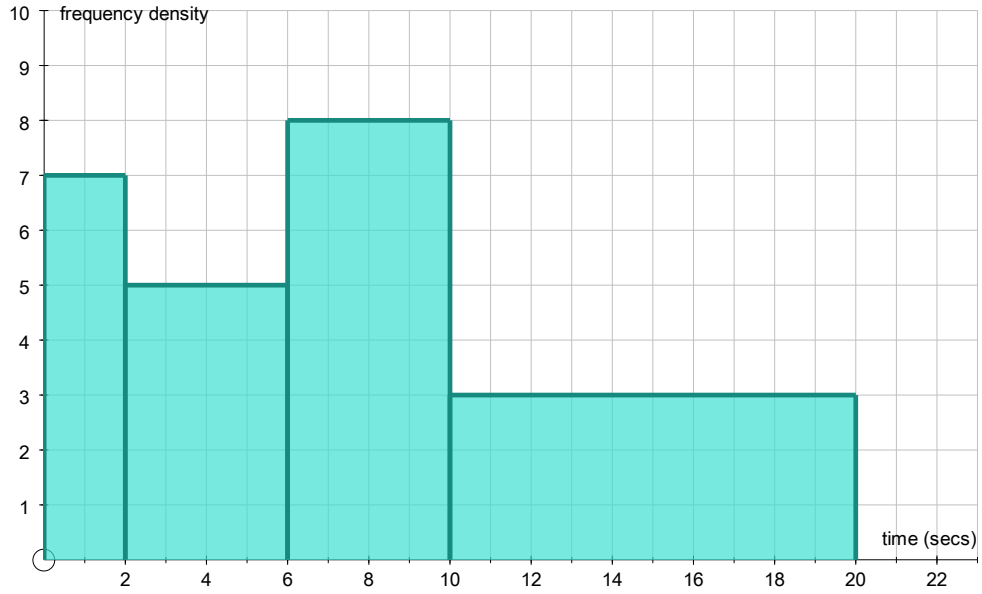
Section 2: Data presentation and interpretation

Section test

1. The times taken by a number of students to answer a mental arithmetic problem correctly were recorded and the following histogram produced:



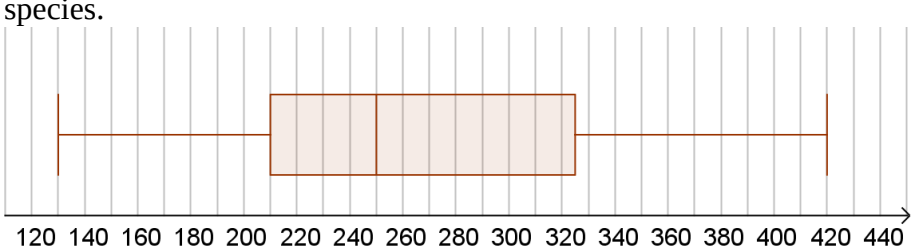
How many students were there?
Estimate the mean time taken to answer the problem.

2. The data below shows the ages of the people at a club meeting.

59 89 38 58 68 62 56 66 83 45 58 77 67 65 54

What is the median?
What is the interquartile range?
Outliers are defined as data points that are more than 1.5 × interquartile range below the lower quartile or above the upper quartile. Using this definition, how many outliers are there?

3. The box-and-whisker plot below shows the heights, in mm, of plants of a particular species.



Which of the following statements are true?

(a) The interquartile range is 115 mm.
(b) Half the plants have height above 250 mm.
(c) There are more plants with heights between 250 mm and 325 mm than between 210 mm and 250 mm.
(d) There are twice as many plants with heights between 130 mm and 210 mm as between 210 mm and 250 mm.

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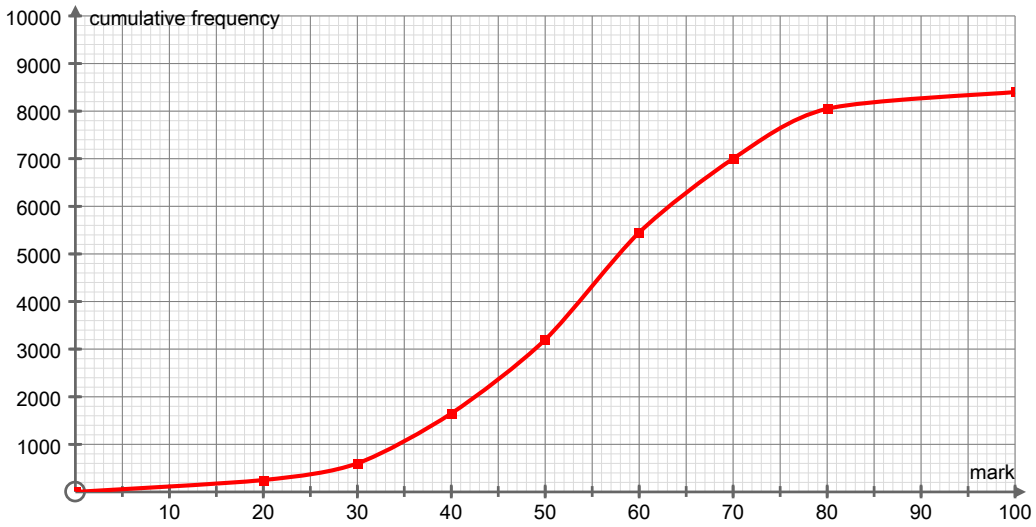
4. In an examination, the marks which 8400 candidates obtained are shown in the cumulative frequency diagram below:



What is the approximate median mark?
What is the approximate interquartile range?
If the pass mark is 38, approximately what percentage of the candidates pass? (Give your answer to the nearest whole number).

5. In a test the mean mark for the 15 boys was 47.6 and the standard deviation was 11.2. The mean mark for the 10 girls was 49.1 and the standard deviation was 15.4.
Find the mean mark and the standard deviation of the marks for the 25 pupils in the class.

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Solutions to section test

1. Frequency = frequency density × class width

Time (sec)	$0 \le t < 2$	$2 \le t < 6$	$6 \le t < 10$	$10 \le t \le 20$
Class width	2	4	4	10
Frequency density (number/sec)	7	5	8	3
Frequency	14	20	32	30

The total number of students = 14 + 20 + 32 + 30 = 96.

Using mid-interval values:

$$\text{Mean} = \frac{(1 \times 14) + (4 \times 20) + (8 \times 32) + (15 \times 30)}{96}$$

$$= 8.33$$

2. In order:

38 45 54 56 58 58 59 (62) 65 66 67 68 77 83 89

There are 15 data items, so the median is the 15th item, which is 62.

Discarding the median value, the upper half of the data is

65 66 67 (68) 77 83 89

The upper quartile is the median of this set of data, which is 68.

Discarding the median value, the lower half of the data is

38 45 54 (56) 58 58 59

The lower quartile is the median of this set of data, which is 56.
Interquartile range = 68 – 56 = 12.

Outliers are 1.5 × the interquartile range above the upper quartile or below the lower quartile.
In this case outliers are above 68 + 18 = 86, or below 56 – 18 = 38.
The only outlier is 89.

3. The interquartile range = 325 – 210 = 115, so this is true.
The median is 250 mm, so it is true that half the plants have heights above the median.
25% of the plants are between the median and the upper quartile and 25% are between the lower quartile and the median; this is how quartiles are defined. So this statement is false.

25% of the plants are between the minimum and the lower quartile and 25% are between the lower quartile and the median; again this is how quartiles and the median are defined. So this statement is false.

4. The median mark is 54 - 55
The lower quartile is 43 – 44
The upper quartile is 65 – 66
The interquartile range is 21 - 23.

A mark of 38 corresponds to a cumulative frequency of about 1400, meaning that about 1400 candidates scored less than 38. Therefore about 7000 candidates passed.

The percentage who passed is $\frac{7000}{8400} \times 100 = 83\%$

5. $\sum x$ for boys $= 47.6 \times 15 = 714$

$\sum x$ for girls $= 49.1 \times 10 = 491$

$\sum x$ for whole class $= 714 + 491 = 1205$

Mean for whole class of 25 students $= \frac{1205}{25} = 48.2$

Standard deviation $= \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n}}$

For boys, standard deviation $= 11.2$

so $11.2 = \sqrt{\frac{\sum x^2 - 15 \times 47.6^2}{15}}$

$\sum x^2 = 35868$

For girls, standard deviation $= 15.4$

so $15.4 = \sqrt{\frac{\sum x^2 - 10 \times 49.1^2}{10}}$

$\sum x^2 = 26479.7$

For whole class, $\sum x^2 = 62347.7$

$$sd = \sqrt{\frac{62347.7 - 25 \times 48.2^2}{25}} = 13.1$$