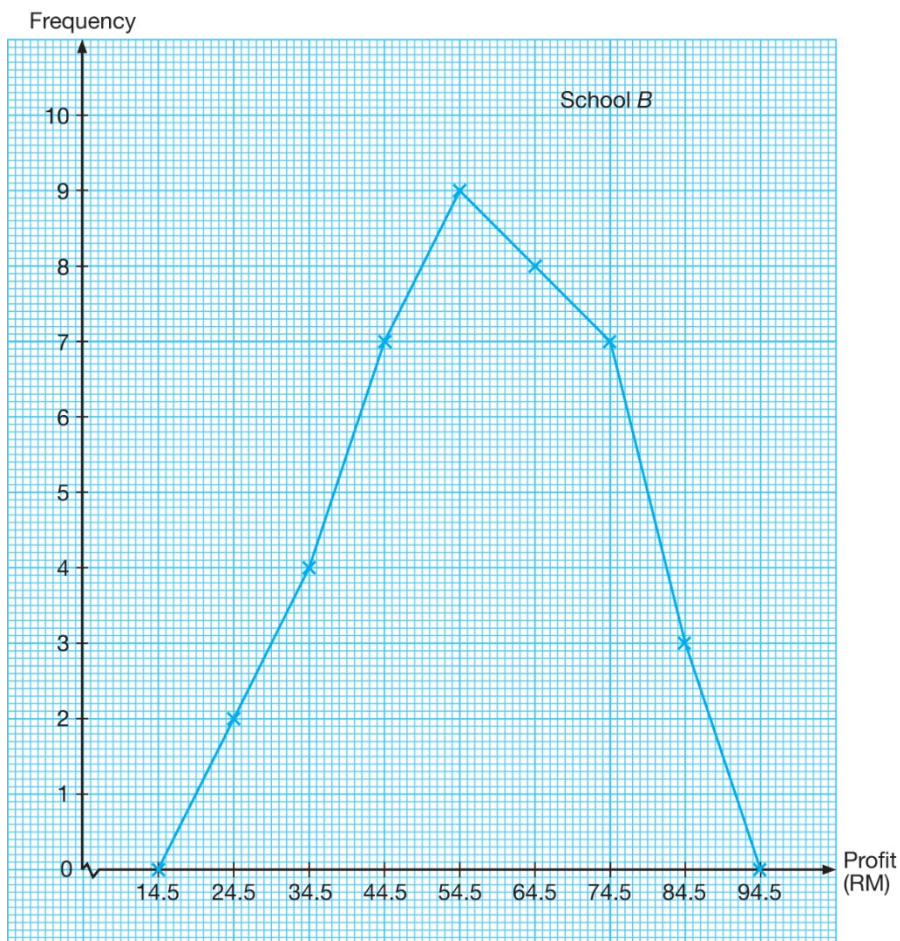
2 (a)

<i>Profit (RM)</i>	<i>Midpoint</i>	<i>Frequency</i>
31 – 40	35.5	0
41 – 50	45.5	6
51 – 60	55.5	7
61 – 70	65.5	10
71 – 80	75.5	7
81 – 90	85.5	5
91 – 100	95.5	3
101 – 110	105.5	0



(b)

<i>Profit (RM)</i>	<i>Midpoint</i>	<i>Frequency</i>
11 – 20	15.5	0
21 – 30	25.5	2
31 – 50	35.5	4
41 – 50	45.5	7
51 – 60	55.5	9
61 – 70	65.5	8
71 – 80	75.5	7
81 – 90	85.5	3
91 – 100	95.5	0



(c) **Frequency polygon of School A**

Interpretation:

The profit distributes from RM41 to RM100. The modal class is RM(61 – 70).

Frequency polygon of School B

Interpretation:

The profit distributes from RM21 to RM90. The modal class is RM(51 – 60).

Conclusion:

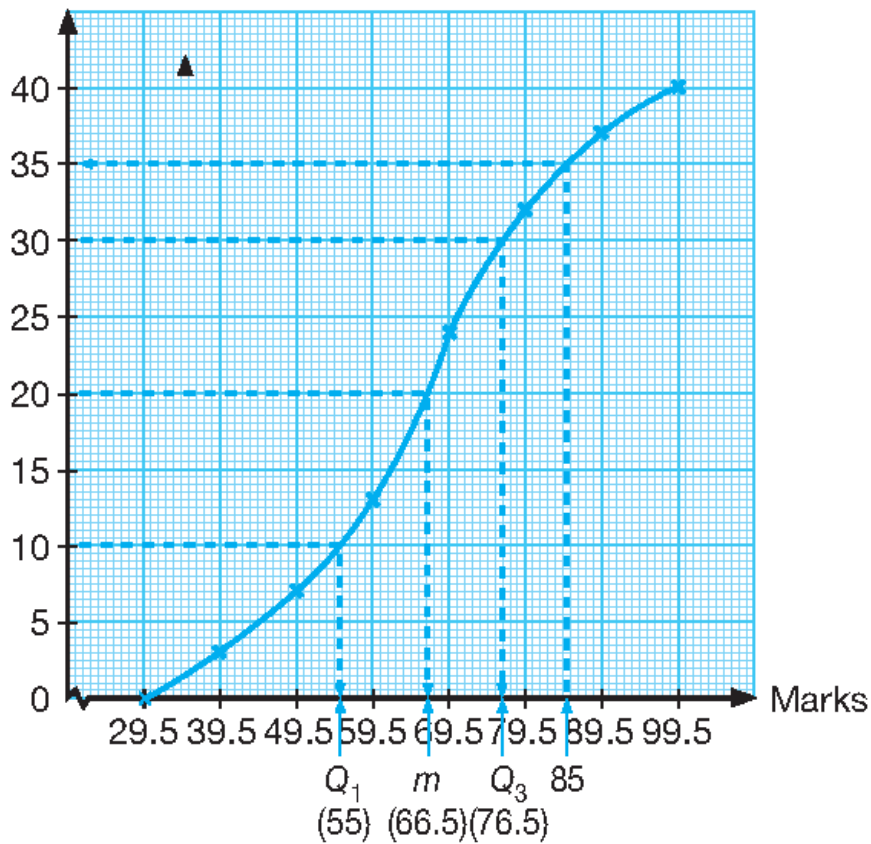
The profits obtained by the students of School A are more than the profits obtained by the students of School B.

The distribution of profits obtained by the students of School B is more widely dispersed as compared to the distribution of profits obtained by the students of School A.

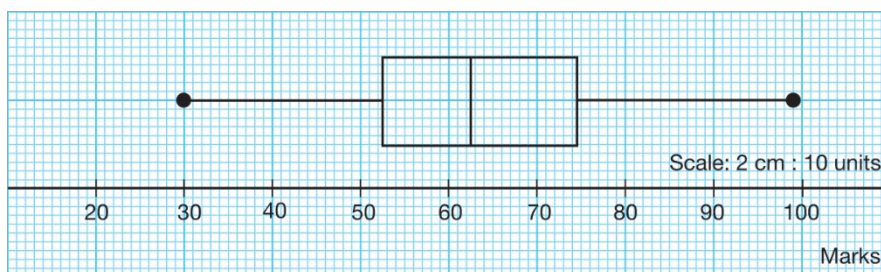
3 (a)

Marks	Frequency	Upper boundary	Cumulative frequency
20 – 29	0	29.5	0
30 – 39	3	39.5	3
40 – 49	4	49.5	7
50 – 59	6	59.5	13
60 – 69	11	69.5	24
70 – 79	8	79.5	32
80 – 89	5	89.5	37
90 – 99	3	99.5	40

Cumulative frequency



(b)



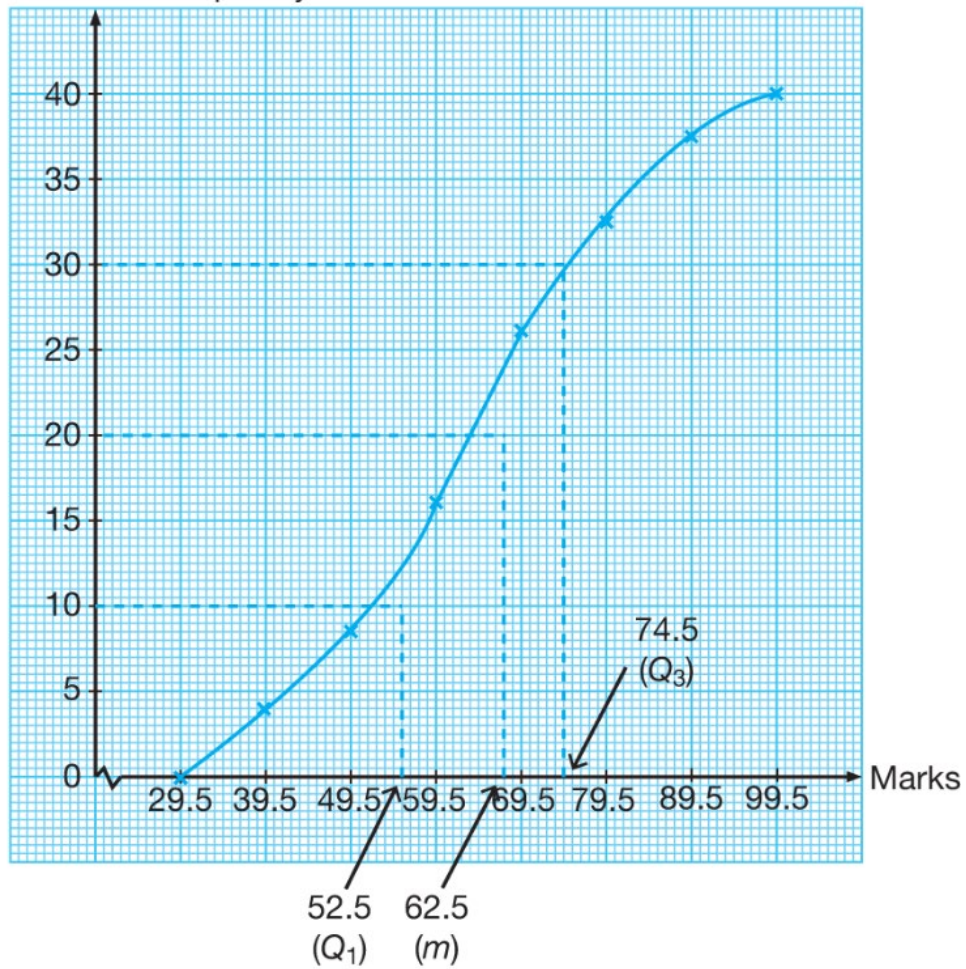
(c) The percentage of students who achieve marks above 85 will be rewarded by their subject teacher

$$\begin{aligned}
 &= \frac{40 - 35}{40} \times 100 \\
 &= 12.5\%
 \end{aligned}$$

4 (a) (i)

Marks	Frequency	Upper boundary	Cumulative frequency
	0	29.5	0
30 – 39	4	39.5	4
40 – 49	5	49.5	9
50 – 59	7	59.5	16
60 – 69	11	69.5	27
70 – 79	7	79.5	34
80 – 89	5	89.5	39
90 – 99	1	99.5	40

5A1
Cumulative frequency

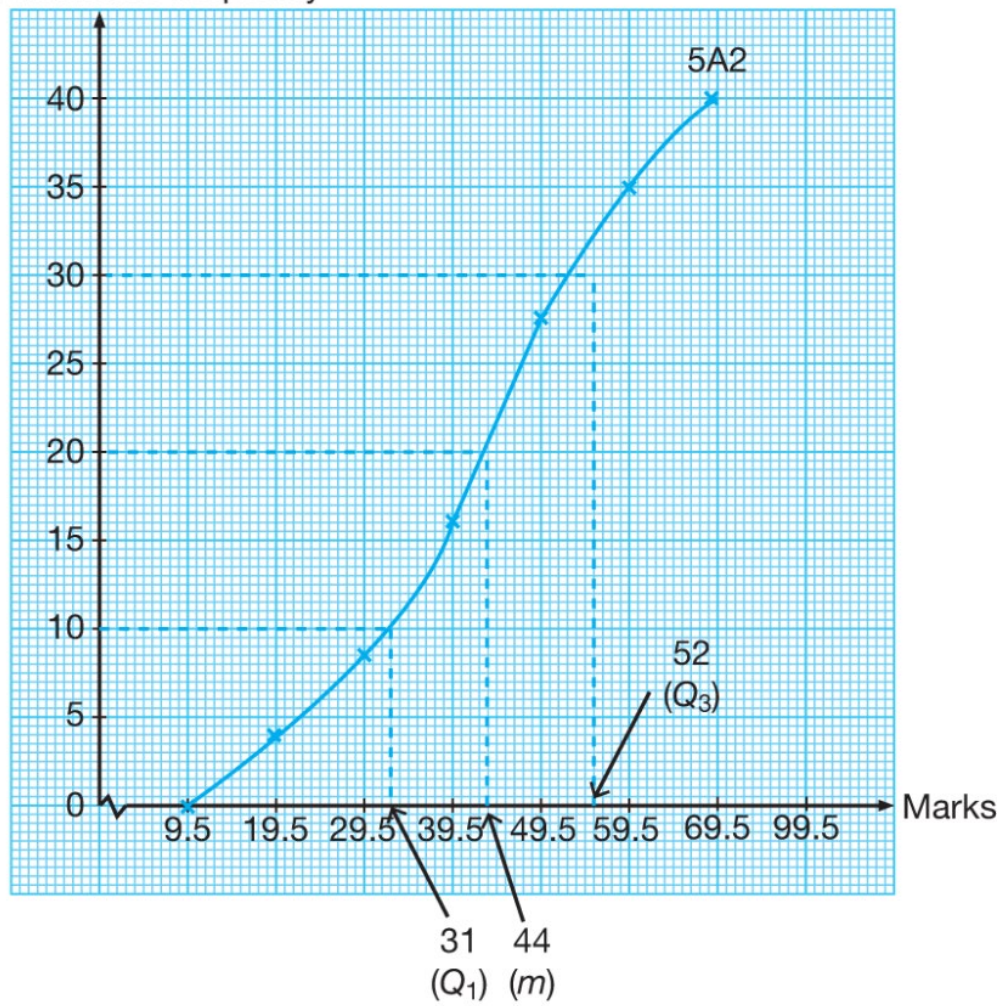


(ii)

Marks	Frequency	Upper boundary	Cumulative frequency
		19.5	0
20 – 29	4	29.5	4
30 – 39	5	39.5	9
40 – 49	7	49.5	16
50 – 59	12	59.5	28
60 – 69	7	69.5	35
70 – 79	5	79.5	40

5A2

Cumulative frequency



(b) (i) $m = 63.5$, $Q_3 - Q_1 = 74.5 - 52.5 = 22$

(ii) $m = 44$, $Q_3 - Q_1 = 52 - 31 = 21$

(c) (i)

Marks	Frequency (f)	Midpoint (x)	fx	fx ²
30 – 39	4	34.5	138	4 761
40 – 49	5	44.5	222.5	9 901.25
50 – 59	7	54.5	381.5	20 791.75
60 – 69	11	64.5	709.5	45 762.75
70 – 79	7	74.5	521.5	38 851.75
80 – 89	5	84.5	422.5	35 701.25
90 – 99	1	94.5	94.5	8 930.25
Sum	40		2 490	164 700

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2} = \sqrt{\frac{164\,700}{40} - \left(\frac{2\,490}{40}\right)^2} = 15.57$$

Marks	Frequency (f)	Midpoint (x)	fx	fx ²
20 – 29	4	29.5	118	3 481
30 – 39	5	39.5	197.5	7 801.25
40 – 49	7	49.5	346.5	17 151.75
50 – 59	12	59.5	714	42 483
60 – 69	7	69.5	486.5	33 811.75
70 – 79	5	79.5	397.5	31 601.25
Sum	40		2 260	163 330

(ii) Standard deviation = $\sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2} = \sqrt{\frac{136\,330}{40} - \left(\frac{2\,260}{40}\right)^2} = 14.70$

(d) Interpretation:

- ✚ The interquartile range of the marks of the students of 5A1 is larger than the interquartile range of the marks of the students of 5A2.
- ✚ The standard deviation of the marks of the students of 5A1 is larger than the standard deviation of the marks of the students of 5A2.
- ✚ The median of the marks of the students of 5A1 is larger than the median of the marks of the students of 5A2.

Conclusion:

The distribution of marks of the students of 5A1 is more widely dispersed compared to the distribution of marks of the students of 5A2. Based on the median, the marks of the students of 5A1 are higher than the marks of the students of 5A2.