

Box Plots

Solutions

For AQA GCSE Mathematics (8300) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

Here are 15 test scores in order.

12 15 17 19 20 22 25 27 29 30 33 36 38 41 45

(a) Work out the median.

There are 15 values, already in order.

The median is the middle value: $(15 + 1) \div 2 = 8\text{th value}$.

The 8th value is 27.

Answer: 27

(b) Work out the interquartile range.

Lower quartile: the $\frac{1}{4}(15 + 1) = 4\text{th value}$, which is 19.

Upper quartile: the $\frac{3}{4}(15 + 1) = 12\text{th value}$, which is 36.

Interquartile range = $UQ - LQ = 36 - 19 = 17$

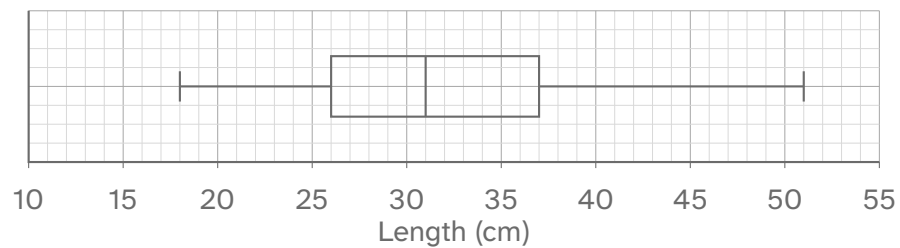
Answer: 17

Tip: The interquartile range is $UQ - LQ$. Do not work out the range $(45 - 12)$ by mistake.

Marks: 1 mark for 19 and 36. 1 mark for 17.

2 (3 marks)

The box plot shows information about the lengths of some fish caught in a river.



- (a) Circle the median value.

Options: 26, 31, 34.5, 37

The median is the line inside the box.

It is at 31 cm.

Answer: 31

Tip: 34.5 is halfway between the ends of the whiskers. The median is the line **inside** the box, which need not be in the middle.

- (b) Work out the interquartile range.

The box goes from the lower quartile (26) to the upper quartile (37).

$$\text{IQR} = 37 - 26 = 11 \text{ cm}$$

Answer: 11 cm

- (c) Work out the range.

The whiskers go from the shortest length (18) to the longest length (51).

$$\text{Range} = 51 - 18 = 33 \text{ cm}$$

Answer: 33 cm

3 (1 mark)

A box plot has a lower quartile of 40 and an interquartile range of 25
Work out the upper quartile.

$IQR = UQ - LQ$, so $UQ = LQ + IQR$.

$$UQ = 40 + 25 = 65$$

Answer: 65

4 (2 marks)

Some students each did a puzzle. Here is some information about the times they took.
The shortest time was 12 minutes and the longest was 40 minutes.

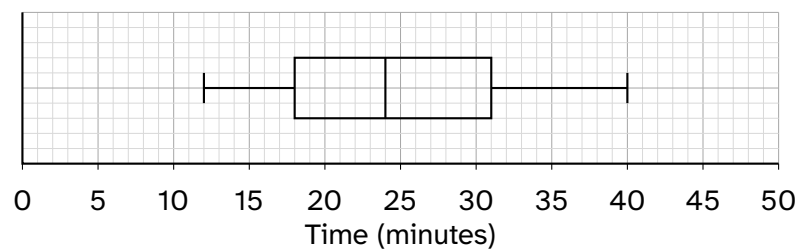
The median was 24 minutes. The lower quartile was 18 minutes and the upper quartile was 31 minutes.

Draw a box plot to show this information.

Draw the box from the lower quartile (18) to the upper quartile (31).

Draw a line across the box at the median (24).

Draw whiskers out to the shortest time (12) and the longest time (40).

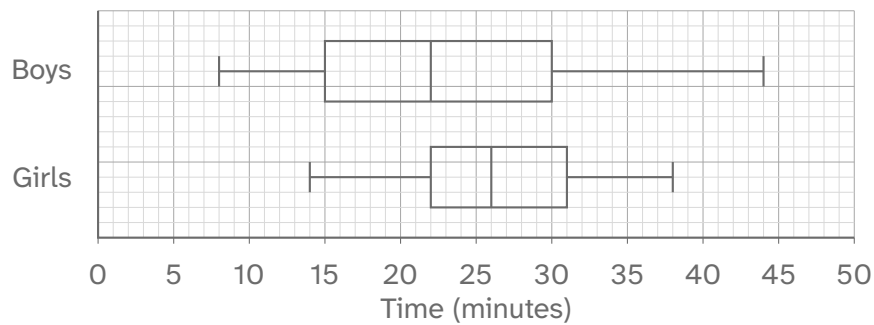


Answer: See box plot

Marks: 2 marks for a fully correct box plot. 1 mark if three of the five values are plotted correctly.

5 (3 marks)

The box plots show the times some boys and girls spent on homework.



- (a) Work out the interquartile range for the boys.

For the boys, LQ = 15 and UQ = 30.

$$\text{IQR} = 30 - 15 = 15 \text{ minutes}$$

Answer: 15

- (b) Compare the times of the boys and the girls.

Median: girls 26 minutes, boys 22 minutes.

So on average, the girls spent longer on homework.

IQR: girls $31 - 22 = 9$ minutes, boys 15 minutes.

The girls' IQR is smaller, so their times were more consistent.

Answer: Girls longer on average; girls more consistent

Tip: Compare the medians for the average, not the highest values or the size of the boxes. A **smaller** IQR means **more** consistent.

Marks: 1 mark for comparing the medians in context. 1 mark for comparing the IQRs (or ranges) in context.

6 (1 mark)

Two machines, *A* and *B*, fill bags of rice.
50 bags filled by each machine are weighed.
The table shows information about the masses, in grams.

	Median	Interquartile range	Range
Machine <i>A</i>	502	6	15
Machine <i>B</i>	499	4	20

Using this data, which statement **must** be true?

Tick **one** box.

The median for machine *A* (502 g) is greater than for machine *B* (499 g), so on average the bags from machine *A* were heavier.

The IQR for machine *A* (6 g) is bigger than for machine *B* (4 g), so machine *A* was **less** consistent.

The range only tells us the difference between the heaviest and lightest bags.

It does not tell us which machine filled the actual heaviest or lightest bag.

Answer: On average, the bags from machine *A* were heavier

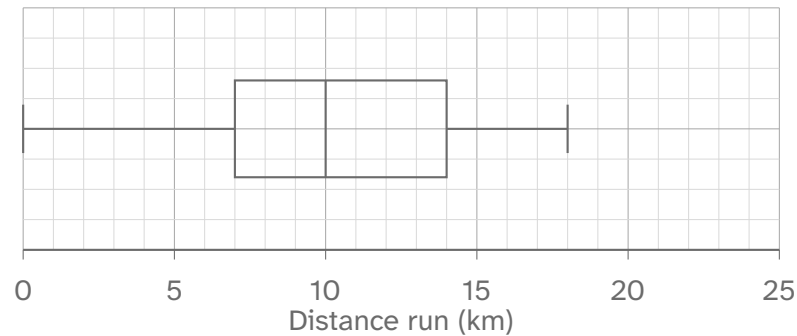
Tip: A bigger range does not mean that machine filled the heaviest bag. The range is a difference, not a value.

7 (2 marks)

Here is some information about the distances members of a running club ran one Sunday.

Shortest distance	3 km
Lower quartile	7 km
Median	10 km
Upper quartile	14 km
Range	18 km

Priya draws this box plot to show the information.



Make **two** criticisms of her box plot.

Check each value against the table. The box (7 to 14) and the median (10) are correct.

1. The lower whisker starts at 0 km. It should start at the shortest distance, 3 km.
2. The upper whisker ends at 18 km, which is the range. The longest distance is $3 + 18 = 21$ km, so it should end at 21 km.

Answer: Lower whisker should start at 3 (not 0); upper whisker should end at 21 (not 18)

Tip: The range is not the highest value. Highest value = lowest value + range.

Marks: 1 mark for each correct criticism.

8 (6 marks)

Lena travels to work by bus or by train. She records her bus journey time, in minutes, on 15 days.

31 25 38 29 22 34 31 27 41 30 36 24 47 28 33

The box plot shows information about her train journey times.

- (a) On the grid, draw a box plot for Lena's bus journey times.

First put the 15 times in order:

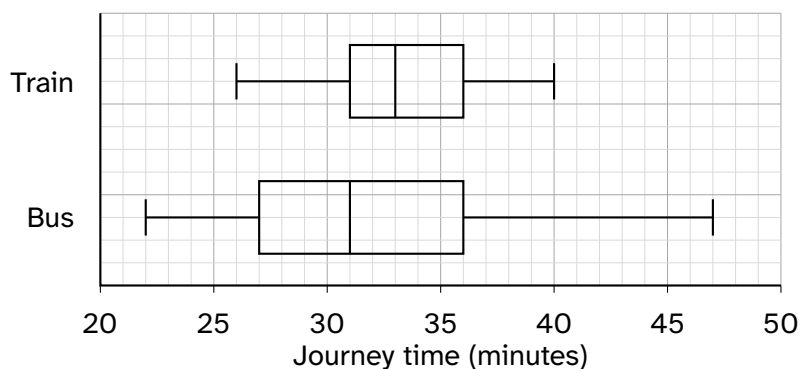
22, 24, 25, **27**, 28, 29, 30, **31**, 31, 33, 34, **36**, 38, 41, 47

Median: the $(15 + 1) \div 2 = 8\text{th}$ value = 31

Lower quartile: the 4th value = 27

Upper quartile: the 12th value = 36

Shortest = 22, longest = 47



Answer: 22, 27, 31, 36, 47

Tip: Order the data first. With 15 values, the quartiles are the 4th and 12th values.

Marks: 1 mark for the median 31. 1 mark for the LQ 27 and UQ 36. 1 mark for the box. 1 mark for whiskers to 22 and 47.

- (b) Lena says,
‘On average, my bus journey is quicker than the train journey.
But the train journey times are more consistent.’

Is Lena correct?

Use statistical measures to support your answer.

Compare the medians: bus 31 minutes, train 33 minutes.

The bus has the lower median, so on average the bus is quicker.

Compare the interquartile ranges: bus $36 - 27 = 9$ minutes, train $36 - 31 = 5$ minutes.

The train has the smaller IQR, so the train times are more consistent.

So Lena is correct.

Answer: Yes: bus median $31 < \text{train } 33$; train IQR $5 < \text{bus IQR } 9$

Tip: Use the median for “on average” and the IQR for “consistent”. A smaller IQR means more consistent.

Marks: 1 mark for comparing the medians (31 and 33). 1 mark for comparing the IQRs (9 and 5) and concluding that Lena is correct.

9 (4 marks)

Eggs from two farms, P and Q , are weighed.
The box plot for farm P is shown on the grid.

For farm Q ,

- the lightest egg was 4 grams heavier than the lightest egg from farm P
- the median was equal to the upper quartile for farm P
- the lower quartile was 60 grams
- the interquartile range was half of the interquartile range for farm P
- the range was 20 grams.

Draw the box plot for farm Q on the grid.

Read farm P from its box plot: lowest 48, LQ 53, median 58, UQ 63, highest 70.

Farm Q lightest = $48 + 4 = 52$ g

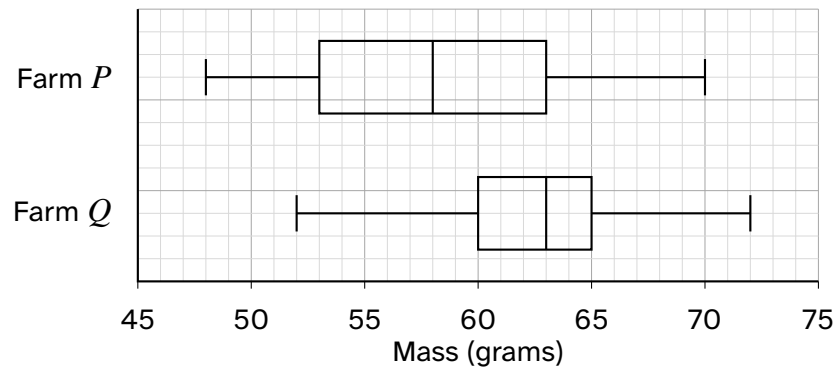
Farm Q median = farm P upper quartile = 63 g

Farm P IQR = $63 - 53 = 10$ g, so farm Q IQR = $10 \div 2 = 5$ g

Farm Q UQ = LQ + IQR = $60 + 5 = 65$ g

Farm Q heaviest = $52 + 20 = 72$ g

Draw the box from 60 to 65, the median at 63, and whiskers to 52 and 72.



Answer: 52, 60, 63, 65, 72

Tip: The heaviest egg is lightest + range = $52 + 20$, not 20. And “half of” farm P ’s IQR means $10 \div 2$.

Marks: 1 mark for the median 63 and lightest 52. 1 mark for IQR 5 or UQ 65. 1 mark for a correct box. 1 mark for the heaviest 72 with correct whiskers.

10 (2 marks)

Jodie writes seven whole numbers in order of size, smallest first.
She covers up four of them: the two quartiles, the median and the largest number.

5 10 17

- lower quartile + upper quartile = 28
- interquartile range = 12
- median = lower quartile + 5
- range = 20

Work out the four covered numbers.

Write them in the boxes.

With 7 values, the LQ is the 2nd value, the median the 4th and the UQ the 6th.

Let the quartiles be L and U .

$$L + U = 28 \text{ and } U - L = 12$$

$$\text{Adding: } 2U = 40, \text{ so } U = 20 \text{ and } L = 8$$

$$\text{Median} = 8 + 5 = 13$$

$$\text{Highest value} = \text{lowest} + \text{range} = 5 + 20 = 25$$

Check the order: 5, 8, 10, 13, 17, 20, 25 ✓

Answer: 5, 8, 10, 13, 17, 20, 25

Tip: The range is highest – lowest, so the highest value is 5 + 20, not 20.

Marks: 1 mark for the lower quartile 8 and upper quartile 20. 1 mark for all four values 8, 13, 20, 25 in the right places.
