# AS-Level

# Topic : Data Representation

# May : 2013-May :2025

# Question

## Question 1

The weights, $x$ kilograms, of 144 people were recorded. The results are summarised in the cumulative frequency table below.

| Weight ($x$ kilograms) | $x < 40$ | $x < 50$ | $x < 60$ | $x < 65$ | $x < 70$ | $x < 90$ |
|---|---|---|---|---|---|---|
| Cumulative frequency | 0 | 12 | 34 | 64 | 92 | 144 |

**(i)** On graph paper, draw a cumulative frequency graph to represent these results. [2]

**(ii)** 64 people weigh more than $c$ kg. Use your graph to find the value of $c$. [2]

**(iii)** Calculate estimates of the mean and standard deviation of the weights. [6]

## Question 2

The following are the annual amounts of money spent on clothes, to the nearest \$10, by 27 people.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 | 40 | 60 | 80 | 100 | 130 | 140 | 140 | 140 |
| 150 | 150 | 150 | 160 | 160 | 160 | 160 | 170 | 180 |
| 180 | 200 | 210 | 250 | 270 | 280 | 310 | 450 | 570 |

**(i)** Construct a stem-and-leaf diagram for the data. [3]

**(ii)** Find the median and the interquartile range of the data. [3]

An 'outlier' is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

**(iii)** List the outliers. [3]

## Question 3

A summary of the speeds, $x$ kilometres per hour, of 22 cars passing a certain point gave the following information:

$$\Sigma(x - 50) = 81.4 \qquad \text{and} \qquad \Sigma(x - 50)^2 = 671.0.$$

Find the variance of the speeds and hence find the value of $\Sigma x^2$. [4]

## Question 4

The following back-to-back stem-and-leaf diagram shows the annual salaries of a group of 39 females and 39 males.

| Females | | | | | | | | | | Males | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (4) | | | | | | 5 | 2 | 0 | 0 | 20 | 3 | | | | | | | | | (1) |
| (9) | 9 | 8 | 8 | 7 | 6 | 4 | 0 | 0 | 0 | 21 | 0 | 0 | 7 | | | | | | | (3) |
| (8) | | 8 | 7 | 5 | 3 | 3 | 1 | 0 | 0 | 22 | 0 | 0 | 4 | 5 | 6 | 6 | | | | (6) |
| (6) | | | | 6 | 4 | 2 | 1 | 0 | 0 | 23 | 0 | 0 | 2 | 3 | 3 | 5 | 6 | 7 | 7 | (9) |
| (6) | | | | 7 | 5 | 4 | 0 | 0 | 0 | 24 | 0 | 1 | 1 | 2 | 5 | 5 | 6 | 8 | 8 | 9 (10) |
| (4) | | | | | | 9 | 5 | 0 | 0 | 25 | 3 | 4 | 5 | 7 | 7 | 8 | 9 | | | (7) |
| (2) | | | | | | | | 5 | 0 | 26 | 0 | 4 | 6 | | | | | | | (3) |

Key: 2 | 20 | 3 means \$20 200 for females and \$20 300 for males.

**(i)** Find the median and the quartiles of the females' salaries. [2]

You are given that the median salary of the males is \$24 000, the lower quartile is \$22 600 and the upper quartile is \$25 300.

**(ii)** Represent the data by means of a pair of box-and-whisker plots in a single diagram on graph paper. [3]

## Question 5

A summary of 30 values of $x$ gave the following information:

$$\Sigma(x - c) = 234, \qquad \Sigma(x - c)^2 = 1957.5,$$

where $c$ is a constant.

**(i)** Find the standard deviation of these values of $x$. [2]

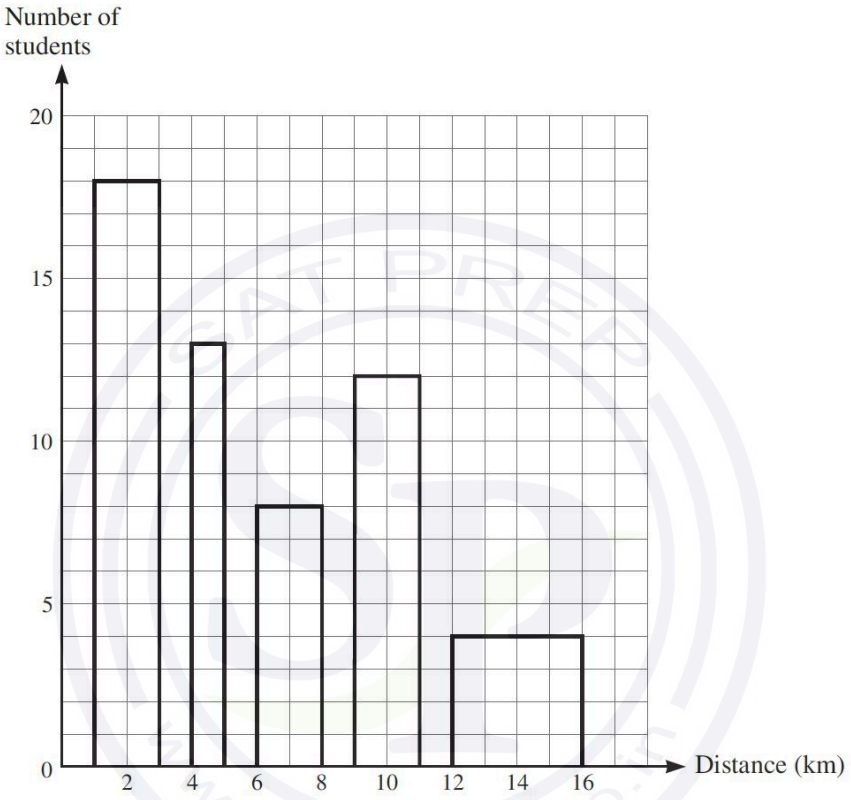
**(ii)** Given that the mean of these values is 86, find the value of $c$. [2]

## Question 6

The distance of a student's home from college, correct to the nearest kilometre, was recorded for each of 55 students. The distances are summarised in the following table.

| Distance from college (km) | 1 – 3 | 4 – 5 | 6 – 8 | 9 – 11 | 12 – 16 |
|---|---|---|---|---|---|
| Number of students | 18 | 13 | 8 | 12 | 4 |

Dominic is asked to draw a histogram to illustrate the data. Dominic's diagram is shown below.




Give two reasons why this is not a correct histogram. [2]

## Question 7

The following are the house prices in thousands of dollars, arranged in ascending order, for 51 houses from a certain area.

253 270 310 354 386 428 433 468 472 477 485 520 520 524 526 531 535
536 538 541 543 546 548 549 551 554 572 583 590 605 614 638 649 652
666 670 682 684 690 710 725 726 731 734 745 760 800 854 863 957 986

**(i)** Draw a box-and-whisker plot to represent the data. [4]

An expensive house is defined as a house which has a price that is more than 1.5 times the interquartile range above the upper quartile.

**(ii)** For the above data, give the prices of the expensive houses. [2]

**(iii)** Give one disadvantage of using a box-and-whisker plot rather than a stem-and-leaf diagram to represent this set of data. [1]

## Question 8

Swati measured the lengths, $x$ cm, of 18 stick insects and found that $\Sigma x^2 = 967$. Given that the mean length is $\frac{58}{9}$ cm, find the values of $\Sigma(x - 5)$ and $\Sigma(x - 5)^2$. [5]

## Question 9

Some adults and some children each tried to estimate, without using a watch, the number of seconds that had elapsed in a fixed time-interval. Their estimates are shown below.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adults: | 55 | 58 | 67 | 74 | 63 | 61 | 63 | 71 | 56 | 53 | 54 | 78 | 73 | 64 | 62 |
| Children: | 86 | 95 | 89 | 72 | 61 | 84 | 77 | 92 | 81 | 54 | 43 | 68 | 62 | 67 | 83 |

**(i)** Draw a back-to-back stem-and-leaf diagram to represent the data. [3]

**(ii)** Make two comparisons between the estimates of the adults and the children. [2]

## Question 10

The times taken by 57 athletes to run 100 metres are summarised in the following cumulative frequency table.

| Time (seconds) | < 10.0 | < 10.5 | < 11.0 | < 12.0 | < 12.5 | < 13.5 |
|---|---|---|---|---|---|---|
| Cumulative frequency | 0 | 4 | 10 | 40 | 49 | 57 |

**(i)** State how many athletes ran 100 metres in a time between 10.5 and 11.0 seconds. [1]

**(ii)** Draw a histogram on graph paper to represent the times taken by these athletes to run 100 metres. [4]

**(iii)** Calculate estimates of the mean and variance of the times taken by these athletes. [4]

## Question 11

A typing test is taken by 111 people. The numbers of typing errors they make in the test are summarised in the table below.

| Number of typing errors | 1 – 5 | 6 – 20 | 21 – 35 | 36 – 60 | 61 – 80 |
|---|---|---|---|---|---|
| Frequency | 24 | 9 | 21 | 15 | 42 |

**(i)** Draw a histogram on graph paper to represent this information. [5]

**(ii)** Calculate an estimate of the mean number of typing errors for these 111 people. [3]

**(iii)** State which class contains the lower quartile and which class contains the upper quartile. Hence find the least possible value of the interquartile range. [3]

## Question 12

A random sample of 25 people recorded the number of glasses of water they drank in a particular week. The results are shown below.

| | | | | |
|---|---|---|---|---|
| 23 | 19 | 32 | 14 | 25 |
| 22 | 26 | 36 | 45 | 42 |
| 47 | 28 | 17 | 38 | 15 |
| 46 | 18 | 26 | 22 | 41 |
| 19 | 21 | 28 | 24 | 30 |

**(i)** Draw a stem-and-leaf diagram to represent the data. [3]

**(ii)** On graph paper draw a box-and-whisker plot to represent the data. [5]

## Question 13

A traffic camera measured the speeds, $x$ kilometres per hour, of 8 cars travelling along a certain street, with the following results.

62.7 59.6 64.2 61.5 68.3 66.9 62.0 62.3

**(i)** Find $\Sigma(x - 62)$. [1]

**(ii)** Find $\Sigma(x - 62)^2$. [1]

**(iii)** Find the mean and variance of the speeds of the 8 cars. [3]

## Question 14

On a certain day in spring, the heights of 200 daffodils are measured, correct to the nearest centimetre. The frequency distribution is given below.

| Height (cm) | 4 – 10 | 11 – 15 | 16 – 20 | 21 – 25 | 26 – 30 |
|---|---|---|---|---|---|
| Frequency | 22 | 32 | 78 | 40 | 28 |

**(i)** Draw a cumulative frequency graph to illustrate the data. [4]

**(ii)** 28% of these daffodils are of height $h$ cm or more. Estimate $h$. [2]

**(iii)** You are given that the estimate of the mean height of these daffodils, calculated from the table, is 18.39 cm. Calculate an estimate of the standard deviation of the heights of these daffodils. [3]

## Question 15

The following back-to-back stem-and-leaf diagram shows the times to load an application on 61 smartphones of type $A$ and 43 smartphones of type $B$.

| | Type $A$ | | Type $B$ | |
|---|---|---|---|---|
| (7) | 9 7 6 6 4 3 3 | 2 | 1 3 5 8 | (4) |
| (7) | 5 5 4 4 2 2 2 | 3 | 0 4 4 5 6 6 6 6 7 8 8 9 | (12) |
| (13) | 9 9 8 8 8 7 6 6 4 3 2 2 0 | 4 | 0 1 1 2 3 6 8 8 9 9 | (10) |
| (9) | 6 5 5 4 3 2 1 1 0 | 5 | 2 5 6 6 9 | (5) |
| (4) | 9 7 3 0 | 6 | 1 3 8 9 | (4) |
| (6) | 8 7 4 4 1 0 | 7 | 5 7 | (2) |
| (10) | 7 6 6 6 5 3 3 2 1 0 | 8 | 1 2 4 4 | (4) |
| (5) | 8 6 5 5 5 | 9 | 0 6 | (2) |

Key: 3 | 2 | 1 means 0.23 seconds for type $A$ and 0.21 seconds for type $B$.

**(i)** Find the median and quartiles for smartphones of type $A$. [3]

You are given that the median, lower quartile and upper quartile for smartphones of type $B$ are 0.46 seconds, 0.36 seconds and 0.63 seconds respectively.

**(ii)** Represent the data by drawing a pair of box-and-whisker plots in a single diagram on graph paper. [3]

**(iii)** Compare the loading times for these two types of smartphone. [1]

## Question 16

Find the mean and variance of the following data. [3]

5 −2 12 7 −3 2 −6 4 0 8

## Question 17

Seventy samples of fertiliser were collected and the nitrogen content was measured for each sample. The cumulative frequency distribution is shown in the table below.

| Nitrogen content | $\leqslant 3.5$ | $\leqslant 3.8$ | $\leqslant 4.0$ | $\leqslant 4.2$ | $\leqslant 4.5$ | $\leqslant 4.8$ |
|---|---|---|---|---|---|---|
| Cumulative frequency | 0 | 6 | 18 | 41 | 62 | 70 |

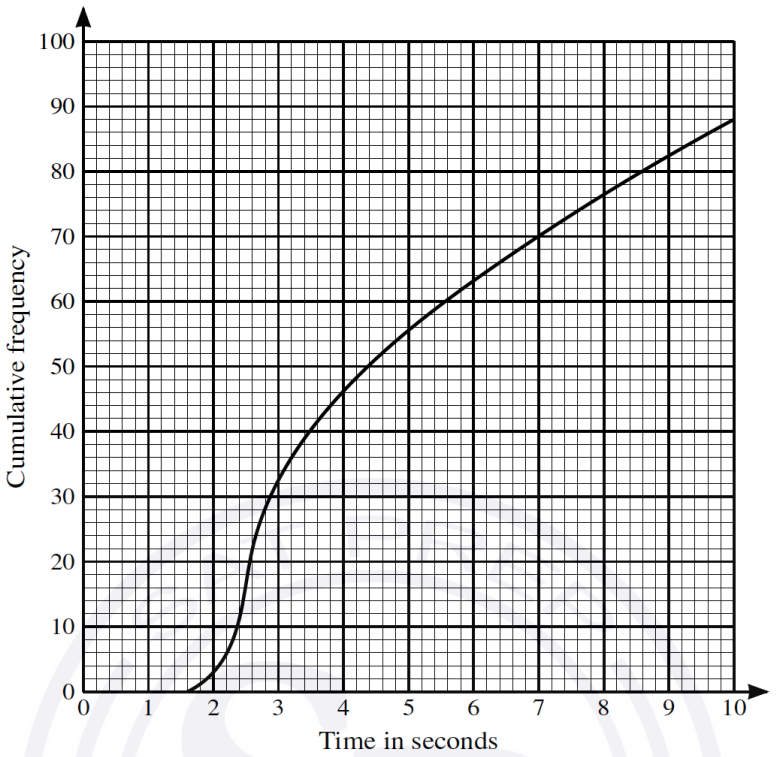
**(i)** On graph paper draw a cumulative frequency graph to represent the data. [3]

**(ii)** Estimate the percentage of samples with a nitrogen content greater than 4.4. [2]

**(iii)** Estimate the median. [1]

**(iv)** Construct the frequency table for these results and draw a histogram on graph paper. [5]

## Question 18




In an open-plan office there are 88 computers. The times taken by these 88 computers to access a particular web page are represented in the cumulative frequency diagram.

**(i)** On graph paper draw a box-and-whisker plot to summarise this information. [4]

An 'outlier' is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

**(ii)** Show that there are no outliers. [2]

## Question 19

120 people were asked to read an article in a newspaper. The times taken, to the nearest second, by the people to read the article are summarised in the following table.

| Time (seconds) | 1 – 25 | 26 – 35 | 36 – 45 | 46 – 55 | 56 – 90 |
|---|---|---|---|---|---|
| Number of people | 4 | 24 | 38 | 34 | 20 |

Calculate estimates of the mean and standard deviation of the reading times. [5]

## Question 20

The table summarises the lengths in centimetres of 104 dragonflies.

| Length (cm) | 2.0 – 3.5 | 3.5 – 4.5 | 4.5 – 5.5 | 5.5 – 7.0 | 7.0 – 9.0 |
|---|---|---|---|---|---|
| Frequency | 8 | 25 | 28 | 31 | 12 |

**(i)** State which class contains the upper quartile. [1]

**(ii)** Draw a histogram, on graph paper, to represent the data. [4]

## Question 21

The heights to the nearest metre of 134 office buildings in a certain city are summarised in the table below.

| Height (m) | 21 – 40 | 41 – 45 | 46 – 50 | 51 – 60 | 61 – 80 |
|---|---|---|---|---|---|
| Frequency | 18 | 15 | 21 | 52 | 28 |

**(i)** Draw a histogram on graph paper to illustrate the data. [4]

**(ii)** Calculate estimates of the mean and standard deviation of these heights. [5]

## Question 22

The time taken, $t$ hours, to deliver letters on a particular route each day is measured on 250 working days. The mean time taken is 2.8 hours. Given that $\Sigma(t - 2.5)^2 = 96.1$, find the standard deviation of the times taken. [3]

## Question 23

The weights, in kilograms, of the 15 rugby players in each of two teams, $A$ and $B$, are shown below.

| Team $A$ | 97 | 98 | 104 | 84 | 100 | 109 | 115 | 99 | 122 | 82 | 116 | 96 | 84 | 107 | 91 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Team $B$ | 75 | 79 | 94 | 101 | 96 | 77 | 111 | 108 | 83 | 84 | 86 | 115 | 82 | 113 | 95 |

**(i)** Represent the data by drawing a back-to-back stem-and-leaf diagram with team $A$ on the left-hand side of the diagram and team $B$ on the right-hand side. [4]

**(ii)** Find the interquartile range of the weights of the players in team $A$. [2]

**(iii)** A new player joins team $B$ as a substitute. The mean weight of the 16 players in team $B$ is now 93.9 kg. Find the weight of the new player. [3]

## Question 24

For $n$ values of the variable $x$, it is given that $\Sigma(x - 100) = 216$ and $\Sigma x = 2416$. Find the value of $n$. [3]

## Question 25

Robert has a part-time job delivering newspapers. On a number of days he noted the time, correct to the nearest minute, that it took him to do his job. Robert used his results to draw up the following table; two of the values in the table are denoted by $a$ and $b$.

| Time ($t$ minutes) | 60 – 62 | 63 – 64 | 65 – 67 | 68 – 71 |
|---|---|---|---|---|
| Frequency (number of days) | 3 | 9 | 6 | $b$ |
| Frequency density | 1 | $a$ | 2 | 1.5 |

**(i)** Find the values of $a$ and $b$. [3]

**(ii)** On graph paper, draw a histogram to represent Robert's times. [3]

## Question 26

A survey was made of the journey times of 63 people who cycle to work in a certain town. The results are summarised in the following cumulative frequency table.

| Journey time (minutes) | $\leqslant 10$ | $\leqslant 25$ | $\leqslant 45$ | $\leqslant 60$ | $\leqslant 80$ |
|---|---|---|---|---|---|
| Cumulative frequency | 0 | 18 | 50 | 59 | 63 |

**(i)** State how many journey times were between 25 and 45 minutes. [1]

**(ii)** Draw a histogram on graph paper to represent the data. [4]

**(iii)** Calculate an estimate of the mean journey time. [2]

## Question 27

For 10 values of $x$ the mean is 86.2 and $\Sigma(x - a) = 362$. Find the value of

**(i)** $\Sigma x$, [1]

**(ii)** the constant $a$. [2]

## Question 28

The monthly rental prices, $\$x$, for 9 apartments in a certain city are listed and are summarised as follows.

$$\Sigma(x - c) = 1845 \qquad \Sigma(x - c)^2 = 477\,450$$

The mean monthly rental price is \$2205.

**(i)** Find the value of the constant $c$. [2]

**(ii)** Find the variance of these values of $x$. [2]

**(iii)** Another apartment is added to the list. The mean monthly rental price is now \$2120.50. Find the rental price of this additional apartment. [2]

## Question 29

A group of children played a computer game which measured their time in seconds to perform a certain task. A summary of the times taken by girls and boys in the group is shown below.

| | Minimum | Lower quartile | Median | Upper quartile | Maximum |
|---|---|---|---|---|---|
| Girls | 5 | 5.5 | 7 | 9 | 13 |
| Boys | 4 | 6 | 8.5 | 11 | 16 |

**(i)** On graph paper, draw two box-and-whisker plots in a single diagram to illustrate the times taken by girls and boys to perform this task. [3]

**(ii)** State two comparisons of the times taken by girls and boys. [2]

## Question 30

The following are the maximum daily wind speeds in kilometres per hour for the first two weeks in April for two towns, Bronlea and Rogate.

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bronlea | 21 | 45 | 6 | 33 | 27 | 3 | 32 | 14 | 28 | 24 | 13 | 17 | 25 | 22 |
| Rogate | 7 | 5 | 4 | 15 | 23 | 7 | 11 | 13 | 26 | 18 | 23 | 16 | 10 | 34 |

**(i)** Draw a back-to-back stem-and-leaf diagram to represent this information. [5]

**(ii)** Write down the median of the maximum wind speeds for Bronlea and find the interquartile range for Rogate. [3]

**(iii)** Use your diagram to make one comparison between the maximum wind speeds in the two towns. [1]

## Question 31

The amounts spent by 160 shoppers at a supermarket are summarised in the following table.

| Amount spent ($\$x$) | $0 < x \leqslant 30$ | $30 < x \leqslant 50$ | $50 < x \leqslant 70$ | $70 < x \leqslant 90$ | $90 < x \leqslant 140$ |
|---|---|---|---|---|---|
| Number of shoppers | 16 | 40 | 48 | 26 | 30 |

**(i)** Draw a cumulative frequency graph of this distribution. [4]

**(ii)** Estimate the median and the interquartile range of the amount spent. [3]

**(iii)** Estimate the number of shoppers who spent more than \$115. [2]

**(iv)** Calculate an estimate of the mean amount spent. [2]

## Question 32

The tables summarise the heights, $h$ cm, of 60 girls and 60 boys.

| Height of girls (cm) | $140 < h \leqslant 150$ | $150 < h \leqslant 160$ | $160 < h \leqslant 170$ | $170 < h \leqslant 180$ | $180 < h \leqslant 190$ |
|---|---|---|---|---|---|
| Frequency | 12 | 21 | 17 | 10 | 0 |

| Height of boys (cm) | $140 < h \leqslant 150$ | $150 < h \leqslant 160$ | $160 < h \leqslant 170$ | $170 < h \leqslant 180$ | $180 < h \leqslant 190$ |
|---|---|---|---|---|---|
| Frequency | 0 | 20 | 23 | 12 | 5 |

**(i)** On graph paper, using the same set of axes, draw two cumulative frequency graphs to illustrate the data. [4]

**(ii)** On a school trip the students have to enter a cave which is 165 cm high. Use your graph to estimate the percentage of the girls who will be unable to stand upright. [3]

**(iii)** The students are asked to compare the heights of the girls and the boys. State one advantage of using a pair of box-and-whisker plots instead of the cumulative frequency graphs to do this. [1]

## Question 33

The number of people a football stadium can hold is called the 'capacity'. The capacities of 130 football stadiums in the UK, to the nearest thousand, are summarised in the table.

| Capacity | 3000–7000 | 8000–12 000 | 13 000–22 000 | 23 000–42 000 | 43 000–82 000 |
|---|---|---|---|---|---|
| Number of stadiums | 40 | 30 | 18 | 34 | 8 |

**(i)** On graph paper, draw a histogram to represent this information. Use a scale of 2 cm for a capacity of 10 000 on the horizontal axis. [5]

**(ii)** Calculate an estimate of the mean capacity of these 130 stadiums. [2]

**(iii)** Find which class in the table contains the median and which contains the lower quartile. [2]

## Question 34

The masses, in grams, of components made in factory $A$ and components made in factory $B$ are shown below.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Factory $A$ | 0.049 | 0.050 | 0.053 | 0.054 | 0.057 | 0.058 | 0.058 |
| | 0.059 | 0.061 | 0.061 | 0.061 | 0.063 | 0.065 | |
| Factory $B$ | 0.031 | 0.056 | 0.049 | 0.044 | 0.038 | 0.048 | 0.051 |
| | 0.064 | 0.035 | 0.042 | 0.047 | 0.054 | 0.058 | |

**(i)** Draw a back-to-back stem-and-leaf diagram to represent the masses of components made in the two factories. [5]

**(ii)** Find the median and the interquartile range for the masses of components made in factory $B$. [3]

**(iii)** Make two comparisons between the masses of components made in factory $A$ and the masses of those made in factory $B$. [2]

## Question 35

The weights in kilograms of packets of cereal were noted correct to 4 significant figures. The following stem-and-leaf diagram shows the data.

| | | |
|---|---|---|
| 747 | 3 | (1) |
| 748 | 1 2 5 7 7 9 | (6) |
| 749 | 0 2 2 2 3 5 5 5 6 7 8 9 | (12) |
| 750 | 1 1 2 2 2 3 4 4 5 6 7 7 8 8 9 | (15) |
| 751 | 0 0 2 3 3 4 4 4 5 5 7 7 9 | (13) |
| 752 | 0 0 0 1 1 2 2 3 4 4 4 | (11) |
| 753 | 2 | (1) |

Key: 748 | 5 represents 0.7485 kg.

**(i)** On the grid, draw a box-and-whisker plot to represent the data. [5]

**(ii)** Name a distribution that might be a suitable model for the weights of this type of cereal packet. Justify your answer. [2]

## Question 36

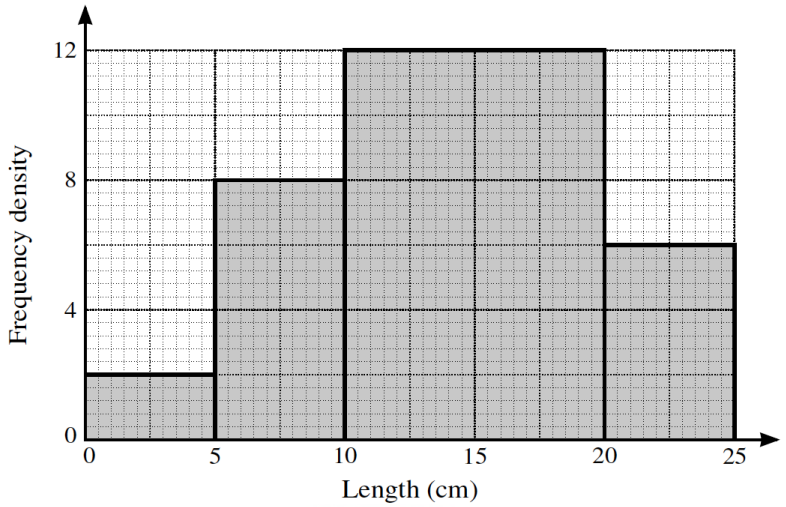
Twelve values of $x$ are shown below.

| | | | | | |
|---|---|---|---|---|---|
| 1761.6 | 1758.5 | 1762.3 | 1761.4 | 1759.4 | 1759.1 |
| 1762.5 | 1761.9 | 1762.4 | 1761.9 | 1762.8 | 1761.0 |

Find the mean and standard deviation of $(x - 1760)$. Hence find the mean and standard deviation of $x$. [4]

## Question 37

The following histogram represents the lengths of worms in a garden.




**(i)** Calculate the frequencies represented by each of the four histogram columns. [2]

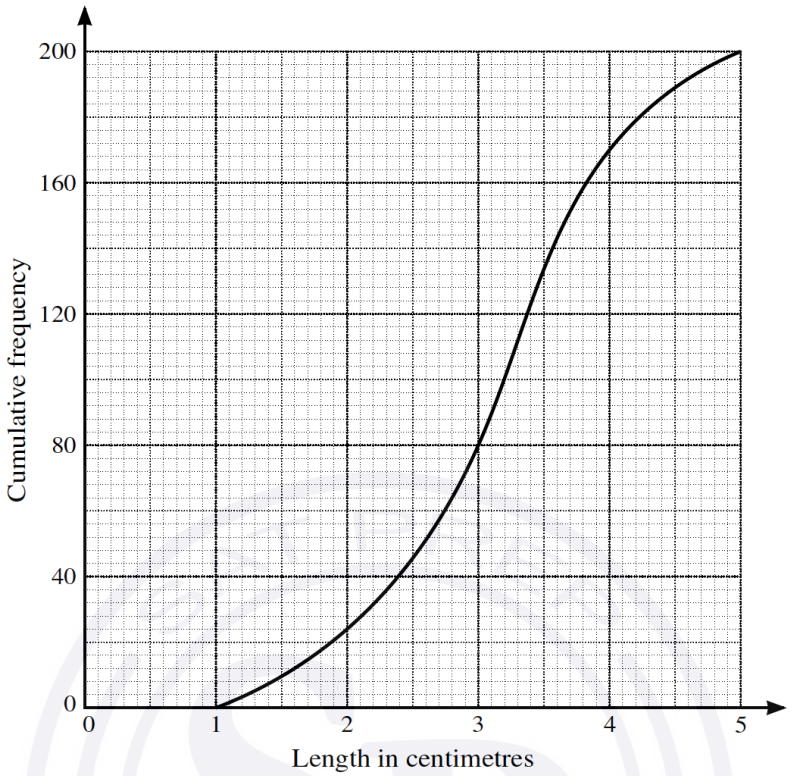
**(ii)** On the grid on the next page, draw a cumulative frequency graph to represent the lengths of worms in the garden. [4]

**(iii)** Use your graph to estimate the median and interquartile range of the lengths of worms in the garden. [3]

**(iv)** Calculate an estimate of the mean length of worms in the garden. [2]

Question 38

Anabel measured the lengths, in centimetres, of 200 caterpillars. Her results are illustrated in the cumulative frequency graph below.




**(i)** Estimate the median and the interquartile range of the lengths. [3]

**(ii)** Estimate how many caterpillars had a length of between 2 and 3.5 cm. [1]

**(iii)** 6% of caterpillars were of length $l$ centimetres or more. Estimate $l$. [2]

## Question 39

The times taken, $t$ seconds, by 1140 people to solve a puzzle are summarised in the table.

| Time ($t$ seconds) | $0 \leqslant t < 20$ | $20 \leqslant t < 40$ | $40 \leqslant t < 60$ | $60 \leqslant t < 100$ | $100 \leqslant t < 140$ |
|---|---|---|---|---|---|
| Number of people | 320 | 280 | 220 | 220 | 100 |

**(i)** On the grid, draw a histogram to illustrate this information. [4]

**(ii)** Calculate an estimate of the mean of $t$. [2]

## Question 40

Kadijat noted the weights, $x$ grams, of 30 chocolate buns. Her results are summarised by

$$\Sigma(x - k) = 315, \qquad \Sigma(x - k)^2 = 4022,$$

where $k$ is a constant. The mean weight of the buns is 50.5 grams.

**(i)** Find the value of $k$. [2]

**(ii)** Find the standard deviation of $x$. [2]

## Question 41

The number of Olympic medals won in the 2012 Olympic Games by the top 27 countries is shown below.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 104 | 88 | 82 | 65 | 44 | 38 | 35 | 34 | 28 |
| 28 | 18 | 18 | 17 | 17 | 14 | 13 | 13 | 12 |
| 12 | 10 | 10 | 10 | 9 | 6 | 5 | 2 | 2 |

**(i)** Draw a stem-and-leaf diagram to illustrate the data. [4]

**(ii)** Find the median and quartiles and draw a box-and-whisker plot on the grid. [5]

**(ii)** Find the median and quartiles and draw a box-and-whisker plot on the grid. [5]

## Question 42

Tien measured the arm lengths, $x$ cm, of 20 people in his class. He found that $\Sigma x = 1218$ and the standard deviation of $x$ was 4.2. Calculate $\Sigma(x - 45)$ and $\Sigma(x - 45)^2$. [3]

## Question 43

The circumferences, $c$ cm, of some trees in a wood were measured. The results are summarised in the table.

| Circumference ($c$ cm) | $40 < c \leqslant 50$ | $50 < c \leqslant 80$ | $80 < c \leqslant 100$ | $100 < c \leqslant 120$ |
|---|---|---|---|---|
| Frequency | 14 | 48 | 70 | 8 |

**(i)** On the grid, draw a cumulative frequency graph to represent the information. [3]

**(ii)** Estimate the percentage of trees which have a circumference larger than 75 cm. [2]

## Question 44

Andy counts the number of emails, $x$, he receives each day and notes that, over a period of $n$ days, $\Sigma(x - 10) = 27$ and the mean number of emails is 11.5. Find the value of $n$. [3]

## Question 45

The ages of a group of 12 people at an Art class have mean 48.7 years and standard deviation 7.65 years. The ages of a group of 7 people at another Art class have mean 38.1 years and standard deviation 4.2 years.

**(i)** Find the mean age of all 19 people. [2]

**(ii)** The individual ages in years of people in the first Art class are denoted by $x$ and those in the second Art class by $y$. By first finding $\Sigma x^2$ and $\Sigma y^2$, find the standard deviation of the ages of all 19 people. [4]

## Question 46

The time taken by a car to accelerate from 0 to 30 metres per second was measured correct to the nearest second. The results from 48 cars are summarised in the following table.

| Time (seconds) | 3 – 5 | 6 – 8 | 9 – 11 | 12 – 16 | 17 – 25 |
|---|---|---|---|---|---|
| Frequency | 10 | 15 | 17 | 4 | 2 |

**(i)** On the grid, draw a cumulative frequency graph to represent this information. [3]

**(ii)** 35 of these cars accelerated from 0 to 30 metres per second in a time more than $t$ seconds. Estimate the value of $t$. [2]

## Question 47

A summary of $n$ values of $x$ gave the following information:

$$\Sigma(x - 20) = 136, \qquad \Sigma(x - 20)^2 = 2888.$$

The mean of the $n$ values of $x$ is 24.25.

**(i)** Find the value of $n$. [2]

**(ii)** Find $\Sigma x^2$. [4]

## Question 48

There are 900 students in a certain year-group. An identical puzzle is given to each student and the time taken, $t$ minutes, to complete the puzzle is recorded. These times are summarised in the following frequency table.

| Time taken, $t$ minutes | $t \leqslant 3$ | $3 < t \leqslant 4$ | $4 < t \leqslant 5$ | $5 < t \leqslant 6$ | $6 < t \leqslant 8$ | $8 < t \leqslant 10$ | $10 < t \leqslant 14$ |
|---|---|---|---|---|---|---|---|
| Frequency | 120 | 180 | 200 | 160 | 110 | 80 | 50 |

On the grid, draw a cumulative frequency graph to represent the data. Use your graph to estimate the median time taken by these students to complete the puzzle. [4]

## Question 49

Farfield Travel and Lacket Travel are two travel companies which arrange tours abroad. The numbers of holidays arranged in a certain week are recorded in the table below, together with the means and standard deviations of the prices.

| | Number of holidays | Mean price ($) | Standard deviation ($) |
|---|---|---|---|
| Farfield Travel | 30 | 1500 | 230 |
| Lacket Travel | 21 | 2400 | 160 |

**(i)** Calculate the mean price of all 51 holidays. [2]

**(ii)** The prices of individual holidays with Farfield Travel are denoted by $\$x_F$ and the prices of individual holidays with Lacket Travel are denoted by $\$x_L$. By first finding $\Sigma x_F^2$ and $\Sigma x_L^2$, find the standard deviation of the prices of all 51 holidays. [5]

## Question 50

The masses in kilograms of 50 children having a medical check-up were recorded correct to the nearest kilogram. The results are shown in the table.

| Mass (kg) | 10 – 14 | 15 – 19 | 20 – 24 | 25 – 34 | 35 – 59 |
|---|---|---|---|---|---|
| Frequency | 6 | 12 | 14 | 10 | 8 |

**(i)** Find which class interval contains the lower quartile. [1]

**(ii)** On the grid, draw a histogram to illustrate the data in the table. [4]

## Question 51

The lengths, $t$ minutes, of 242 phone calls made by a family over a period of 1 week are summarised in the frequency table below.

| Length of phone call ($t$ minutes) | $0 < t \leqslant 1$ | $1 < t \leqslant 2$ | $2 < t \leqslant 5$ | $5 < t \leqslant 10$ | $10 < t \leqslant 30$ |
|---|---|---|---|---|---|
| Frequency | 14 | 46 | 102 | $a$ | 40 |

**(i)** Find the value of $a$. [1]

**(ii)** Calculate an estimate of the mean length of these phone calls. [2]

**(iii)** On the grid, draw a histogram to illustrate the data in the table. [4]

## Question 52

Each of a group of 10 boys estimates the length of a piece of string. The estimates, in centimetres, are as follows.

37 40 45 38 36 38 42 38 40 39

**(i)** Find the mode. [1]

**(ii)** Find the median and the interquartile range. [3]

## Question 53

In a survey 55 students were asked to record, to the nearest kilometre, the total number of kilometres they travelled to school in a particular week. The results are shown below.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 5 | 9 | 10 | 13 | 13 | 13 | 15 | 15 | 15 | 15 |
| 16 | 18 | 18 | 18 | 19 | 19 | 20 | 20 | 20 | 20 | 21 |
| 21 | 21 | 21 | 23 | 25 | 25 | 27 | 27 | 29 | 30 | 33 |
| 35 | 38 | 39 | 40 | 42 | 45 | 48 | 50 | 50 | 51 | 51 |
| 52 | 55 | 57 | 57 | 60 | 61 | 64 | 65 | 66 | 69 | 70 |

**(i)** On the grid, draw a box-and-whisker plot to illustrate the data. [5]

An 'outlier' is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

**(ii)** Show that there are no outliers. [2]

## Question 54

In a statistics lesson 12 people were asked to think of a number, $x$, between 1 and 20 inclusive. From the results Tom found that $\Sigma x = 186$ and that the standard deviation of $x$ is 4.5. Assuming that Tom's calculations are correct, find the values of $\Sigma(x - 10)$ and $\Sigma(x - 10)^2$. [3]

## Question 55

The heights, in cm, of the 11 members of the Anvils athletics team and the 11 members of the Brecons swimming team are shown below.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Anvils | 173 | 158 | 180 | 196 | 175 | 165 | 170 | 169 | 181 | 184 | 172 |
| Brecons | 166 | 170 | 171 | 172 | 172 | 178 | 181 | 182 | 183 | 183 | 192 |

**(i)** Draw a back-to-back stem-and-leaf diagram to represent this information, with Anvils on the left-hand side of the diagram and Brecons on the right-hand side. [4]

**(ii)** Find the median and the interquartile range for the heights of the Anvils. [3]

The heights of the 11 members of the Anvils are denoted by $x$ cm. It is given that $\Sigma x = 1923$ and $\Sigma x^2 = 337\,221$. The Anvils are joined by 3 new members whose heights are 166 cm, 172 cm and 182 cm.

**(iii)** Find the standard deviation of the heights of all 14 members of the Anvils. [4]

## Question 56

The following back-to-back stem-and-leaf diagram shows the reaction times in seconds in an experiment involving two groups of people, $A$ and $B$.

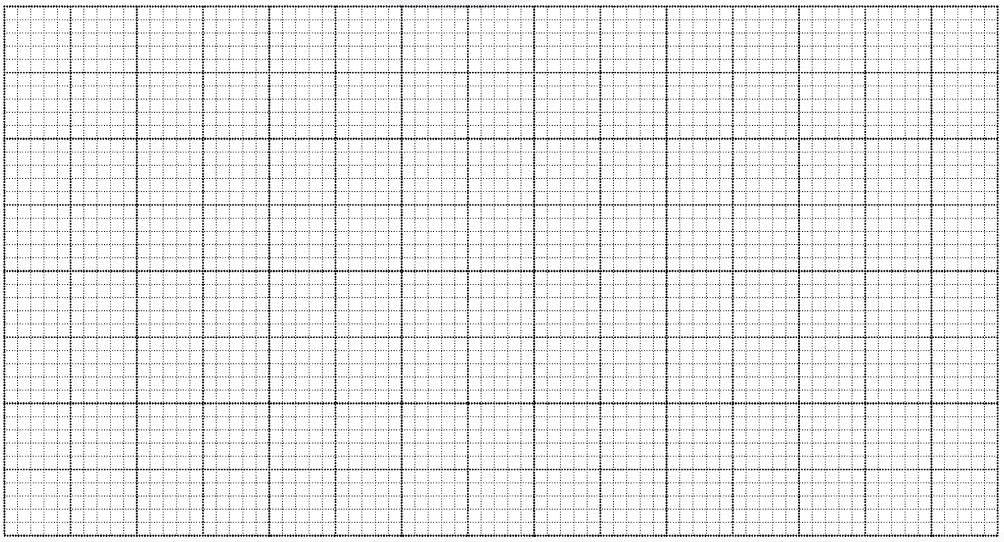
| $A$ | | | $B$ | |
|---|---|---|---|---|
| (4) | 4 2 0 0 | 20 | 5 6 7 | (3) |
| (5) | 9 8 5 0 0 | 21 | 1 2 2 3 7 7 | (6) |
| (8) | 9 8 7 5 3 2 2 2 | 22 | 1 3 5 6 6 8 9 | (7) |
| (6) | 8 7 6 5 2 1 | 23 | 4 5 7 8 8 9 9 9 | (8) |
| (3) | 8 6 3 | 24 | 2 4 5 6 7 8 8 | (7) |
| (1) | 0 | 25 | 0 2 7 8 | (4) |

Key: 5 | 22 | 6 means a reaction time of 0.225 seconds for $A$ and 0.226 seconds for $B$

**(i)** Find the median and the interquartile range for group $A$. [3]

The median value for group $B$ is 0.235 seconds, the lower quartile is 0.217 seconds and the upper quartile is 0.245 seconds.

**(ii)** Draw box-and-whisker plots for groups $A$ and $B$ on the grid. [3]



## Question 57

The Quivers Archery club has 12 Junior members and 20 Senior members. For the Junior members, the mean age is 15.5 years and the standard deviation of the ages is 1.2 years. The ages of the Senior members are summarised by $\Sigma y = 910$ and $\Sigma y^2 = 42\,850$, where $y$ is the age of a Senior member in years.

**(i)** Find the mean age of all 32 members of the club. [2]

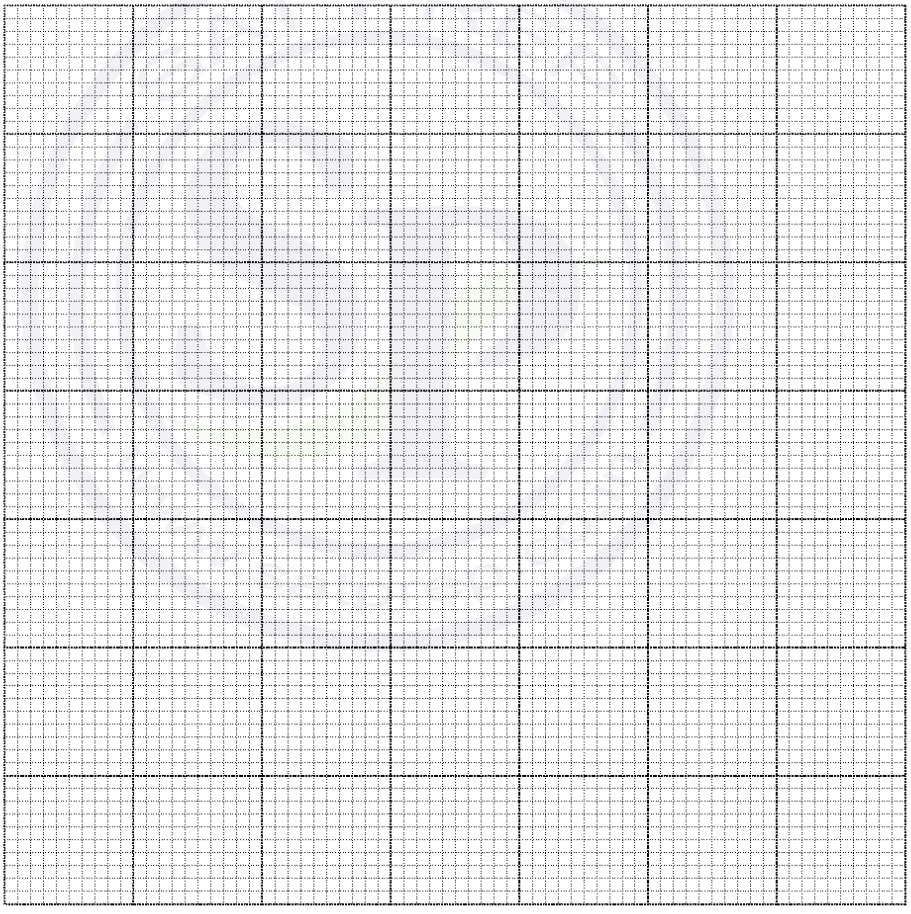
**(ii)** Find the standard deviation of the ages of all 32 members of the club. [4]

## Question 58

The daily rainfall, $x$ mm, in a certain village is recorded on 250 consecutive days. The results are summarised in the following cumulative frequency table.

| Rainfall, $x$ mm | $x \leqslant 20$ | $x \leqslant 30$ | $x \leqslant 40$ | $x \leqslant 50$ | $x \leqslant 70$ | $x \leqslant 100$ |
|---|---|---|---|---|---|---|
| Cumulative frequency | 52 | 94 | 142 | 172 | 222 | 250 |

**(i)** On the grid, draw a cumulative frequency graph to illustrate the data. [2]



**(ii)** On 100 of the days, the rainfall was $k$ mm or more. Use your graph to estimate the value of $k$. [2]

**(iii)** Calculate estimates of the mean and standard deviation of the daily rainfall in this village. [6]

## Question 59

For 40 values of the variable $x$, it is given that $\Sigma(x - c)^2 = 3099.2$, where $c$ is a constant. The standard deviation of these values of $x$ is 3.2.

**(i)** Find the value of $\Sigma(x - c)$. [3]

**(ii)** Given that $c = 50$, find the mean of these values of $x$. [1]

## Question 60

The weights, in kg, of the 11 members of the Dolphins swimming team and the 11 members of the Sharks swimming team are shown below.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dolphins | 62 | 75 | 69 | 82 | 63 | 80 | 65 | 65 | 73 | 82 | 72 |
| Sharks | 68 | 84 | 59 | 70 | 71 | 64 | 77 | 80 | 66 | 74 | 72 |

**(i)** Draw a back-to-back stem-and-leaf diagram to represent this information, with Dolphins on the left-hand side of the diagram and Sharks on the right-hand side. [4]

**(ii)** Find the median and interquartile range for the Dolphins. [3]

## Question 61

The times in minutes taken by 13 pupils at each of two schools in a cross-country race are recorded in the table below.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thaters School | 38 | 43 | 48 | 52 | 54 | 56 | 57 | 58 | 58 | 61 | 62 | 66 | 75 |
| Whitefay Park School | 45 | 47 | 53 | 56 | 56 | 61 | 64 | 66 | 69 | 73 | 75 | 78 | 83 |

**(i)** Draw a back-to-back stem-and-leaf diagram to illustrate these times with Thaters School on the left. [4]

**(ii)** Find the interquartile range of the times for pupils at Thaters School. [2]

The times taken by pupils at Whitefay Park School are denoted by $x$ minutes.

**(iii)** Find the value of $\Sigma(x - 60)^2$. [2]

**(iv)** It is given that $\Sigma(x - 60) = 46$. Use this result, together with your answer to part **(iii)**, to find the variance of $x$. [2]

## Question 62

**(i)** Give one advantage and one disadvantage of using a box-and-whisker plot to represent a set of data. [2]

**(ii)** The times in minutes taken to run a marathon were recorded for a group of 13 marathon runners and were found to be as follows.

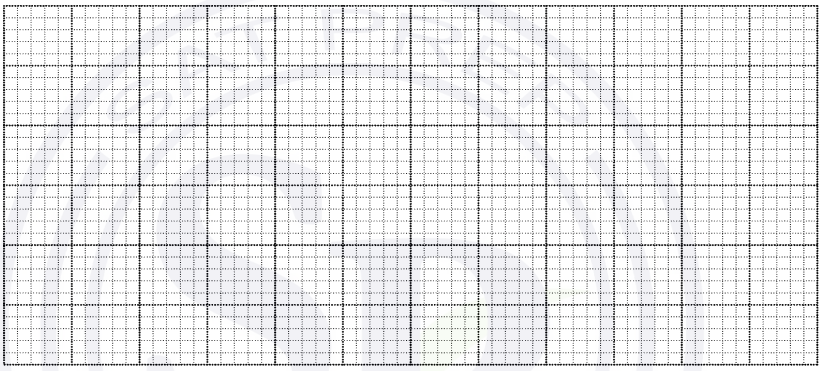
180 275 235 242 311 194 246 229 238 768 332 227 228

State which of the mean, mode or median is most suitable as a measure of central tendency for these times. Explain why the other measures are less suitable. [3]

**(iii)** Another group of 33 people ran the same marathon and their times in minutes were as follows.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 190 | 203 | 215 | 246 | 249 | 253 | 255 | 254 | 258 | 260 | 261 |
| 263 | 267 | 269 | 274 | 276 | 280 | 288 | 283 | 287 | 294 | 300 |
| 307 | 318 | 327 | 331 | 336 | 345 | 351 | 353 | 360 | 368 | 375 |

**(a)** On the grid below, draw a box-and-whisker plot to illustrate the times for these 33 people. [4]



**(b)** Find the interquartile range of these times. [1]

## Question 62

The times, $t$ seconds, taken to swim 100 m were recorded for a group of 9 swimmers and were found to be as follows.

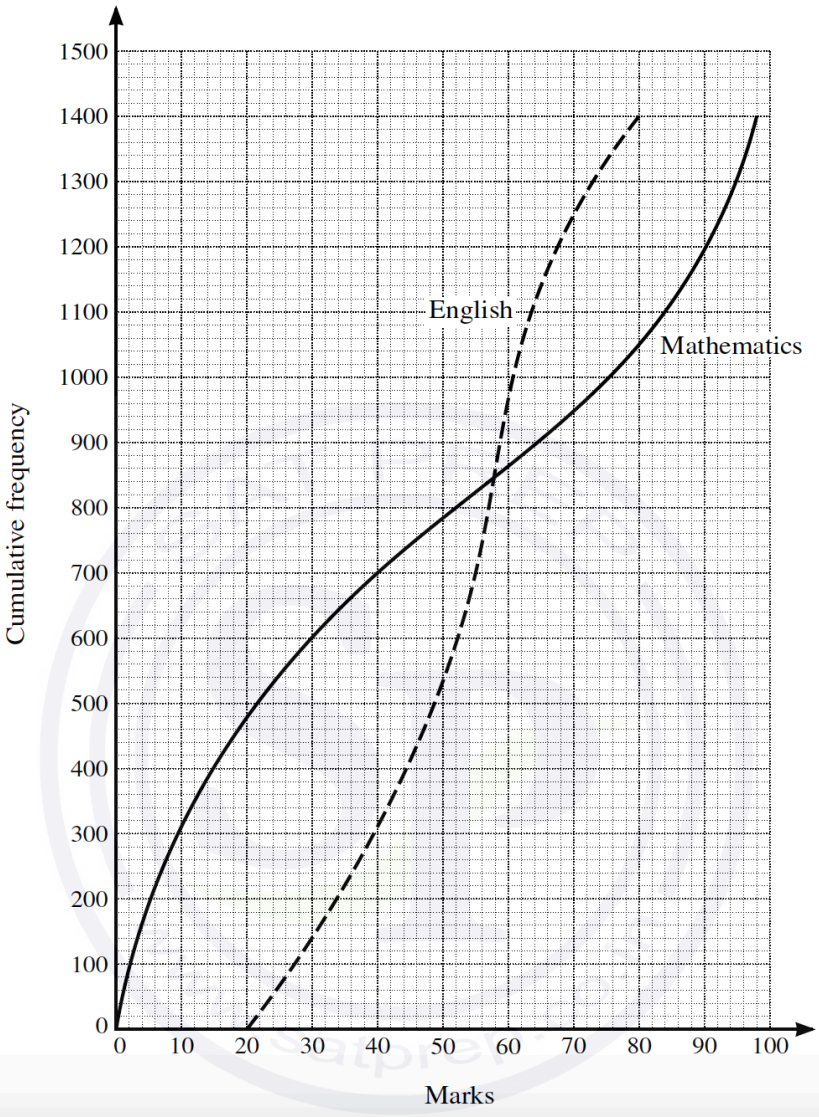
95 126 117 135 120 125 114 119 136

**(i)** Find the values of $\Sigma(t - 120)$ and $\Sigma(t - 120)^2$. [2]

**(ii)** Using your values found in part **(i)**, calculate the variance of $t$. [2]

## Question 63

The Mathematics and English A-level marks of 1400 pupils all taking the same examinations are shown in the cumulative frequency graphs below. Both examinations are marked out of 100.



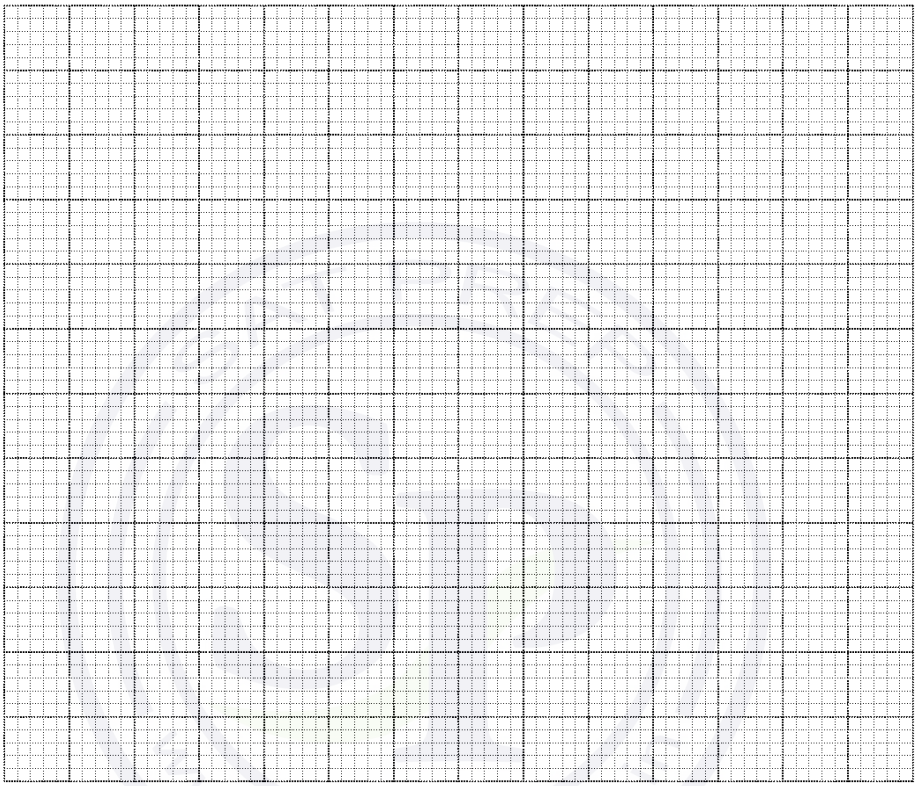

Use suitable data from these graphs to compare the central tendency and spread of the marks in Mathematics and English. [6]

Question 64

Last Saturday, 200 drivers entering a car park were asked the time, in minutes, that it had taken them to travel from home to the car park. The results are summarised in the following cumulative frequency table.

| Time ($t$ minutes) | $t \leqslant 10$ | $t \leqslant 20$ | $t \leqslant 30$ | $t \leqslant 50$ | $t \leqslant 70$ | $t \leqslant 90$ |
|---|---|---|---|---|---|---|
| Cumulative frequency | 16 | 50 | 106 | 146 | 176 | 200 |

**(i)** On the grid, draw a cumulative frequency graph to illustrate the data. [2]



**(ii)** Use your graph to estimate the median of the data. [1]

**(iii)** For 80 of the drivers, the time taken was at least $T$ minutes. Use your graph to estimate the value of $T$. [2]

**(iv)** Calculate an estimate of the mean time taken by all 200 drivers to travel to the car park. [4]

## Question 65

Twelve tourists were asked to estimate the height, in metres, of a new building. Their estimates were as follows.

50 45 62 30 40 55 110 38 52 60 55 40

**(i)** Find the median and the interquartile range for the data. [3]

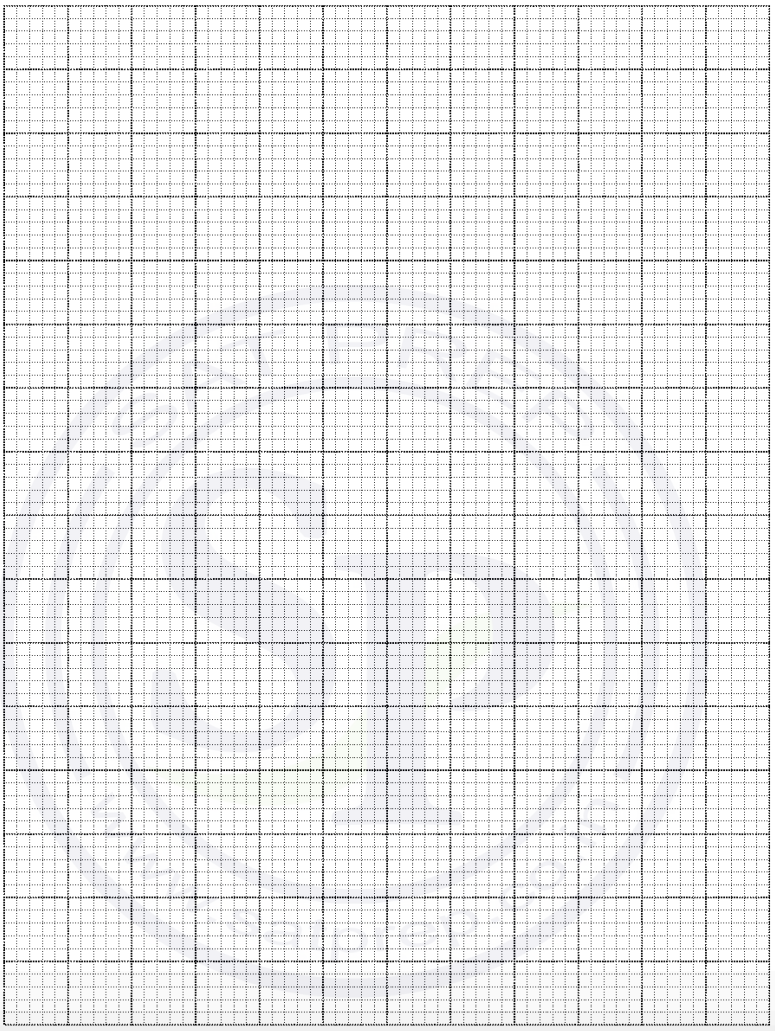
**(ii)** Give a disadvantage of using the mean as a measure of the central tendency in this case. [1]

## Question 66

The speeds, in $\text{km h}^{-1}$, of 90 cars as they passed a certain marker on a road were recorded, correct to the nearest $\text{km h}^{-1}$. The results are summarised in the following table.

| Speed ($\text{km h}^{-1}$) | 10 – 29 | 30 – 39 | 40 – 49 | 50 – 59 | 60 – 89 |
|---|---|---|---|---|---|
| Frequency | 10 | 24 | 30 | 14 | 12 |

**(i)** On the grid, draw a histogram to illustrate the data in the table. [4]



**(ii)** Calculate an estimate for the mean speed of these 90 cars as they pass the marker. [2]

## Question 67

The mean and standard deviation of 20 values of $x$ are 60 and 4 respectively.

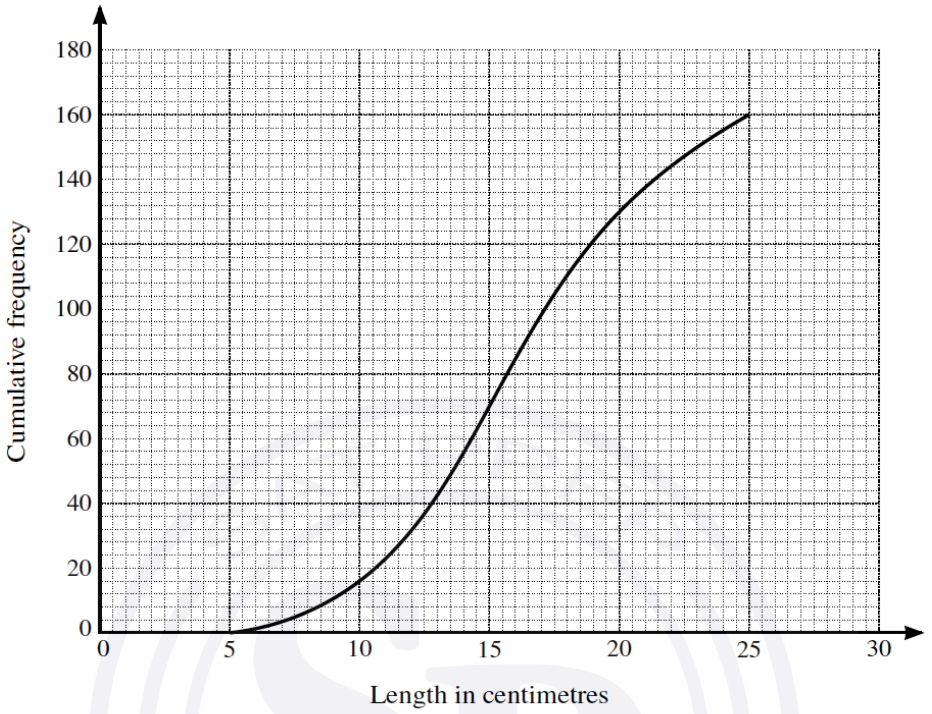
**(i)** Find the values of $\Sigma x$ and $\Sigma x^2$. [3]

Another 10 values of $x$ are such that their sum is 550 and the sum of their squares is 40 500.

**(ii)** Find the mean and standard deviation of all these 30 values of $x$. [4]

## Question 68

Ransha measured the lengths, in centimetres, of 160 palm leaves. His results are illustrated in the cumulative frequency graph below.

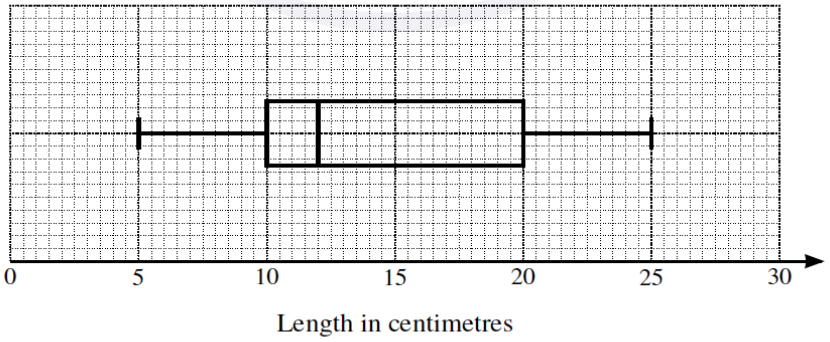



**(i)** Estimate how many leaves have a length between 14 and 24 centimetres. [1]

**(ii)** 10% of the leaves have a length of $L$ centimetres or more. Estimate the value of $L$. [2]

**(iii)** Estimate the median and the interquartile range of the lengths. [3]

Sharim measured the lengths, in centimetres, of 160 palm leaves of a different type. He drew a box-and-whisker plot for the data, as shown on the grid below.




**(iv)** Compare the central tendency and the spread of the two sets of data. [2]

Question 69

For 40 values of the variable $x$, it is given that $\Sigma(x - c)^2 = 3099.2$, where $c$ is a constant. The standard deviation of these values of $x$ is 3.2.

**(i)** Find the value of $\Sigma(x - c)$. [3]

**(ii)** Given that $c = 50$, find the mean of these values of $x$. [1]

## Question 70

The weights, in kg, of the 11 members of the Dolphins swimming team and the 11 members of the Sharks swimming team are shown below.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dolphins | 62 | 75 | 69 | 82 | 63 | 80 | 65 | 65 | 73 | 82 | 72 |
| Sharks | 68 | 84 | 59 | 70 | 71 | 64 | 77 | 80 | 66 | 74 | 72 |

**(i)** Draw a back-to-back stem-and-leaf diagram to represent this information, with Dolphins on the left-hand side of the diagram and Sharks on the right-hand side. [4]

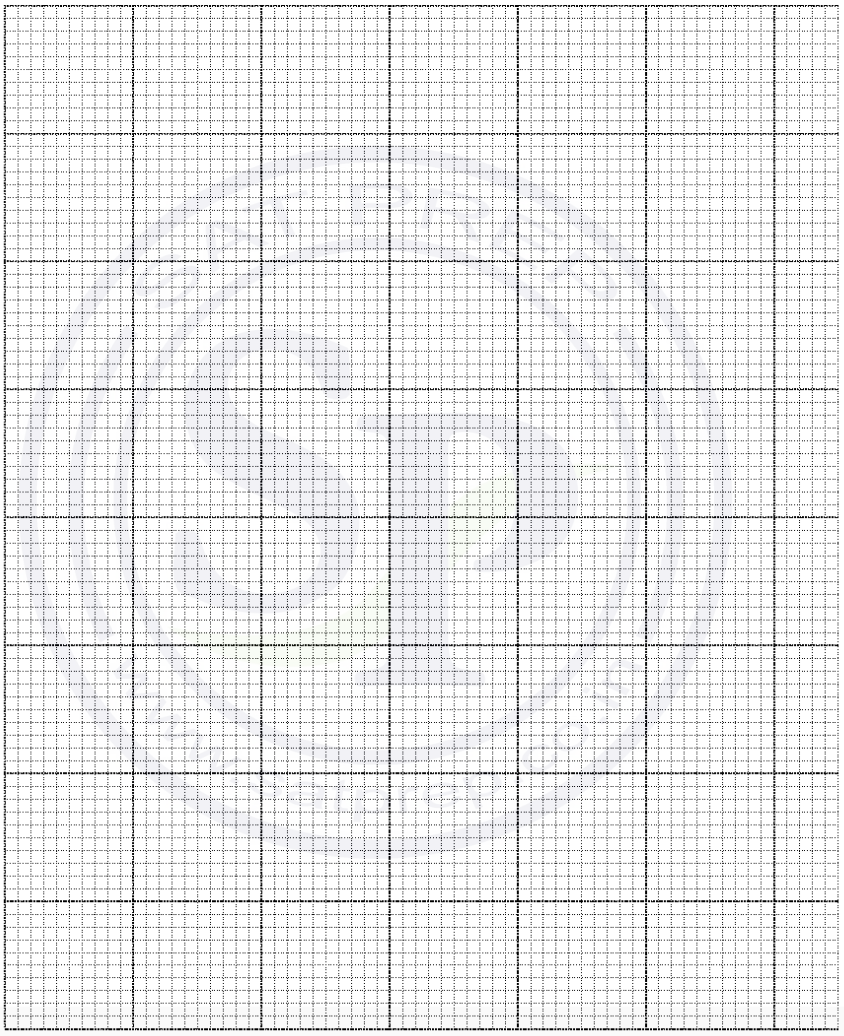
**(ii)** Find the median and interquartile range for the Dolphins. [3]

## Question 71

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]

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]

## Question 72

The annual salaries, in thousands of dollars, for 11 employees at each of two companies $A$ and $B$ are shown below.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Company $A$ | 30 | 32 | 35 | 41 | 41 | 42 | 47 | 49 | 52 | 53 | 64 |
| Company $B$ | 26 | 47 | 30 | 52 | 41 | 38 | 35 | 42 | 49 | 31 | 42 |

**(a)** Represent the data by drawing a back-to-back stem-and-leaf diagram with company $A$ on the left-hand side of the diagram. [4]

**(b)** Find the median and the interquartile range of the salaries of the employees in company $A$. [3]

A new employee joins company $B$. The mean salary of the 12 employees is now \$38 500.

**(c)** Find the salary of the new employee. [3]

## Question 73

For $n$ values of the variable $x$, it is given that

$$\Sigma(x - 50) = 144 \quad \text{and} \quad \Sigma x = 944.$$

Find the value of $n$. [3]

## Question 74

Two machines, $A$ and $B$, produce metal rods of a certain type. The lengths, in metres, of 19 rods produced by machine $A$ and 19 rods produced by machine $B$ are shown in the following back-to-back stem-and-leaf diagram.

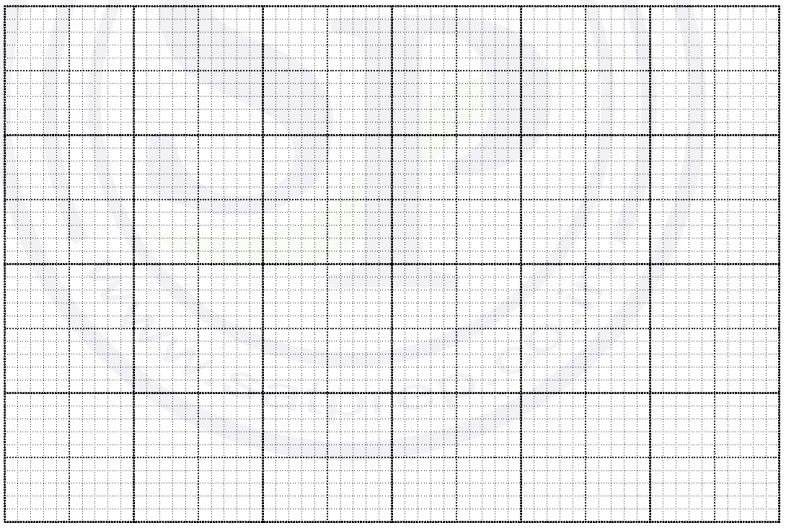
| $A$ | | | | | | | $B$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 21 | 1 | 2 | 4 | | | | |
| | | 7 | 6 | 3 | 0 | 22 | 2 | 4 | 5 | 5 | 6 | | |
| 8 | 7 | 4 | 3 | 1 | 1 | 23 | 0 | 2 | 6 | 8 | 9 | 9 | |
| | 5 | 5 | 5 | 3 | 2 | 24 | 3 | 3 | 4 | 6 | | | |
| | | 4 | 3 | 1 | 0 | 25 | 6 | | | | | | |

Key: 7 | 22 | 4 means 0.227 m for machine $A$ and 0.224 m for machine $B$.

**(a)** Find the median and the interquartile range for machine $A$. [3]

It is given that for machine $B$ the median is 0.232 m, the lower quartile is 0.224 m and the upper quartile is 0.243 m.

**(b)** Draw box-and-whisker plots for $A$ and $B$. [3]



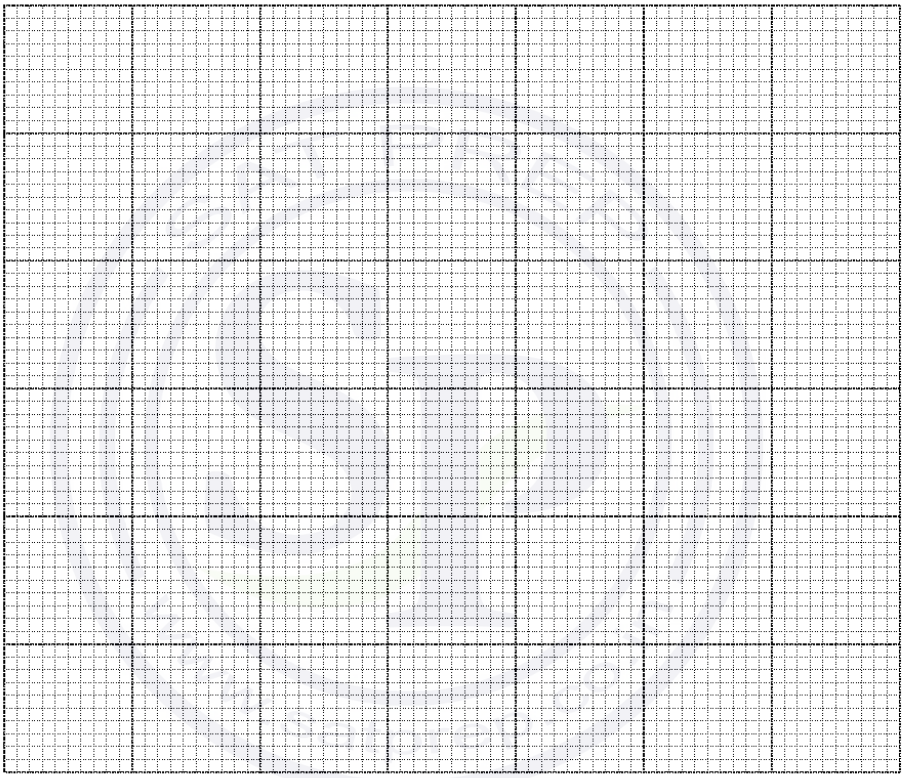
**(c)** Hence make two comparisons between the lengths of the rods produced by machine $A$ and those produced by machine $B$. [2]

## Question 75

The numbers of chocolate bars sold per day in a cinema over a period of 100 days are summarised in the following table.

| Number of chocolate bars sold | 1 – 10 | 11 – 15 | 16 – 30 | 31 – 50 | 51 – 60 |
|---|---|---|---|---|---|
| Number of days | 18 | 24 | 30 | 20 | 8 |

**(a)** Draw a histogram to represent this information. [5]



**(b)** What is the greatest possible value of the interquartile range for the data? [2]

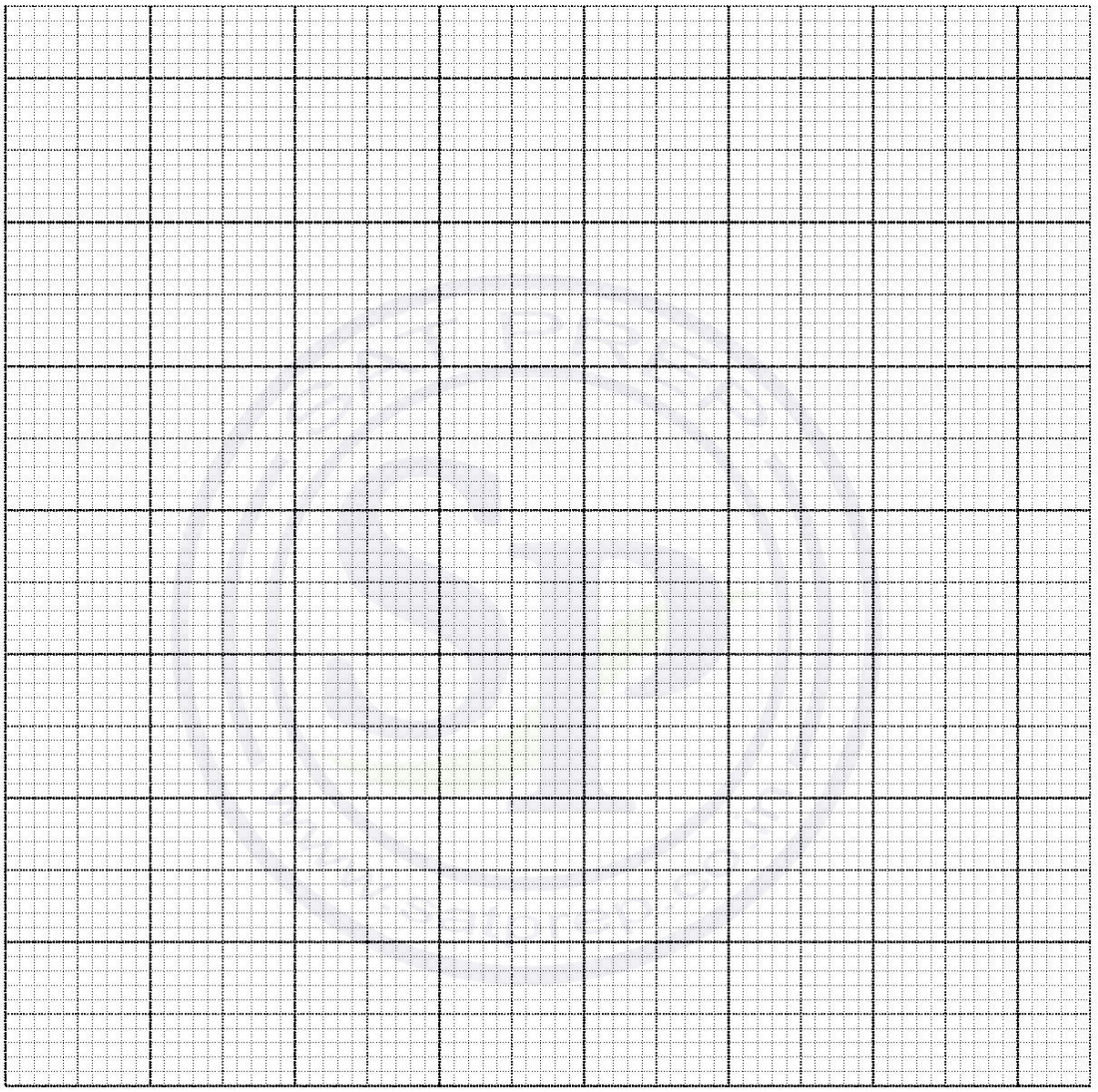
**(c)** Calculate estimates of the mean and standard deviation of the number of chocolate bars sold. [4]

## Question 76

A particular piece of music was played by 91 pianists and for each pianist, the number of incorrect notes was recorded. The results are summarised in the table.

| Number of incorrect notes | 1 – 5 | 6 – 10 | 11 – 20 | 21 – 40 | 41 – 70 |
|---|---|---|---|---|---|
| Frequency | 10 | 5 | 26 | 32 | 18 |

**(a)** Draw a histogram to represent this information. [5]



**(b)** State which class interval contains the lower quartile and which class interval contains the upper quartile.

Hence find the greatest possible value of the interquartile range. [2]

**(c)** Calculate an estimate for the mean number of incorrect notes. [3]

## Question77

The following table gives the weekly snowfall, in centimetres, for 11 weeks in 2018 at two ski resorts, Dados and Linva.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dados | 6 | 8 | 12 | 15 | 10 | 36 | 42 | 28 | 10 | 22 | 16 |
| Linva | 2 | 11 | 15 | 16 | 0 | 32 | 36 | 40 | 10 | 12 | 9 |

**(a)** Represent the information in a back-to-back stem-and-leaf diagram. [4]

**(b)** Find the median and the interquartile range for the weekly snowfall in Dados. [3]

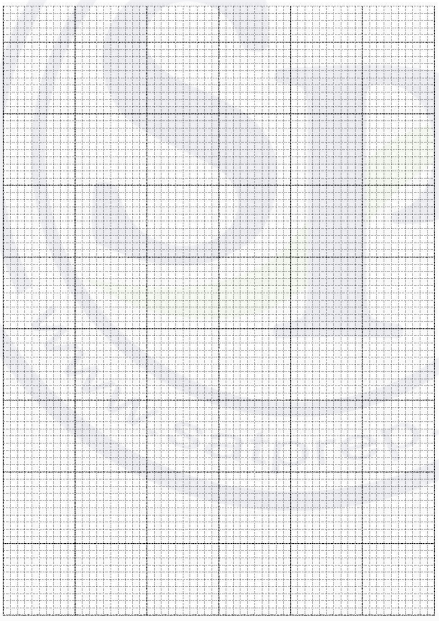
**(c)** The median, lower quartile and upper quartile of the weekly snowfall for Linva are 12, 9 and 32 cm respectively. Use this information and your answers to part **(b)** to compare the central tendency and the spread of the weekly snowfall in Dados and Linva. [2]

## Question 78

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) | $t \leqslant 20$ | $t \leqslant 30$ | $t \leqslant 40$ | $t \leqslant 60$ | $t \leqslant 100$ |
|---|---|---|---|---|---|
| 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]

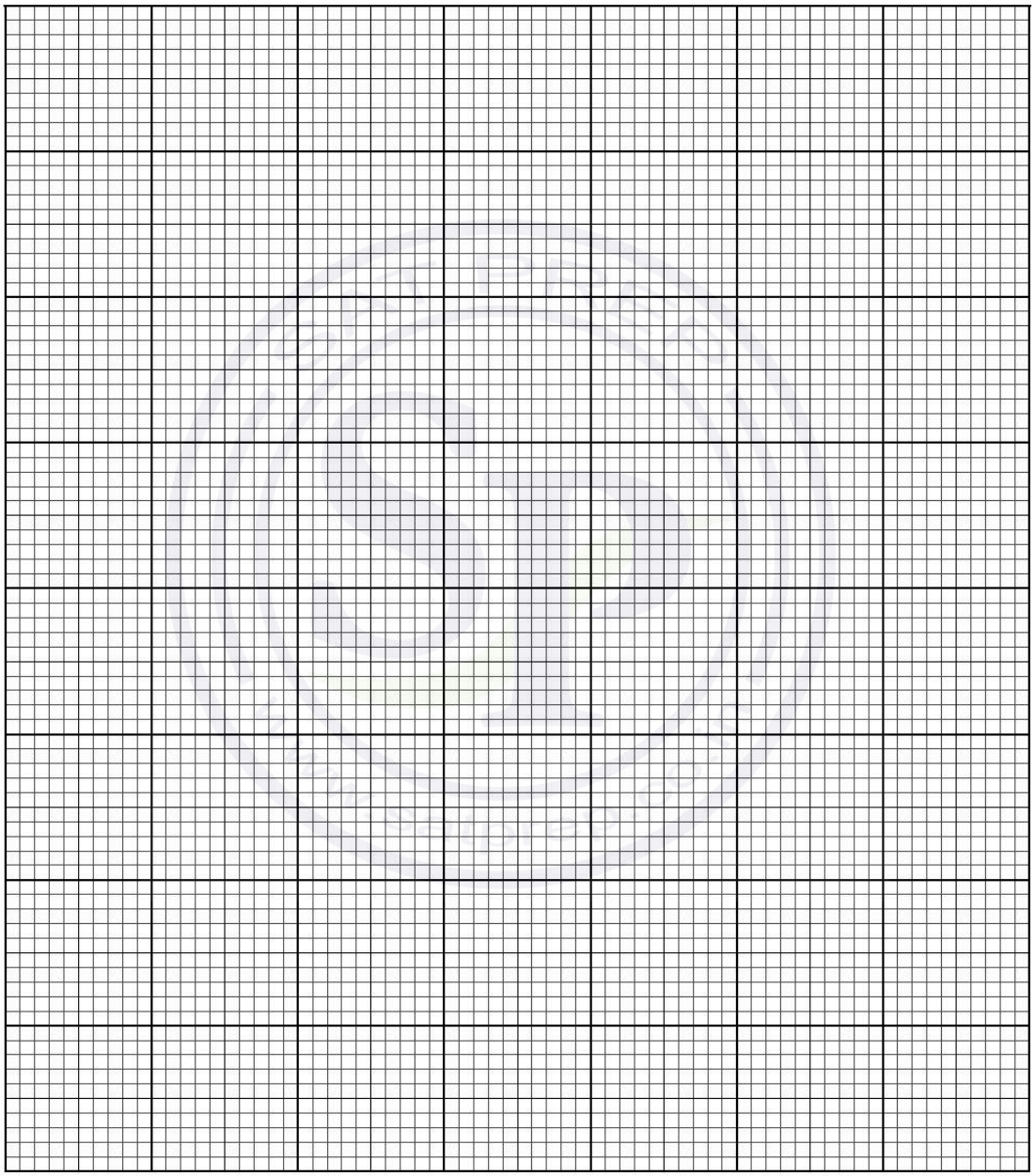
**(c)** Calculate estimates of the mean and the standard deviation of the time taken to complete the challenge. [6]

## Question 79

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]

**(c)** Calculate an estimate of the mean distance travelled for the 150 journeys. [3]

## Question 80

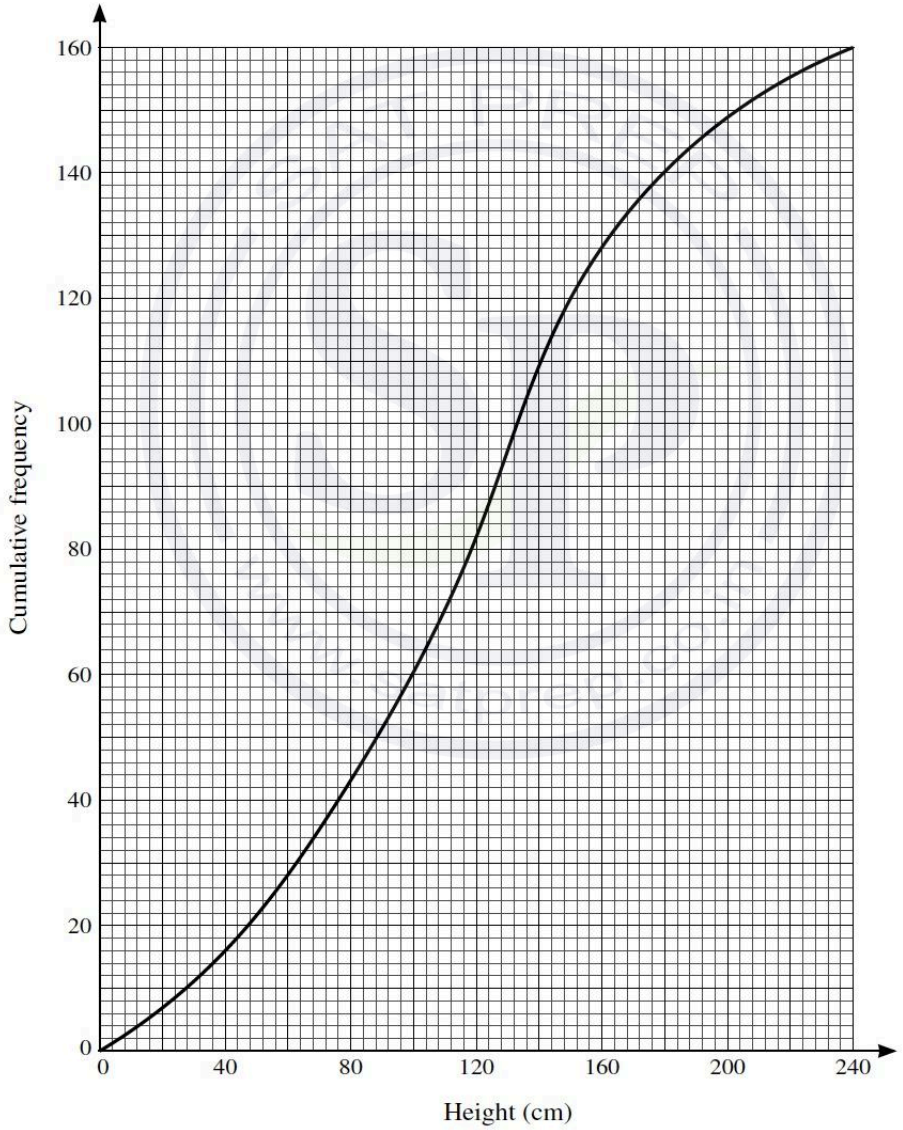
A sports club has a volleyball team and a hockey team. The heights of the 6 members of the volleyball team are summarised by $\Sigma x = 1050$ and $\Sigma x^2 = 193\,700$, where $x$ is the height of a member in cm. The heights of the 11 members of the hockey team are summarised by $\Sigma y = 1991$ and $\Sigma y^2 = 366\,400$, where $y$ is the height of a member in cm.

**(a)** Find the mean height of all 17 members of the club. [2]

**(b)** Find the standard deviation of the heights of all 17 members of the club. [3]

## Question 81

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]

**(b)** Use the graph to estimate the 65th percentile of the distribution. [2]

**(c)** Use the graph to estimate the interquartile range of the heights of these plants. [2]

## Question 82

The heights, in cm, of the 11 basketball players in each of two clubs, the Amazons and the Giants, are shown below.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Amazons | 205 | 198 | 181 | 182 | 190 | 215 | 201 | 178 | 202 | 196 | 184 |
| Giants | 175 | 182 | 184 | 187 | 189 | 192 | 193 | 195 | 195 | 195 | 204 |

**(a)** State an advantage of using a stem-and-leaf diagram compared to a box-and-whisker plot to illustrate this information. [1]

**(b)** Represent the data by drawing a back-to-back stem-and-leaf diagram with Amazons on the left-hand side of the diagram. [4]

**(c)** Find the interquartile range of the heights of the players in the Amazons. [2]

Four new players join the Amazons. The mean height of the 15 players in the Amazons is now 191.2 cm. The heights of three of the new players are 180 cm, 185 cm and 190 cm.

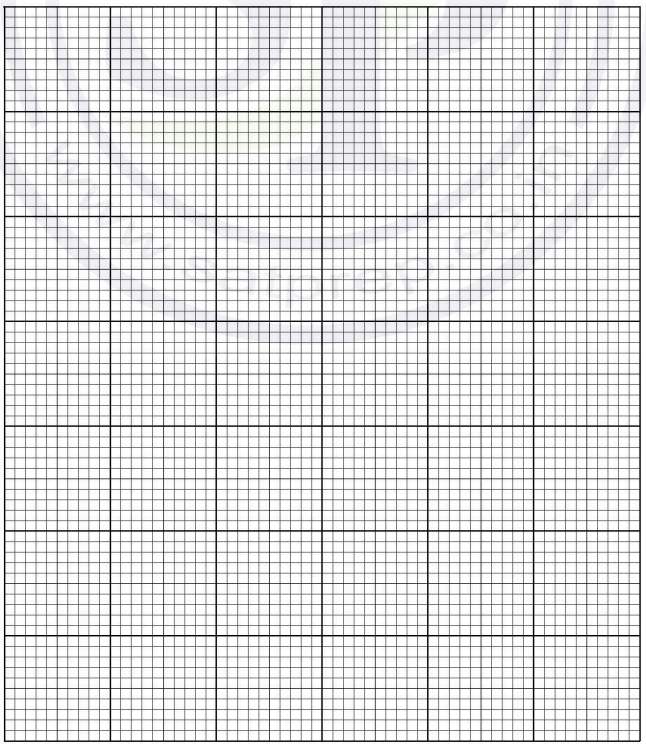
**(d)** Find the height of the fourth new player. [3]

## Question 83

The times taken by 200 players to solve a computer puzzle are summarised in the following table.

| Time ($t$ seconds) | $0 \leqslant t < 10$ | $10 \leqslant t < 20$ | $20 \leqslant t < 40$ | $40 \leqslant t < 60$ | $60 \leqslant t < 100$ |
|---|---|---|---|---|---|
| Number of players | 16 | 54 | 78 | 32 | 20 |

**(a)** Draw a histogram to represent this information. [4]



**(b)** Calculate an estimate of the mean time taken by these 200 players. [2]

**(c)** Find the greatest possible value of the interquartile range of these times. [2]

## Question 84

Lakeview and Riverside are two schools. The pupils at both schools took part in a competition to see how far they could throw a ball. The distances thrown, to the nearest metre, by 11 pupils from each school are shown in the following table.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lakeview | 10 | 14 | 19 | 22 | 26 | 27 | 28 | 30 | 32 | 33 | 41 |
| Riverside | 23 | 36 | 21 | 18 | 37 | 25 | 18 | 20 | 24 | 30 | 25 |

**(a)** Draw a back-to-back stem-and-leaf diagram to represent this information, with Lakeview on the left-hand side. [4]

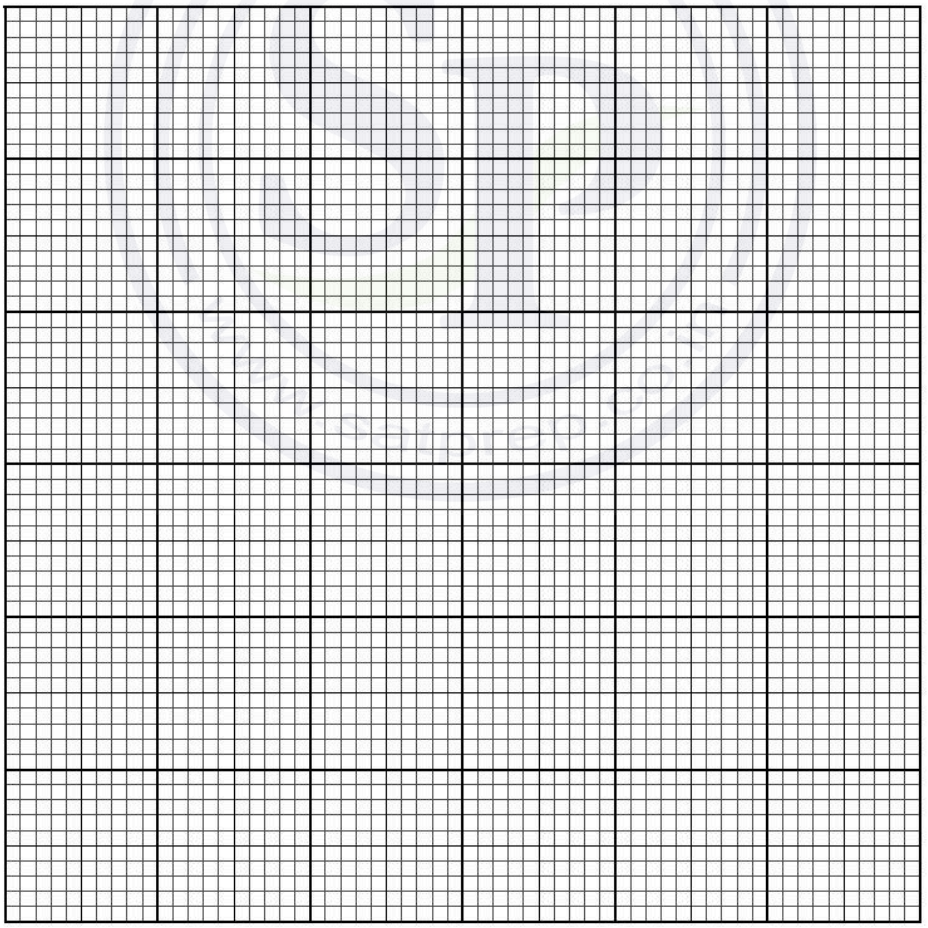
**(b)** Find the interquartile range of the distances thrown by the 11 pupils at Lakeview school. [2]

## Question 85

The times taken, in minutes, by 360 employees at a large company to travel from home to work are summarised in the following table.

| Time, $t$ minutes | $0 \leqslant t < 5$ | $5 \leqslant t < 10$ | $10 \leqslant t < 20$ | $20 \leqslant t < 30$ | $30 \leqslant t < 50$ |
|---|---|---|---|---|---|
| Frequency | 23 | 102 | 135 | 76 | 24 |

**(a)** Draw a histogram to represent this information. [4]



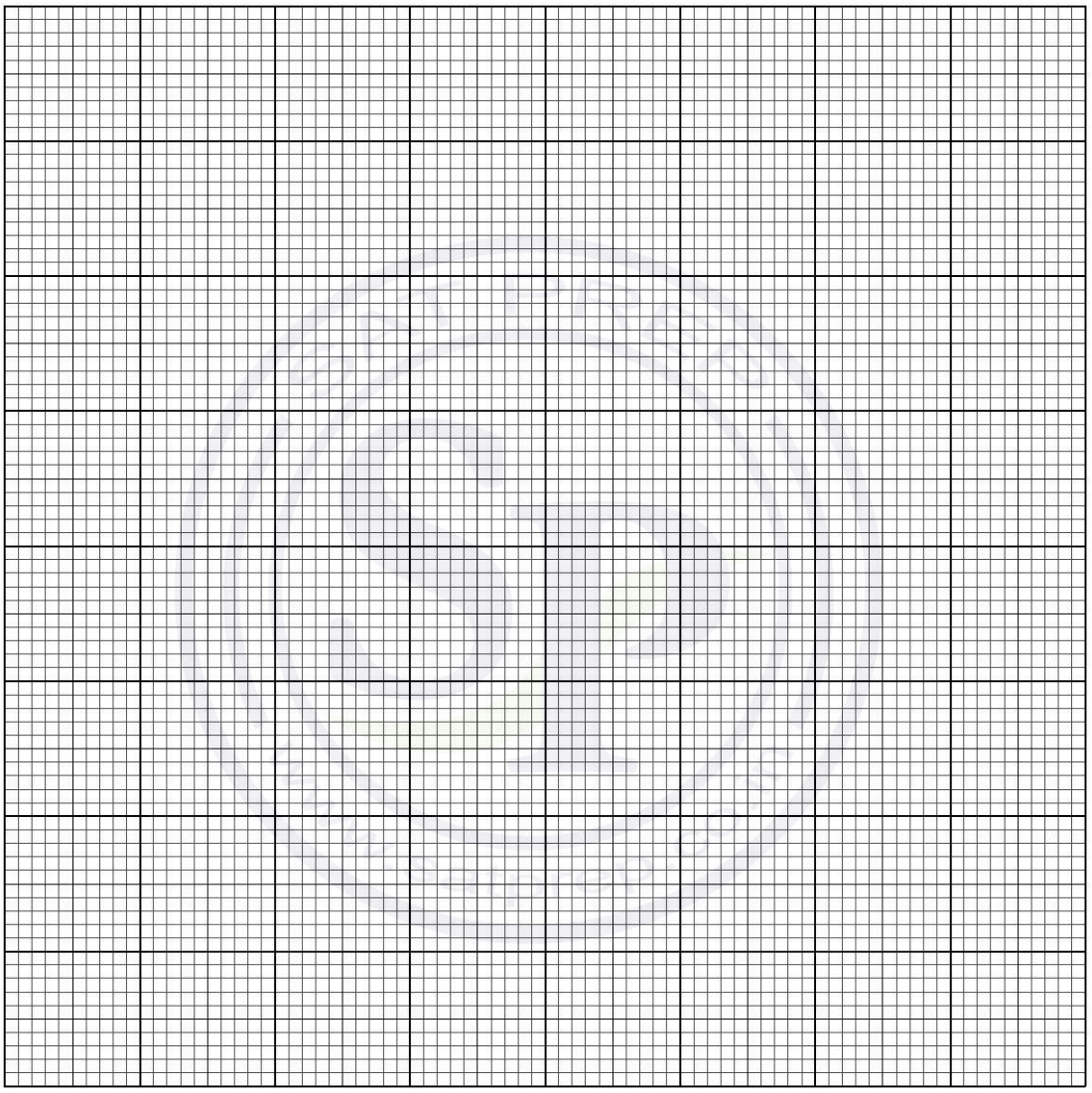
**(b)** Calculate an estimate of the mean time taken by an employee to travel to work. [2]

## Question 86

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

| Distance, $x$ m | $x \leqslant 200$ | $x \leqslant 300$ | $x \leqslant 500$ | $x \leqslant 900$ | $x \leqslant 1200$ | $x \leqslant 1600$ |
|---|---|---|---|---|---|---|
| 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]

**(c)** Calculate estimates of the mean and standard deviation of the distances. [6]

## Question 87

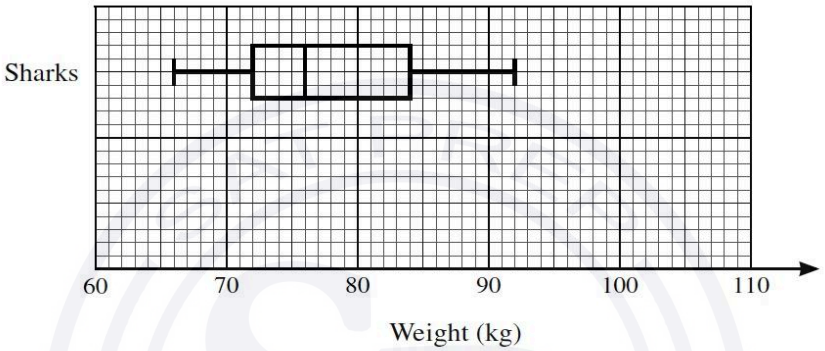
The weights, in kg, of 15 rugby players in the Rebels club and 15 soccer players in the Sharks club are shown below.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rebels | 75 | 78 | 79 | 80 | 82 | 82 | 83 | 84 | 85 | 86 | 89 | 93 | 95 | 99 | 102 |
| Sharks | 66 | 68 | 71 | 72 | 74 | 75 | 75 | 76 | 78 | 83 | 83 | 84 | 85 | 86 | 92 |

**(a)** Represent the data by drawing a back-to-back stem-and-leaf diagram with Rebels on the left-hand side of the diagram. [4]

**(b)** Find the median and the interquartile range for the Rebels. [3]

A box-and-whisker plot for the Sharks is shown below.




**(c)** On the same diagram, draw a box-and-whisker plot for the Rebels. [2]

**(d)** Make one comparison between the weights of the players in the Rebels club and the weights of the players in the Sharks club. [1]

## Question 88

A summary of 40 values of $x$ gives the following information:

$$\Sigma(x - k) = 520, \qquad \Sigma(x - k)^2 = 9640,$$

where $k$ is a constant.

**(a)** Given that the mean of these 40 values of $x$ is 34, find the value of $k$. [2]

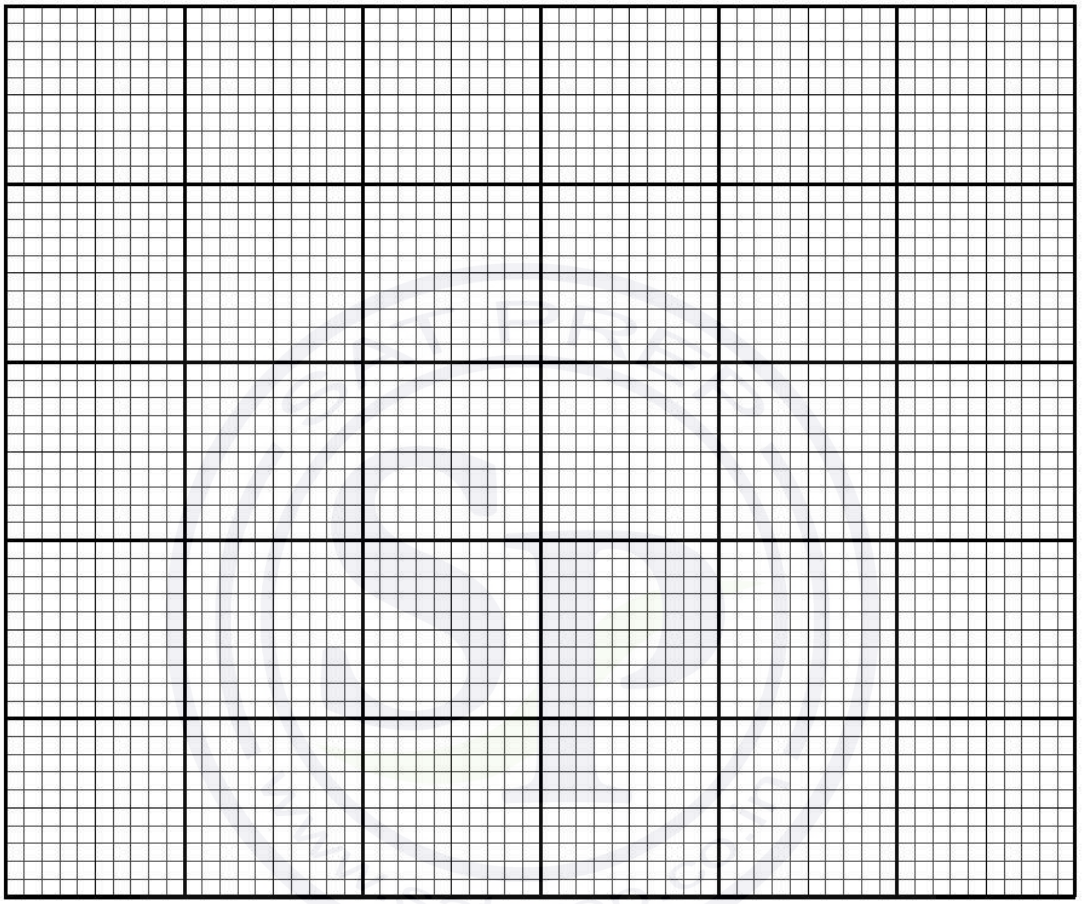
**(b)** Find the variance of these 40 values of $x$. [2]

## Question 89

At a summer camp an arithmetic test is taken by 250 children. The times taken, to the nearest minute, to complete the test were recorded. The results are summarised in the table.

| Time taken, in minutes | 1 – 30 | 31 – 45 | 46 – 65 | 66 – 75 | 76 – 100 |
|---|---|---|---|---|---|
| Frequency | 21 | 30 | 68 | 86 | 45 |

**(a)** Draw a histogram to represent this information. [4]



**(b)** State which class interval contains the median. [1]

**(c)** Given that an estimate of the mean time is 61.05 minutes, state what feature of the distribution accounts for the median and the mean being different. [1]

## Question 90

Twenty children were asked to estimate the height of a particular tree. Their estimates, in metres, were as follows.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4.1 | 4.2 | 4.4 | 4.5 | 4.6 | 4.8 | 5.0 | 5.2 | 5.3 | 5.4 |
| 5.5 | 5.8 | 6.0 | 6.2 | 6.3 | 6.4 | 6.6 | 6.8 | 6.9 | 19.4 |

**(a)** Find the mean of the estimated heights. [1]

**(b)** Find the median of the estimated heights. [1]

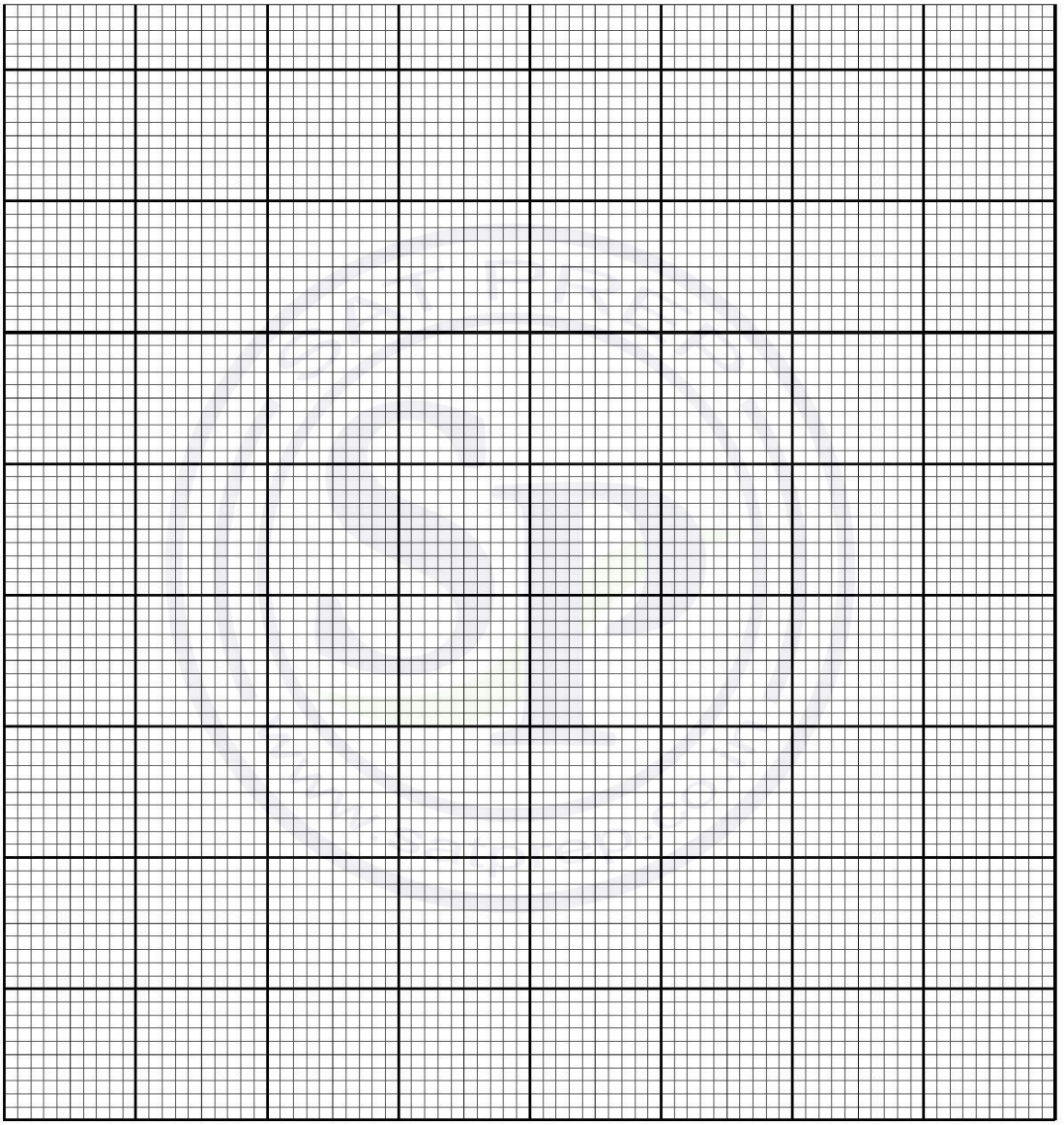
**(c)** Give a reason why the median is likely to be more suitable than the mean as a measure of the central tendency for this information. [1]

## Question 91

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) | $t \leqslant 25$ | $t \leqslant 50$ | $t \leqslant 75$ | $t \leqslant 100$ | $t \leqslant 150$ | $t \leqslant 200$ |
|---|---|---|---|---|---|---|
| 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. [1]

.....

.....

## Question 92

The back-to-back stem-and-leaf diagram shows the diameters, in cm, of 19 cylindrical pipes produced by each of two companies, $A$ and $B$.

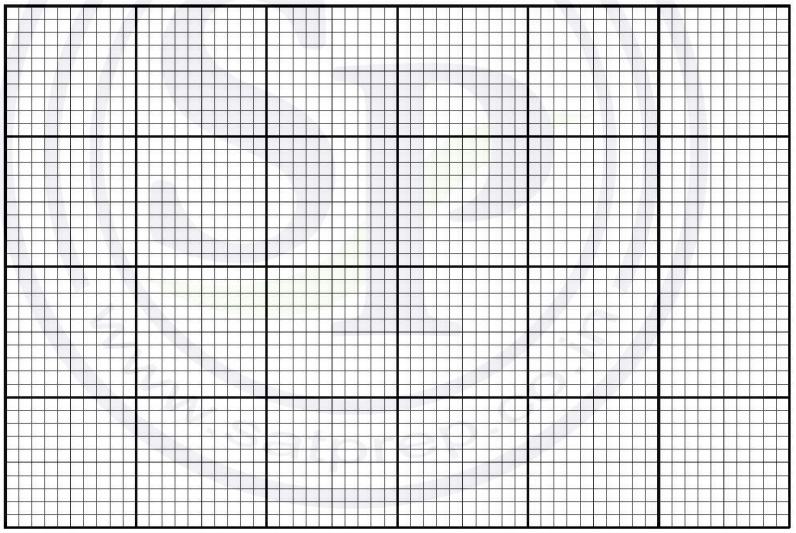
| Company $A$ | | | | | | | Company $B$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 4 | 33 | 1 | 2 | 8 | | |
| | 9 | 8 | 3 | 2 | 0 | 34 | 1 | 6 | 8 | 9 | 9 |
| 8 | 7 | 5 | 4 | 1 | 1 | 35 | 1 | 2 | 2 | 3 | |
| | | 9 | 6 | 5 | 2 | 36 | 5 | 6 | | | |
| | | | 4 | 3 | 1 | 37 | 0 | 3 | 4 | | |
| | | | | | | 38 | 2 | 8 | | | |

Key: 1 | 35 | 3 means the pipe diameter from company $A$ is 0.351 cm and from company $B$ is 0.353 cm.

**(a)** Find the median and interquartile range of the pipes produced by company $A$. [3]

It is given that for the pipes produced by company $B$ the lower quartile, median and upper quartile are 0.346 cm, 0.352 cm and 0.370 cm respectively.

**(b)** Draw box-and-whisker plots for companies $A$ and $B$ on the grid below. [3]



**(c)** Make one comparison between the diameters of the pipes produced by companies $A$ and $B$. [1]

## Question 93

For $n$ values of the variable $x$, it is given that

$$\Sigma(x - 200) = 446 \quad \text{and} \quad \Sigma x = 6846.$$

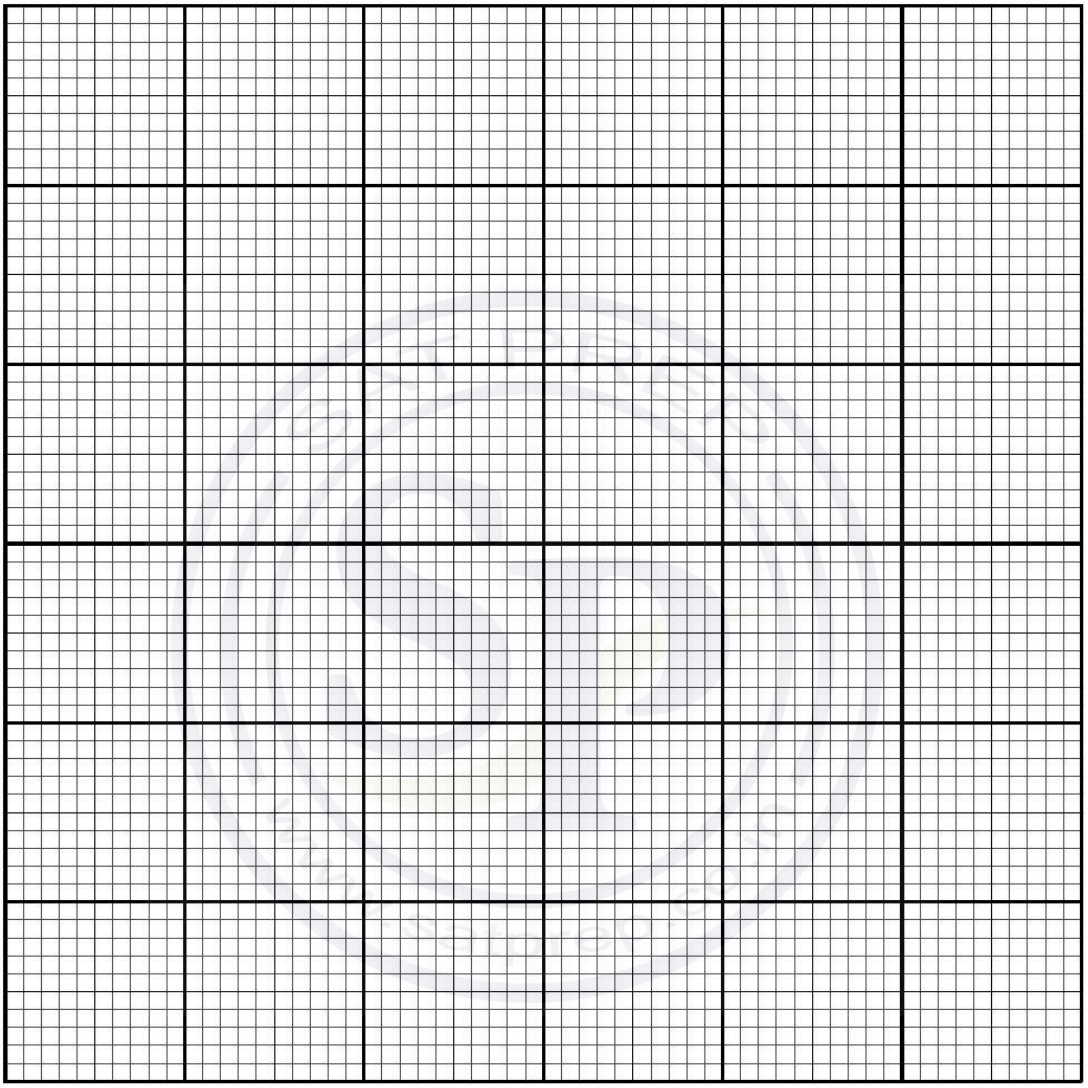
Find the value of $n$. [3]

## Question 94

The times taken to travel to college by 2500 students are summarised in the table.

| Time taken ($t$ minutes) | $0 \leqslant t < 20$ | $20 \leqslant t < 30$ | $30 \leqslant t < 40$ | $40 \leqslant t < 60$ | $60 \leqslant t < 90$ |
|---|---|---|---|---|---|
| Frequency | 440 | 720 | 920 | 300 | 120 |

**(a)** Draw a histogram to represent this information. [4]



From the data, the estimate of the mean value of $t$ is 31.44.

**(b)** Calculate an estimate of the standard deviation of the times taken to travel to college. [3]

**(c)** In which class interval does the upper quartile lie? [1]

It was later discovered that the times taken to travel to college by two students were incorrectly recorded. One student's time was recorded as 15 instead of 5 and the other's time was recorded as 65 instead of 75.

**(d)** Without doing any further calculations, state with a reason whether the estimate of the standard deviation in part **(b)** would be increased, decreased or stay the same. [1]

## Question 95

50 values of the variable $x$ are summarised by

$$\Sigma(x - 20) = 35 \qquad \text{and} \qquad \Sigma x^2 = 25\,036.$$

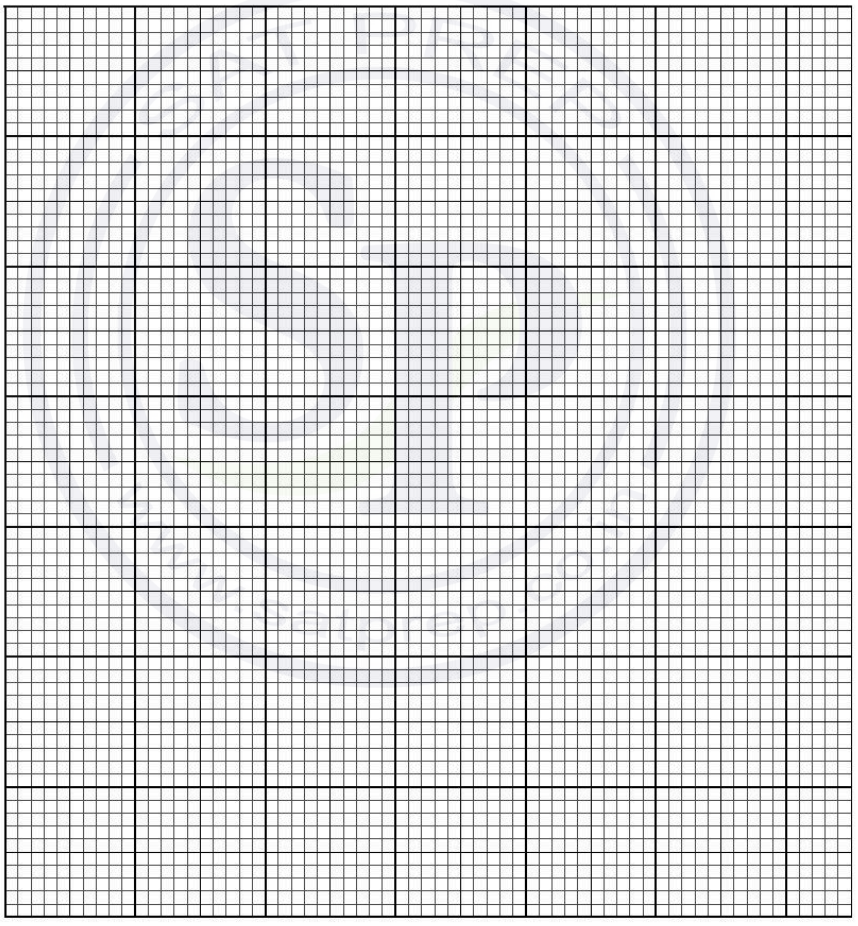
Find the variance of these 50 values. [3]

## Question 96

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) | $t \leqslant 20$ | $t \leqslant 30$ | $t \leqslant 35$ | $t \leqslant 40$ | $t \leqslant 50$ | $t \leqslant 60$ |
|---|---|---|---|---|---|---|
| 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]

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

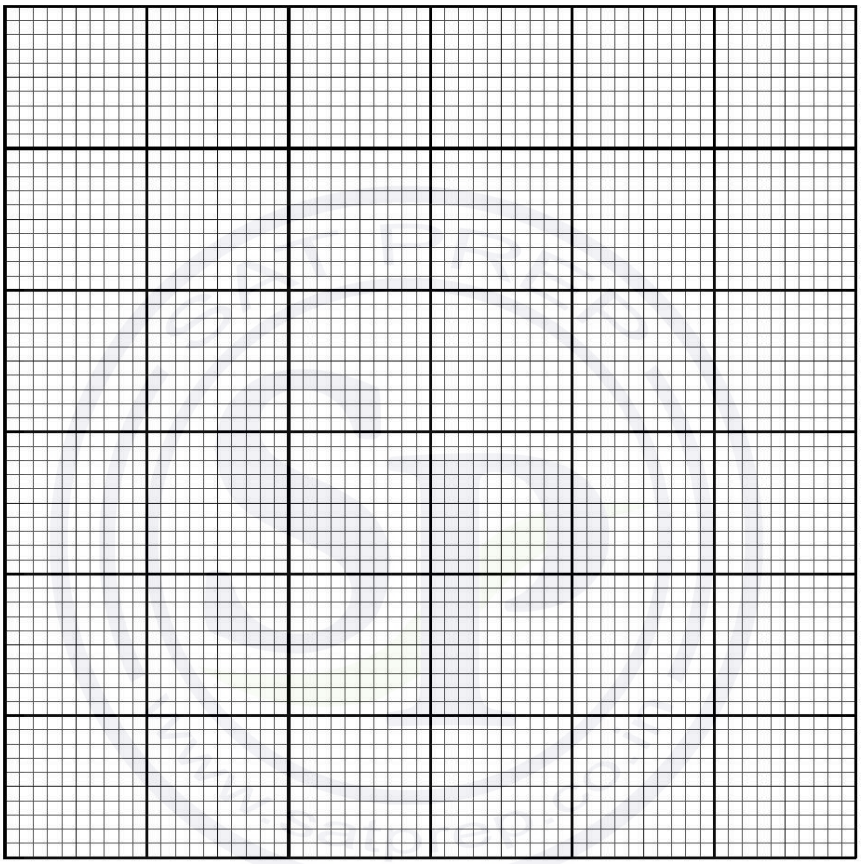
**(c)** Calculate an estimate for the standard deviation of the times taken to complete the challenge by these 250 members. [4]

## Question 97

The times taken, in minutes, to complete a word processing task by 250 employees at a particular company are summarised in the table.

| Time taken ($t$ minutes) | $0 \leqslant t < 20$ | $20 \leqslant t < 40$ | $40 \leqslant t < 50$ | $50 \leqslant t < 60$ | $60 \leqslant t < 100$ |
|---|---|---|---|---|---|
| Frequency | 32 | 46 | 96 | 52 | 24 |

**(a)** Draw a histogram to represent this information. [4]



From the data, the estimate of the mean time taken by these 250 employees is 43.2 minutes.

**(b)** Calculate an estimate for the standard deviation of these times. [3]

## Question 98

The Lions and the Tigers are two basketball clubs. The heights, in cm, of the 11 players in each of their first team squads are given in the table.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lions | 178 | 186 | 181 | 187 | 179 | 190 | 189 | 190 | 180 | 169 | 196 |
| Tigers | 194 | 179 | 187 | 190 | 183 | 201 | 184 | 180 | 195 | 191 | 197 |

**(a)** Draw a back-to-back stem-and-leaf diagram to represent this information, with the Lions on the left. [4]

**(b)** Find the median and the interquartile range of the heights of the Lions first team squad. [3]

It is given that for the Tigers, the lower quartile is 183 cm, the median is 190 cm and the upper quartile is 195 cm.

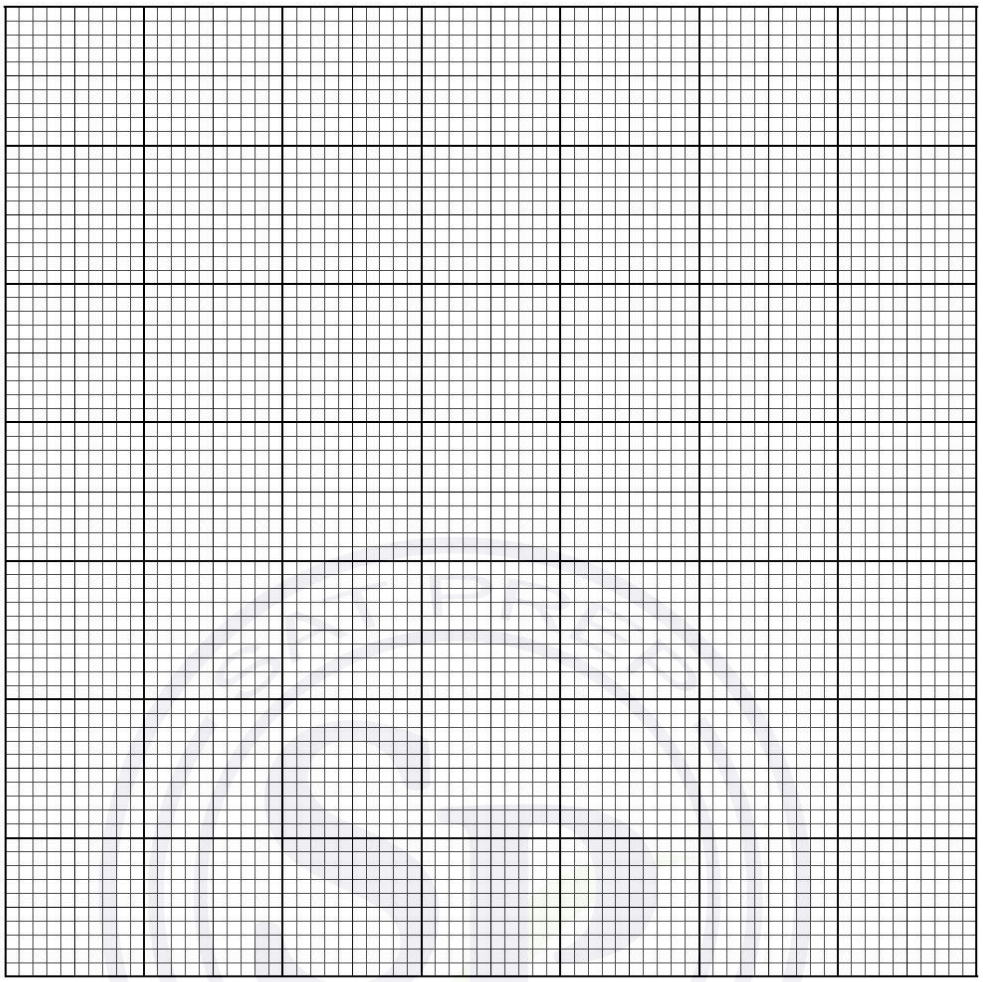
**(c)** Make two comparisons between the heights of the players in the Lions first team squad and the heights of the players in the Tigers first team squad. [2]

## Question 99

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.

| $x$ | $30 \leqslant x < 60$ | $60 \leqslant x < 90$ | $90 \leqslant x < 110$ | $110 \leqslant x < 140$ | $140 \leqslant x < 180$ | $180 \leqslant x \leqslant 240$ |
|---|---|---|---|---|---|---|
| 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]

**(c)** Calculate an estimate for the mean number of hours of sunshine in Kintoo during June over the last 60 years. [3]

## Question 100

The times taken, in minutes, to complete a cycle race by 19 cyclists from each of two clubs, the Cheetahs and the Panthers, are represented in the following back-to-back stem-and-leaf diagram.

| Cheetahs | | | | | | Panthers | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 9 | 8 | 7 | 4 | | | | | |
| 8 | 7 | 3 | 2 | 0 | 8 | 6 | 8 | | | | |
| | | 9 | 8 | 7 | 9 | 1 | 7 | 8 | 9 | 9 | |
| 6 | 5 | 3 | 3 | 1 | 10 | 2 | 3 | 4 | 4 | 5 | 6 |
| | | 9 | 8 | 2 | 11 | 1 | 2 | 8 | | | |
| | | | | 4 | 12 | 0 | 6 | | | | |

Key: 7 |9| 1 means 97 minutes for Cheetahs and 91 minutes for Panthers

**(a)** Find the median and the interquartile range of the times of the Cheetahs. [3]

The median and interquartile range for the Panthers are 103 minutes and 14 minutes respectively.

**(b)** Make two comparisons between the times taken by the Cheetahs and the times taken by the Panthers. [2]

Another cyclist, Kenny, from the Cheetahs also took part in the race. The mean time taken by the 20 cyclists from the Cheetahs was 99 minutes.

**(c)** Find the time taken by Kenny to complete the race. [3]

## Question 101

The following back-to-back stem-and-leaf diagram represents the monthly salaries, in dollars, of 27 employees at each of two companies, $A$ and $B$.

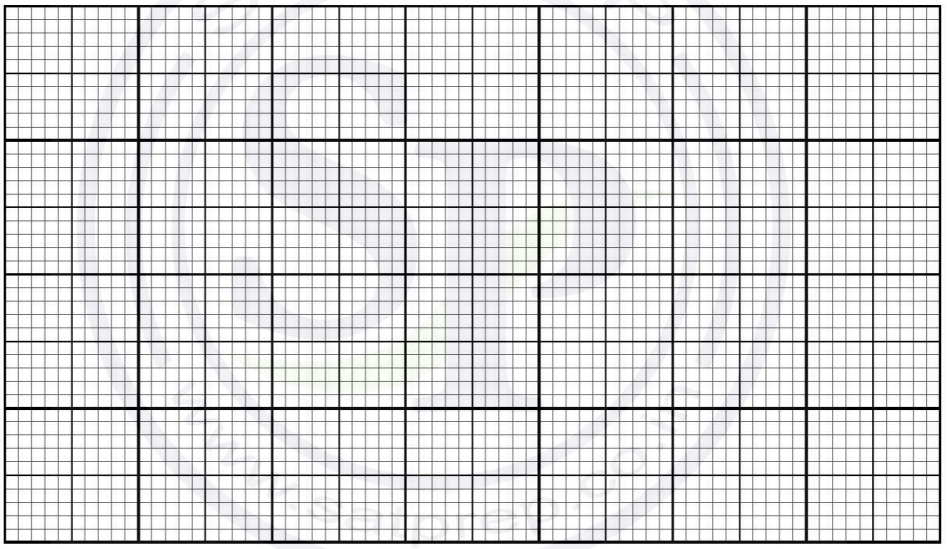
| Company $A$ | | | | | | | | Company $B$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | 4 | 1 | 1 | 0 | 25 | 4 | 4 | 5 | 6 | 6 | 7 | | |
| 9 | 9 | 8 | 7 | 2 | 1 | 0 | 26 | 0 | 1 | 3 | 5 | 5 | 7 | 9 | 9 |
| | 8 | 6 | 4 | 2 | 1 | 0 | 27 | 1 | 3 | 4 | 6 | 6 | 8 | 8 | |
| | | 6 | 5 | 4 | 2 | 0 | 28 | 0 | 1 | 2 | 2 | 2 | | | |
| | | | | 9 | 8 | 5 | 29 | | | | | | | | |
| | | | | | | 1 | 30 | 9 | | | | | | | |

Key: 1 $|$27$|$ 6 means \$2710 for company $A$ and \$2760 for company $B$

**(a)** Find the median and the interquartile range of the monthly salaries of employees in company $A$. [3]

The lower quartile, median and upper quartile for company $B$ are \$2600, \$2690 and \$2780 respectively.

**(b)** Draw two box-and-whisker plots in a single diagram to represent the information for the salaries of employees at companies $A$ and $B$. [3]



**(c)** Comment on whether the mean would be a more appropriate measure than the median for comparing the given information for the two companies. [1]

## Question 102

A summary of 50 values of $x$ gives

$$\Sigma(x - q) = 700, \qquad \Sigma(x - q)^2 = 14\,235,$$

where $q$ is a constant.

**(a)** Find the standard deviation of these values of $x$. [2]

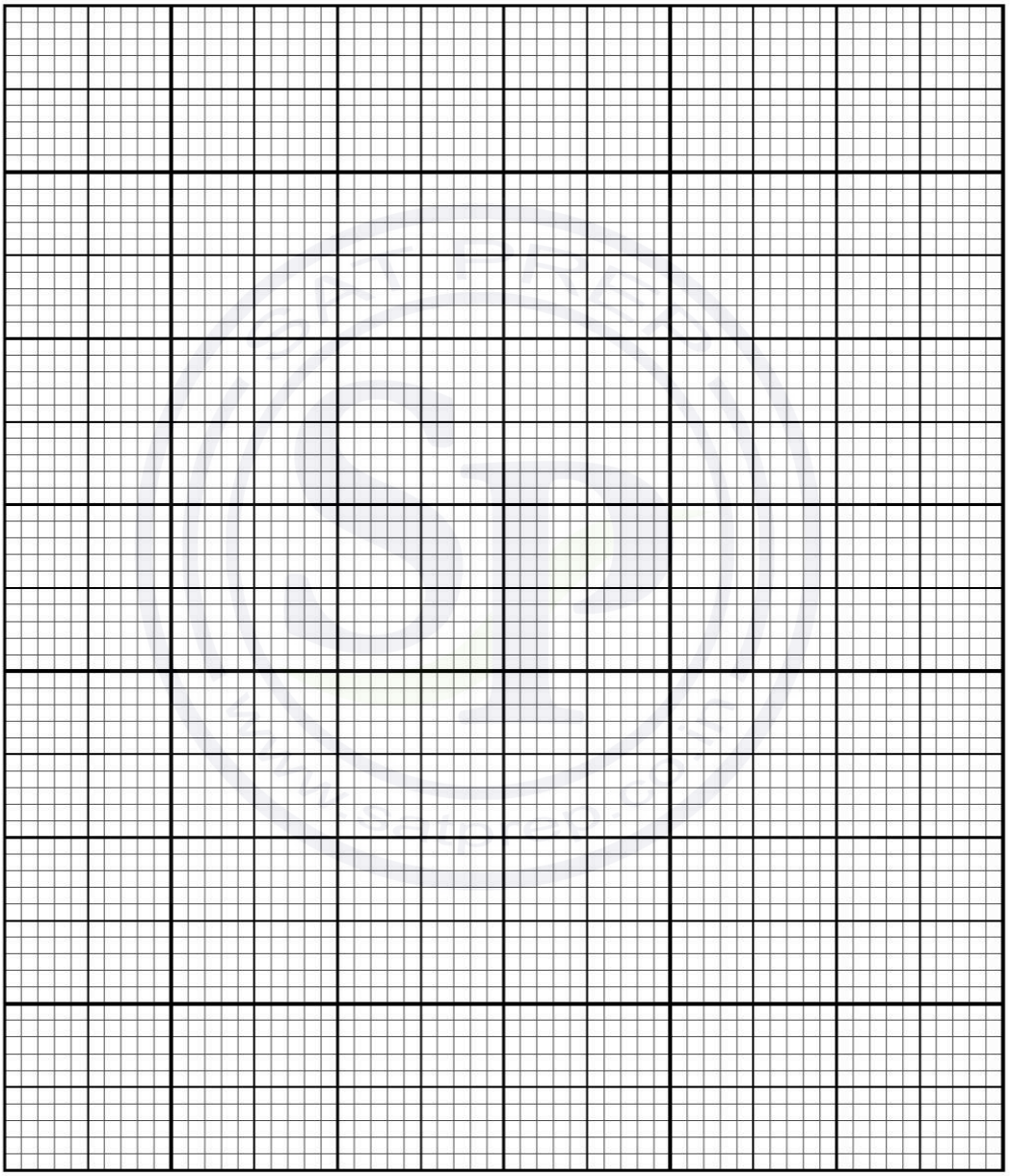
**(b)** Given that $\Sigma x = 2865$, find the value of $q$. [2]

## Question 103

The populations of 150 villages in the UK, to the nearest hundred, are summarised in the table.

| Population | 100 – 800 | 900 – 1200 | 1300 – 2000 | 2100 – 3200 | 3300 – 4800 |
|---|---|---|---|---|---|
| Number of villages | 8 | 12 | 50 | 48 | 32 |

**(a)** Draw a histogram to represent this information. [4]



**(b)** Write down the class interval which contains the median for this information. [1]

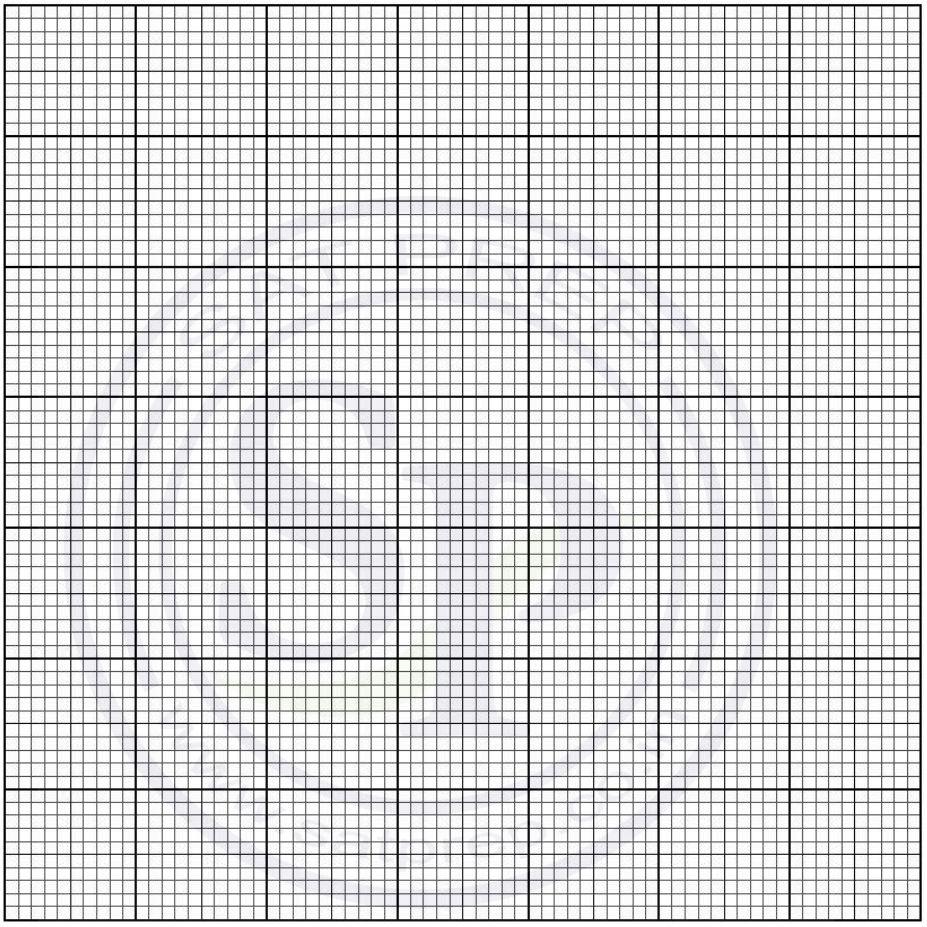
**(c)** Find the greatest possible value of the interquartile range for the populations of the 150 villages. [2]

## Question 104

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

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

**(a)** Draw a cumulative frequency graph to represent this information. [2]



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

Use your graph to estimate the value of $W$. [2]

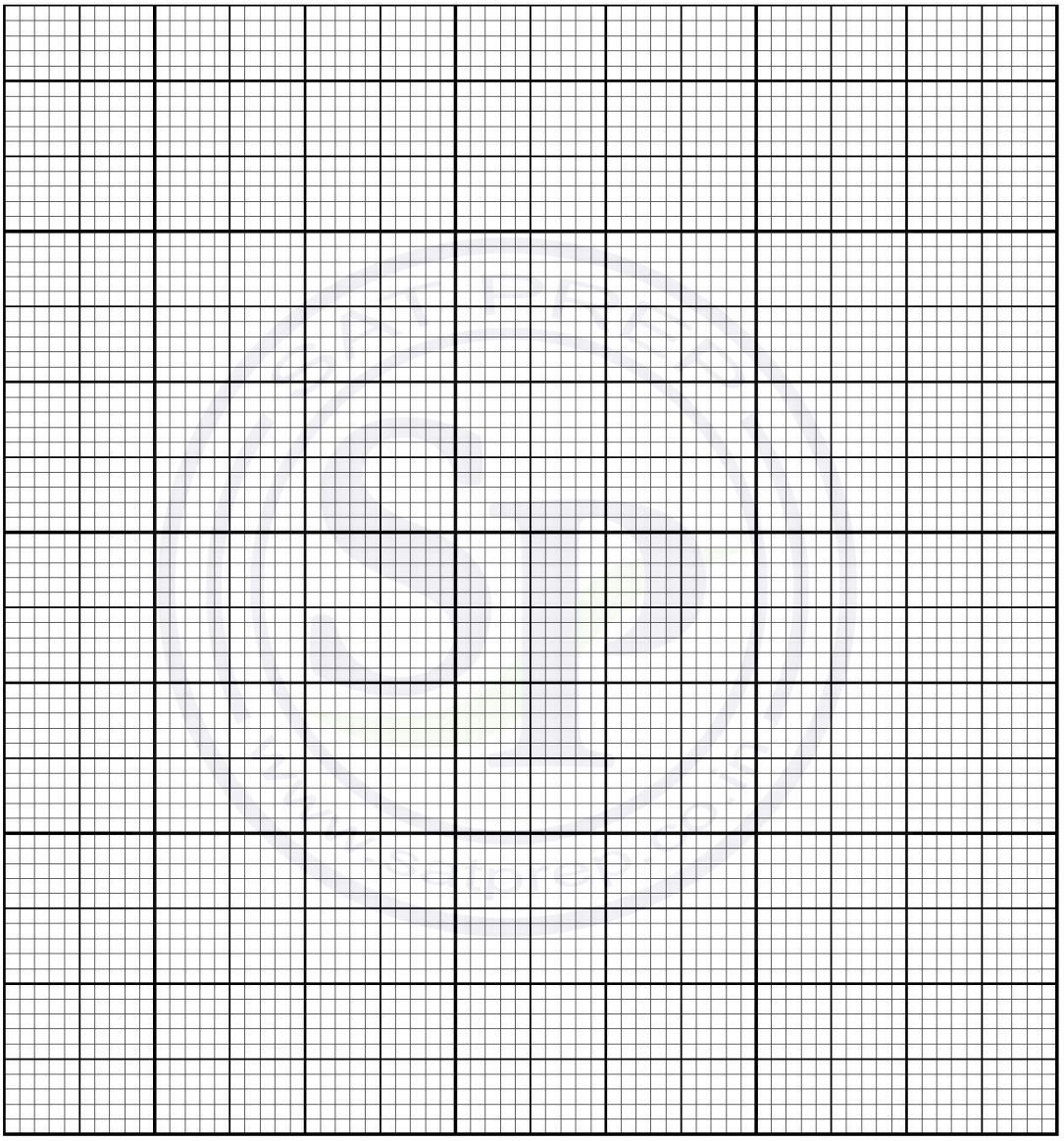
**(c)** Calculate estimates for the mean and standard deviation of the weights of the 120 students. [6]

## Question 105

The times, to the nearest minute, of 150 athletes taking part in a charity run are recorded. The results are summarised in the table.

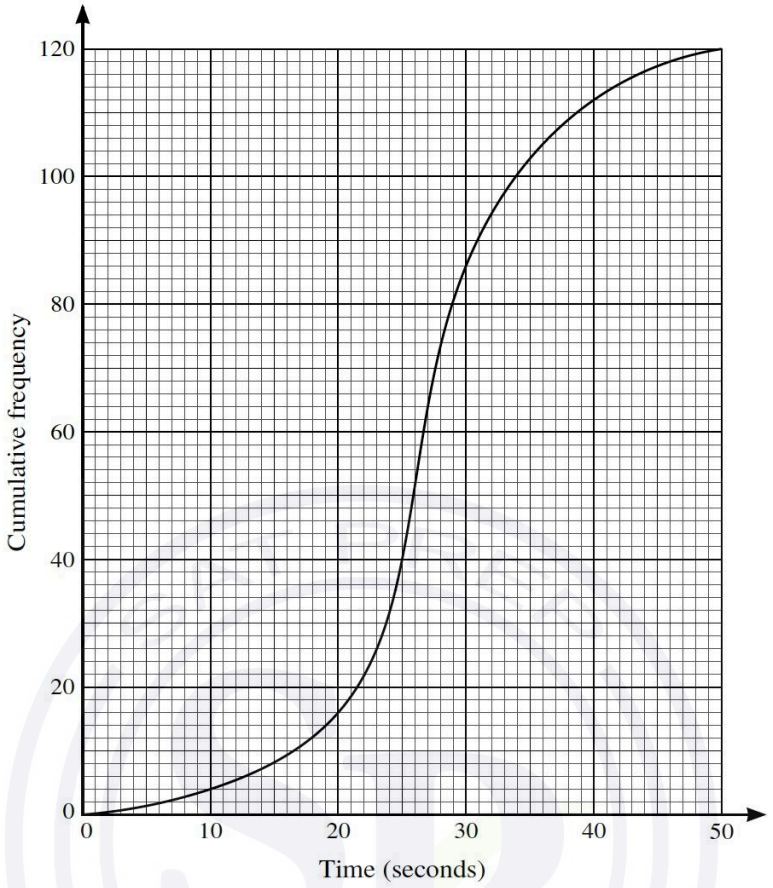
| Time in minutes | 101 – 120 | 121 – 130 | 131 – 135 | 136 – 145 | 146 – 160 |
|---|---|---|---|---|---|
| Frequency | 18 | 48 | 34 | 32 | 18 |

**(a)** Draw a histogram to represent this information. [4]



**(b)** Calculate estimates for the mean and standard deviation of the times taken by the athletes. [5]

Question 106




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]

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

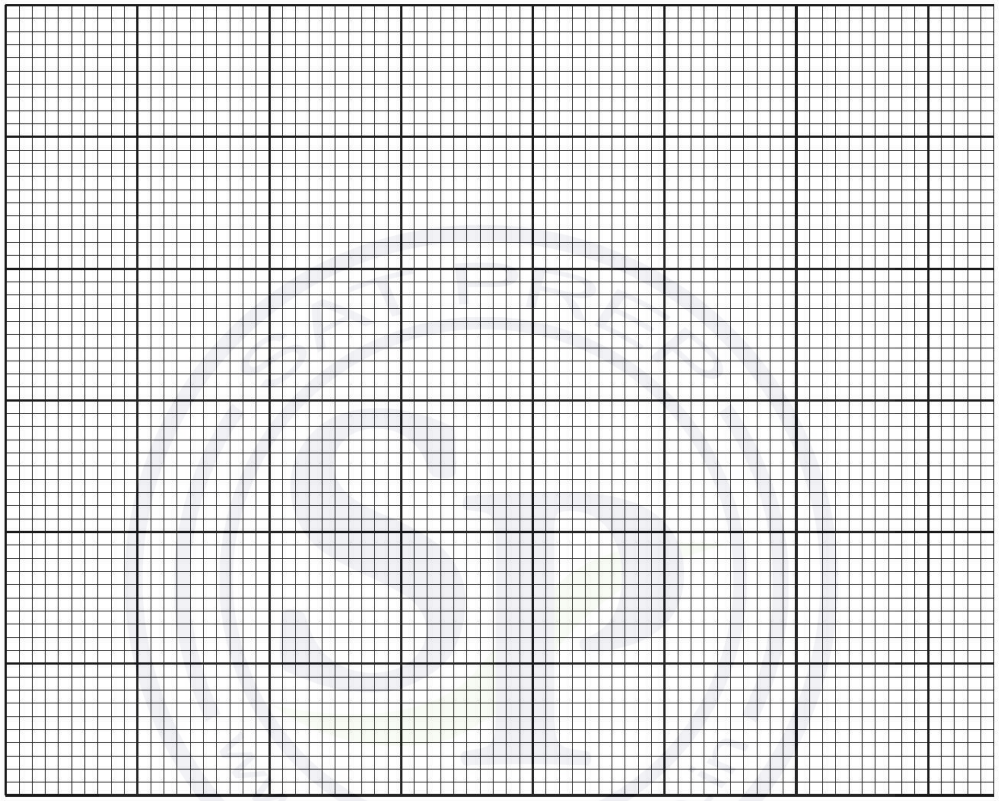
**(b)** Use the graph to estimate the value of $T$. [2]

## Question 107

The times taken, in minutes, by 150 students to complete a puzzle are summarised in the table.

| Time taken ($t$ minutes) | $0 \leqslant t < 20$ | $20 \leqslant t < 30$ | $30 \leqslant t < 35$ | $35 \leqslant t < 40$ | $40 \leqslant t < 50$ | $50 \leqslant t < 70$ |
|---|---|---|---|---|---|---|
| Frequency | 8 | 23 | 35 | 52 | 20 | 12 |

**(a)** Draw a histogram to represent this information. [4]



**(b)** Calculate an estimate for the mean time for these students to complete the puzzle. [3]

**(c)** In which class interval does the lower quartile of the times lie? [1]

## Question 108

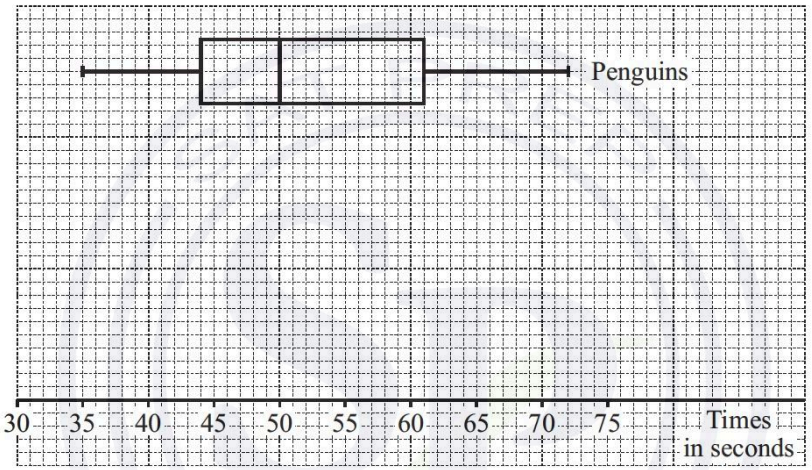
The times taken, in seconds, by 15 members of each of two swimming clubs, the Penguins and the Dolphins, to swim 50 metres are shown in the following table.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Penguins | 35 | 39 | 42 | 44 | 45 | 45 | 48 | 50 | 56 | 58 | 59 | 61 | 66 | 68 | 72 |
| Dolphins | 36 | 41 | 43 | 48 | 49 | 49 | 50 | 51 | 54 | 56 | 56 | 60 | 61 | 64 | 71 |

**(a)** Draw a back-to-back stem-and-leaf diagram to represent this information, with Penguins on the left-hand side. [4]

The diagram shows a box-and-whisker plot representing the times for the Penguins.

**(b)** On the same diagram, draw a box-and-whisker plot to represent the times for the Dolphins. [3]




**(c)** Hence state **one** difference between the distributions of the times for the Penguins and the Dolphins. [1]

## Question 109

The back-to-back stem-and-leaf diagram shows the annual salaries of 19 employees at each of two companies, Petral and Ravon.

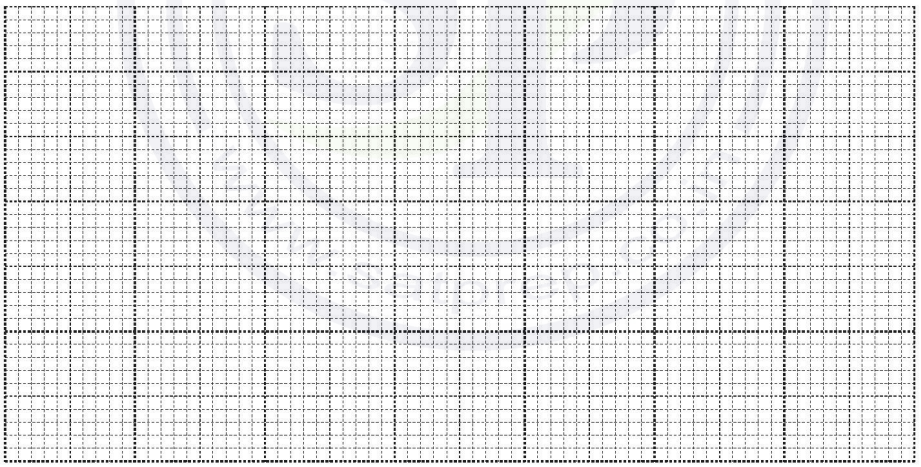
| Petral | | | | | | | Ravon | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 0 | 0 | 30 | 2 | 6 | | | |
| 9 | 9 | 8 | 2 | 2 | 1 | 31 | 1 | 5 | | | |
| | | 5 | 5 | 4 | 0 | 32 | 0 | 0 | 2 | | |
| | | | 7 | 5 | 3 | 33 | 0 | 4 | 8 | 9 | |
| | | | | 1 | 0 | 34 | 1 | 1 | 3 | 4 | 6 |
| | | | | | | 35 | 3 | | | | |
| | | | | | 8 | 36 | 7 | 9 | | | |

Key: 2 | 31 | 5 means \$31 200 for a Petral employee and \$31 500 for a Ravon employee.

**(a)** Find the median and the interquartile range of the salaries of the Petral employees. [3]

The median salary of the Ravon employees is \$33 800, the lower quartile is \$32 000 and the upper quartile is \$34 400.

**(b)** Represent the data shown in the back-to-back stem-and-leaf diagram by a pair of box-and-whisker plots in a single diagram. [3]



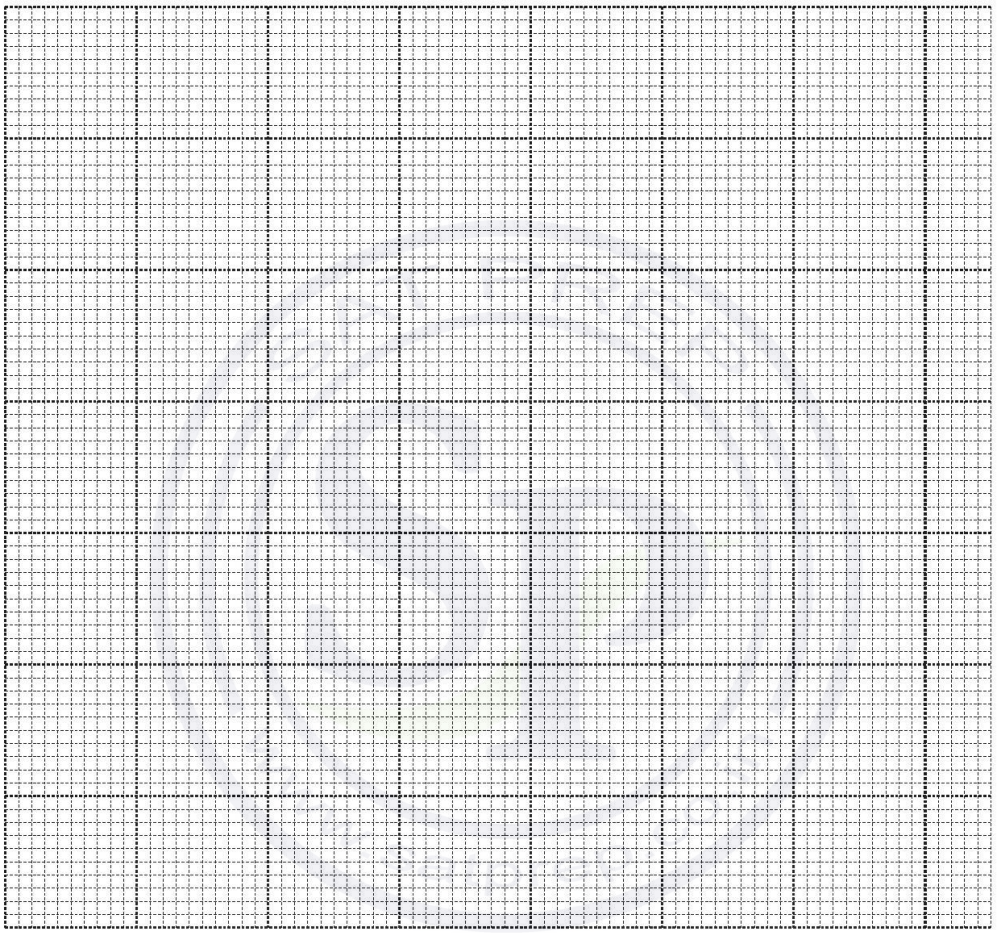
**(c)** Comment on whether the mean or the median would be a better representation of the data for the employees at Petral. [1]

## Question 110

**3** The heights, in cm, of 200 adults in Barimba are summarised in the following table.

| Height ($h$ cm) | $130 \leqslant h < 150$ | $150 \leqslant h < 160$ | $160 \leqslant h < 170$ | $170 \leqslant h < 175$ | $175 \leqslant h < 195$ |
|---|---|---|---|---|---|
| Frequency | 16 | 32 | 76 | 64 | 12 |

**(a)** Draw a histogram to represent this information. [4]



**(b)** The interquartile range is $R$ cm. Show that $R$ is **not** greater than 15. [2]

## Question 111

A summary of 20 values of $x$ gives

$$\Sigma(x-30) = 439, \qquad \Sigma(x-30)^2 = 12\,405.$$

A summary of another 25 values of $x$ gives

$$\Sigma(x-30) = 470, \qquad \Sigma(x-30)^2 = 11\,346.$$

**(a)** Find the mean of all 45 values of $x$. [2]

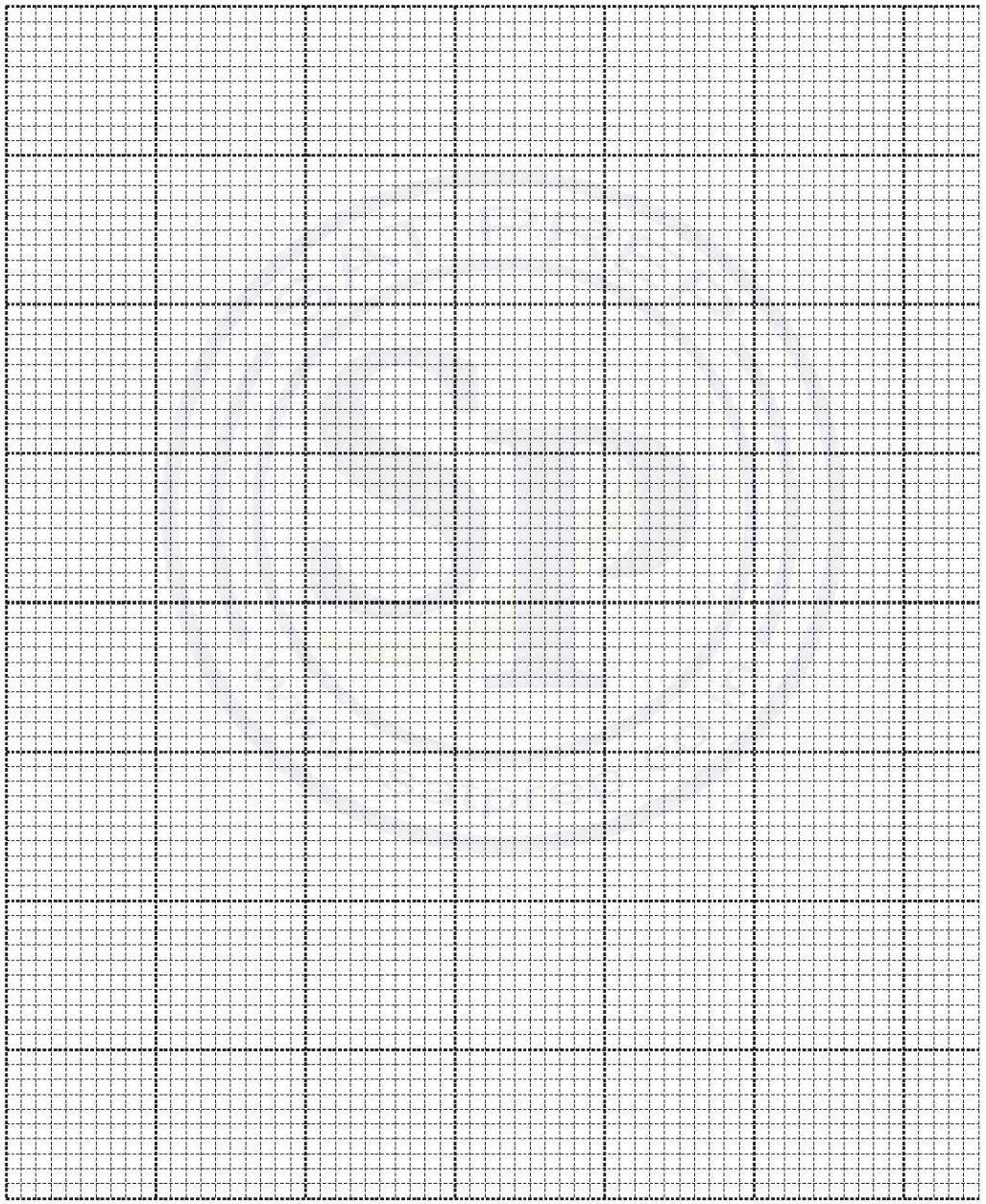
**(b)** Find the standard deviation of all 45 values of $x$. [2]

## Question 112

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]



**(b)** Use your graph to estimate the 30th percentile of the heights of the sunflower plants. [2]

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

## Question 113

Teams of 15 runners took part in a charity run last Saturday. The times taken, in minutes, to complete the course by the runners from the Falcons and the runners from the Kites are shown in the table.

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Falcons | 38 | 39 | 42 | 44 | 46 | 48 | 50 | 51 | 52 | 56 | 58 | 59 | 64 | 69 | 76 |
| Kites | 32 | 40 | 40 | 45 | 47 | 48 | 52 | 54 | 58 | 59 | 59 | 60 | 61 | 63 | 65 |

**(a)** Draw a back-to-back stem-and-leaf diagram to represent this information, with the Falcons on the left-hand side. [4]

**(b)** Find the median and the interquartile range of the times for the Falcons. [3]

Let $x$ and $y$ denote the times, in minutes, of a runner from the Falcons and a runner from the Kites respectively.

It is given that

$$\Sigma x = 792, \qquad \Sigma x^2 = 43\,504, \qquad \Sigma y = 783, \qquad \Sigma y^2 = 42\,223.$$

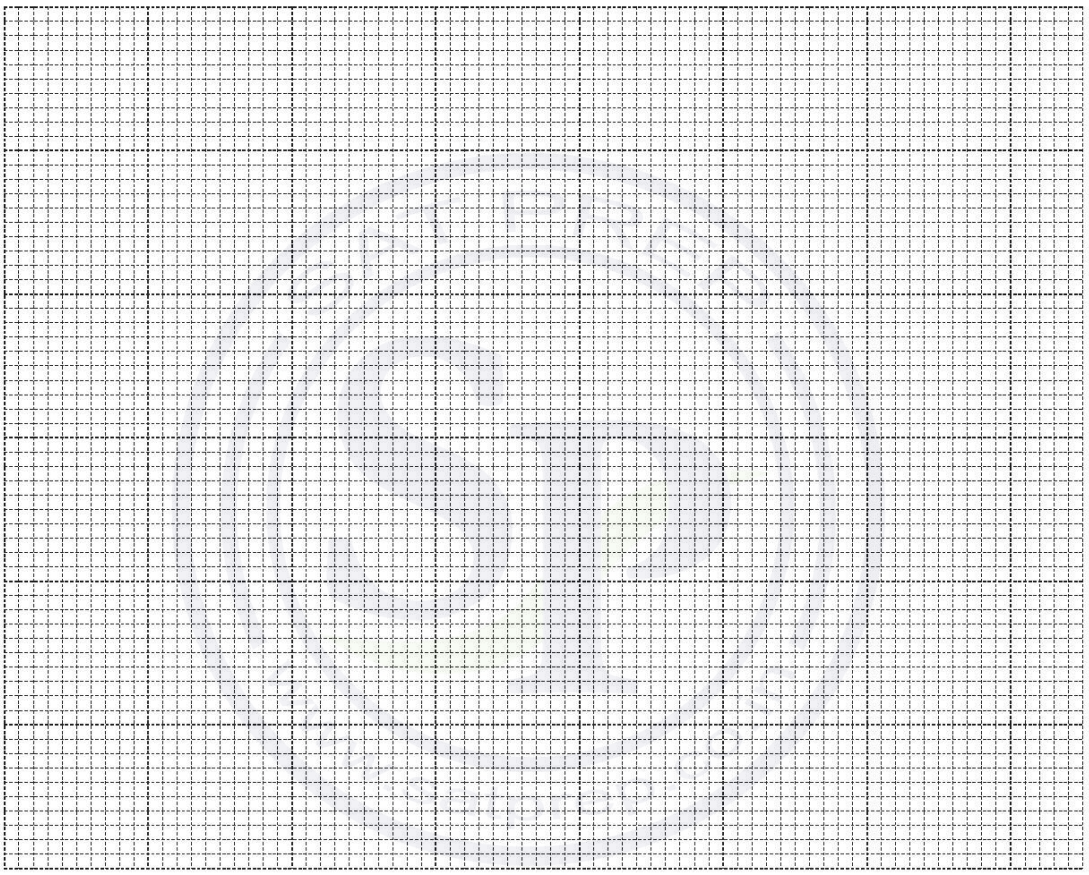
**(c)** Find the mean and the standard deviation of the times taken by all 30 runners from the two teams. [3]

## Question 114

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) | $t \leqslant 15$ | $t \leqslant 25$ | $t \leqslant 30$ | $t \leqslant 40$ | $t \leqslant 50$ | $t \leqslant 70$ |
|---|---|---|---|---|---|---|
| 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]

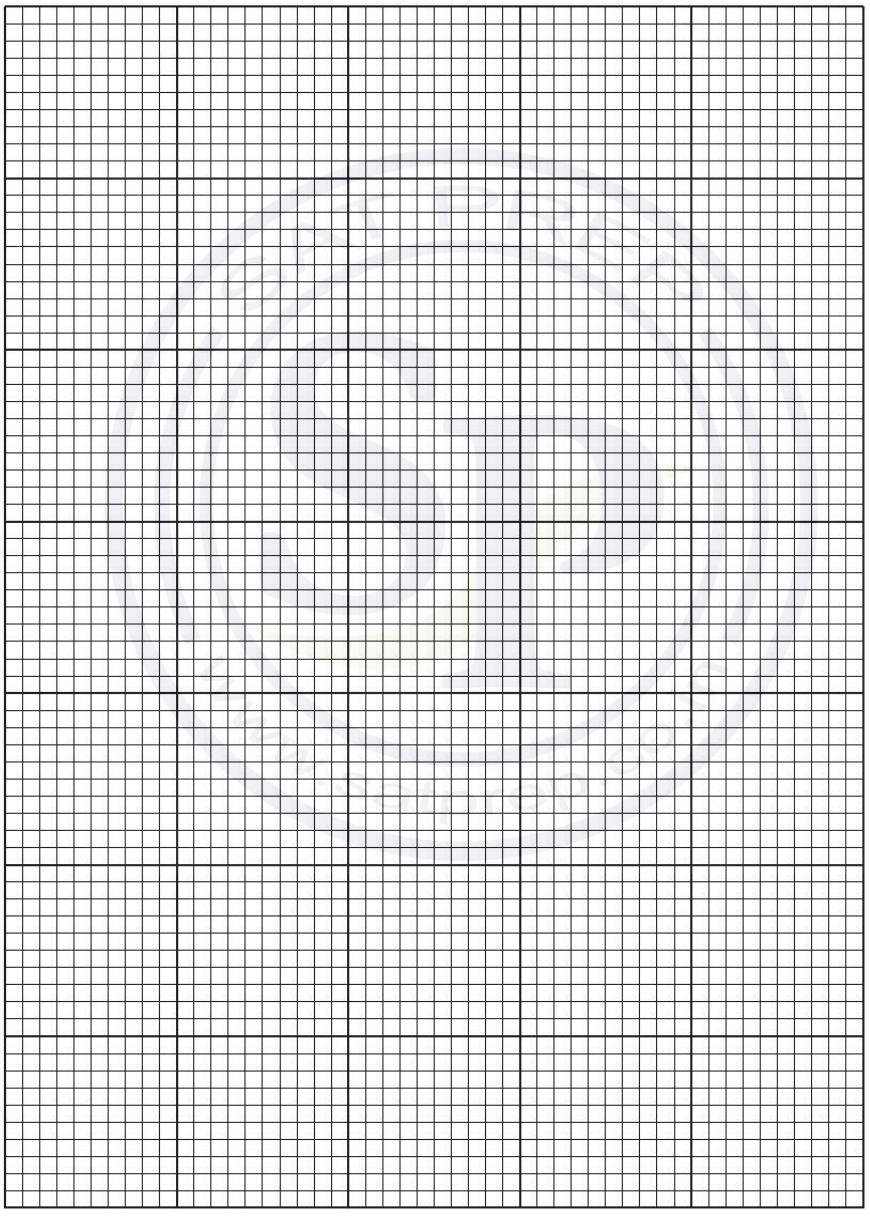
**(c)** Calculate an estimate for the mean value of the times taken by the 200 pupils to walk to school. [3]

## Question 115

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.

| Length (cm) | 5 – 9 | 10 – 14 | 15 – 19 | 20 – 24 | 25 – 29 | 30 – 39 |
|---|---|---|---|---|---|---|
| Frequency | 18 | 28 | 60 | 72 | 48 | 24 |

**(a)** On the grid below, draw a cumulative frequency graph to illustrate this information. [4]



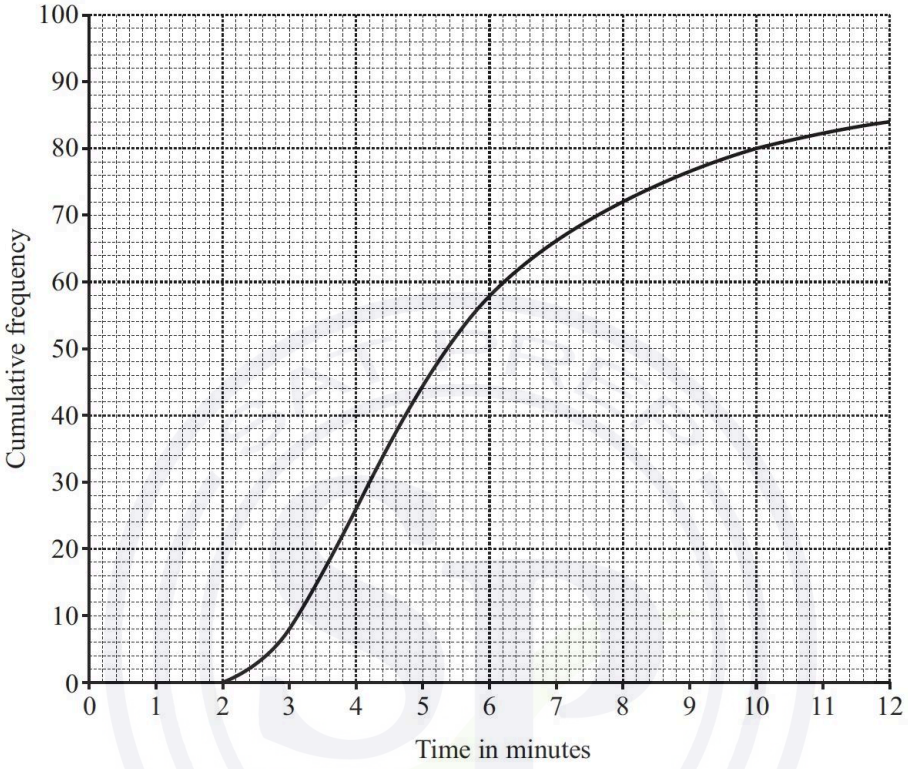
**(b)** 38% of these leaves are of length $k$ cm or more.

Use your graph to find an estimate for $k$. [2]

**(c)** Calculate an estimate for the mean length of these 250 leaves. [3]

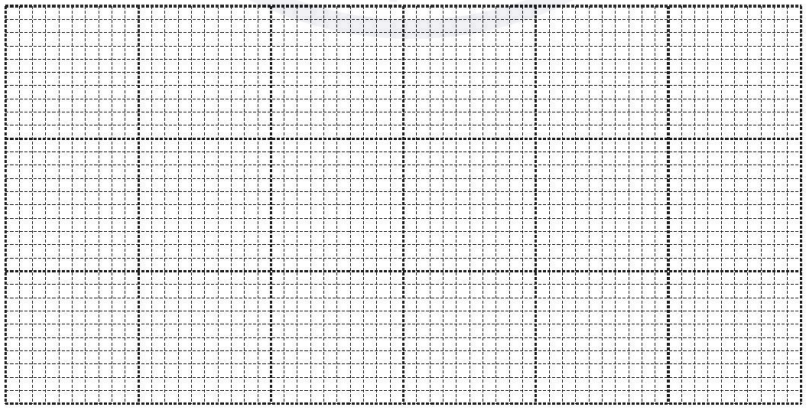
## Question 116

84 people attempt a particular puzzle. The times taken, in minutes, to complete the puzzle are recorded. These times are represented in the cumulative frequency graph below.




**(a)** Use the graph to estimate how many people took between 4 and 7.5 minutes to complete the puzzle. [1]

**(b)** On the grid below, draw a box-and-whisker plot to summarise the information in the cumulative frequency graph. [4]



## Question 117

For a set of 40 values of $x$, it is found that

$$\Sigma(x-k) = 836.0, \qquad \Sigma(x-k)^2 = 25410.8,$$

where $k$ is a constant.

**(a)** Given that the mean of these 40 values is 124.0, find the value of $k$. [2]

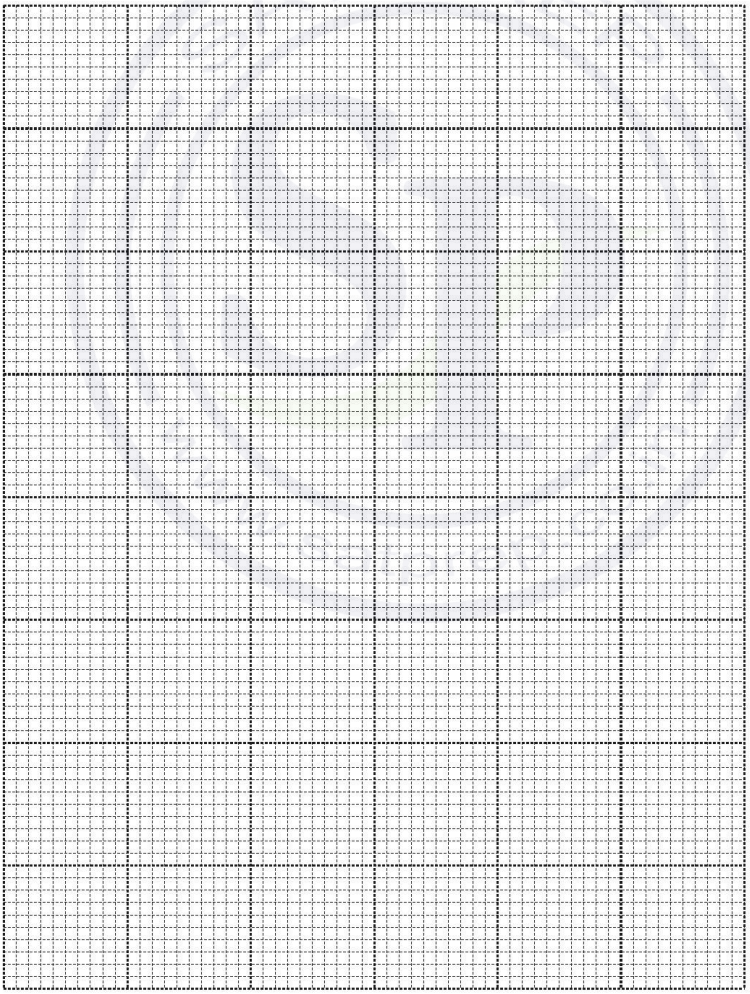
**(b)** Find the standard deviation of these 40 values of $x$. [2]

## Question 118

The times taken, $t$ minutes, by 300 students to travel to Hollowton College are recorded. The results are summarised in the table below.

| Time ($t$ minutes) | $t \leqslant 10$ | $t \leqslant 20$ | $t \leqslant 30$ | $t \leqslant 40$ | $t \leqslant 60$ | $t \leqslant 90$ |
|---|---|---|---|---|---|---|
| Cumulative frequency | 34 | 86 | 142 | 208 | 265 | 300 |

**(a)** On the grid, draw a cumulative frequency graph to illustrate this information. [2]



**(b)** 120 students take more than $k$ minutes to travel to college. Use your graph to estimate the value of $k$. [2]

**(c)** Calculate estimates of the mean and standard deviation of the times taken to travel to college by the 300 students. [6]

## Question 119

Last Sunday, teams of runners took part in a charity event. The time taken, in seconds, to run 50 m was recorded, correct to 1 decimal place, for each runner. The times recorded for 11 runners from each of the Gulls and the Herons are shown in the table.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gulls | 7.9 | 8.2 | 8.3 | 8.6 | 8.6 | 8.8 | 9.2 | 9.7 | 9.8 | 10.0 | 10.4 |
| Herons | 9.5 | 9.9 | 8.5 | 8.1 | 9.2 | 10.8 | 8.3 | 9.7 | 9.3 | 9.9 | 8.7 |

**(a)** Draw a back-to-back stem-and-leaf diagram to represent this information, with Gulls on the left-hand side. [4]

**(b)** Find the median and the interquartile range of the times of the runners from the Gulls. [3]

Two other teams of runners, the Eagles and the Swifts, also took part in the event. The recorded times in seconds for 20 runners from the Eagles and 30 runners from the Swifts are denoted by $x$ and $y$ respectively.

It is given that $\Sigma x = 175.0$ and that the mean of $y$ is 8.4.

**(c)** Find the mean of the times taken by all 50 runners. [2]

It is given that $\Sigma x^2 = 1823.0$.

It is also known that the standard deviation of the times taken by all 50 runners is 1.38 seconds.

**(d)** Find the value of $\Sigma y^2$, correct to 1 decimal place. [3]