Basic stats *[32 marks]*

A college runs a mathematics course in the morning. Scores for a test from this class are shown below.

$25 \quad 33 \quad 51 \quad 62 \quad 63 \quad 63 \quad 70 \quad 74 \quad 79 \quad 79 \quad 81 \quad 88 \quad 90 \quad 90 \quad 98$

For these data, the lower quartile is 62 and the upper quartile is 88.

1a. Show that the test score of 25 would not be considered an outlier. *[3 marks]*

Markscheme

$(88-62)\times 1.5$ **OR** 26×1.5 seen anywhere **OR** 39 seen anywhere ***(M1)***

$62-39$

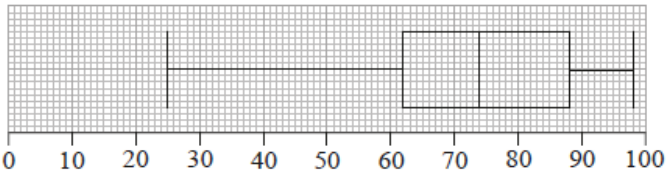
23 ***A1***

$25>23$ ***R1***

so is not an outlier ***AG***

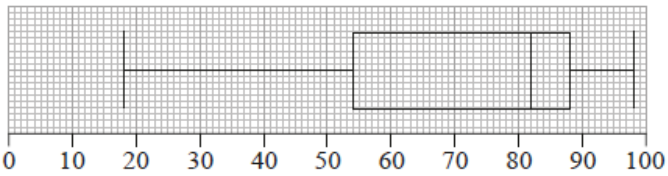
[3 marks]

The box and whisker diagram showing these scores is given below.



Test scores

Another mathematics class is run by the college during the evening. A box and whisker diagram showing the scores from this class for the same test is given below.



Test scores

A researcher reviews the box and whisker diagrams and believes that the evening class performed better than the morning class.

1b. With reference to the box and whisker diagrams, state one aspect that may support the researcher's opinion and one aspect that may counter it. *[2 marks]*

Markscheme

The median score for the evening class is higher than the median score for the morning class. ***A1***

THEN

but the scores are more spread out in the evening class than in the morning class ***A1***

OR

the scores are more inconsistent in the evening class ***A1***

OR

the lowest scores are in the evening class ***A1***

OR

the interquartile range is lower in the morning class ***A1***

OR

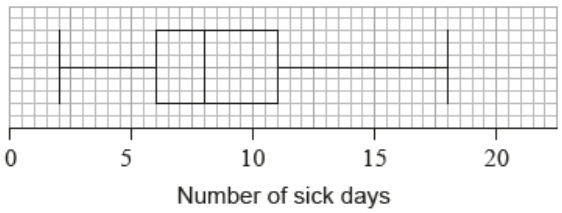
the lower quartile is lower in the evening class ***A1***

Note: If an incorrect comparison is also made, award at most ***A1A0***.

Award ***A0*** for a comparison that references "the mean score" unless working is shown for the estimated means of the data sets, calculated from the mid-points of the 4 intervals. The estimated mean for the morning class is 71.375 and the estimated mean for the evening class is 70.5.

[2 marks]

The number of sick days taken by each employee in a company during a year was recorded. The data was organized in a box and whisker diagram as shown below:



For this data, write down

2a. the minimum number of sick days taken during the year. *[1 mark]*

Markscheme

2 ***A1***

[1 mark]

2b. the lower quartile. *[1 mark]*

Markscheme

6 ***A1***

[1 mark]

2c. the median. *[1 mark]*

Markscheme

8 ***A1***

[1 mark]

2d. Paul claims that this box and whisker diagram can be used to infer that the percentage of employees who took fewer than six sick days is smaller than the percentage of employees who took more than eleven sick days. *[2 marks]*

State whether Paul is correct. Justify your answer.

Markscheme

EITHER

Each of these percentages represent approximately 25% of the employees. ***R1***

OR

The diagram is not explicit enough to show what is happening at the quartiles regarding 6 and 11 / we do not have the data points ***R1***

OR

Discrete data not clear how to interpret “fewer”. ***R1***

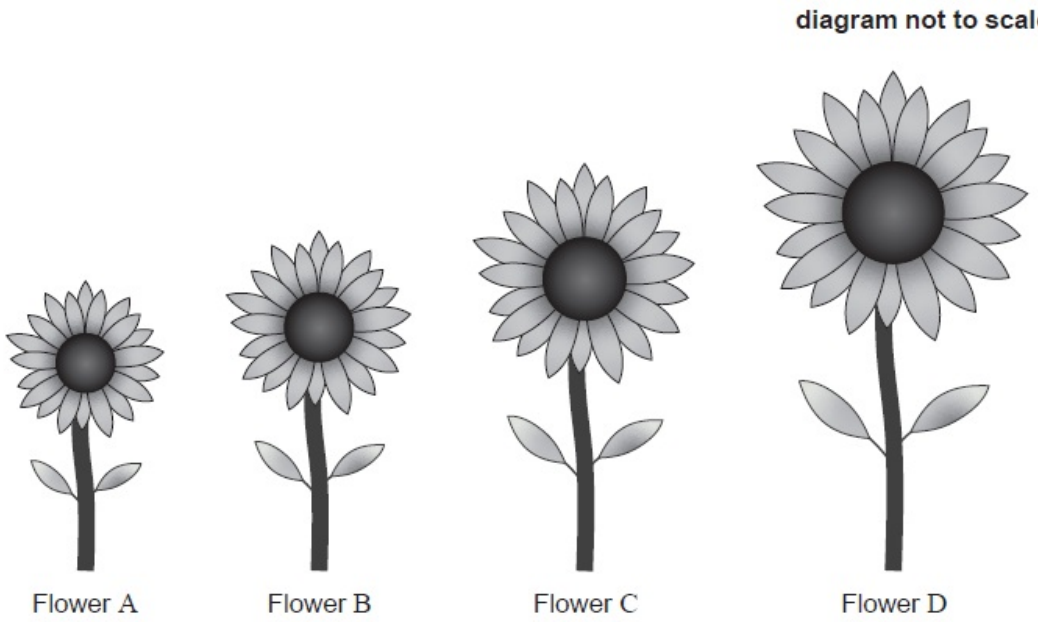
THEN

Hence, Paul is not correct (**OR** no such inference can be made). ***A1***

Note: Do not award ***R0A1***.

[2 marks]

Anne-Marie planted four sunflowers in order of height, from shortest to tallest.



Flower C is $32\ \mathrm{cm}$ tall.

The median height of the flowers is $24\ \mathrm{cm}$.

3a. Find the height of Flower B. *[2 marks]*

Markscheme

* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

$24-8$ **OR** $24-(32-24)$ **OR** $24=\frac{32+h}{2}$ ***(M1)***

Note: Award ***(M1)*** for subtracting 8 from the median, or equivalent.

$16\ (\mathrm{cm})$ ***(A1)*** ***(C2)***

[2 marks]

The range of the heights is $50\ \mathrm{cm}$. The height of Flower A is $p\ \mathrm{cm}$ and the height of Flower D is $q\ \mathrm{cm}$.

3b. Using this information, write down an equation in p and q. *[1 mark]*

Markscheme

$q - p = 50$ (or equivalent) ***(A1)*** ***(C1)***

[1 mark]

The mean height of the flowers is $27\ \text{cm}$.

3c. Write down a second equation in p and q. *[1 mark]*

Markscheme

$\frac{p+16+32+q}{4} = 27$ **OR** $p + q = 60$ (or equvalent) ***(A1)*****(ft)** ***(C1)***

Note: Follow through from part (a).

[1 mark]

3d. Using your answers to **parts (b)** and **(c)**, find the height of Flower A. *[1 mark]*

Markscheme

$5\,(\text{cm})$ ***(A1)*****(ft)** ***(C1)***

Note: Follow through from parts (b) and (c).

[1 mark]

3e. Using your answers to **parts (b)** and **(c)**, find the height of Flower D. *[1 mark]*

Markscheme

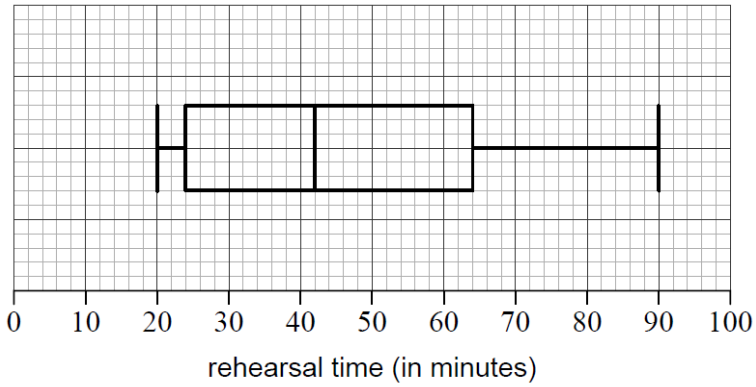
$55\,(\text{cm})$ ***(A1)*****(ft)** ***(C1)***

Note: Follow through from parts (b) and (c).

[1 mark]

Stephen was invited to perform a piano recital. In preparation for the event, Stephen recorded the amount of time, in minutes, that he rehearsed each day for the piano recital.

Stephen rehearsed for 32 days and data for all these days is displayed in the following box-and-whisker diagram.



4a. Write down the median rehearsal time. *[1 mark]*

Markscheme

42 (minutes) ***(A1)*** ***(C1)***

[1 mark]

Stephen states that he rehearsed on each of the 32 days.

4b. State whether Stephen is correct. Give a reason for your answer. *[2 marks]*

Markscheme

Stephen is correct. ***(A1)***

the minimum rehearsal time is greater than zero ***(R1)***

OR

he rehearsed at least 20 minutes every day ***(R1) (C2)***

Note: Do not award ***(A1)(R0)***. Accept equivalent reasoning based on the box-and-whisker diagram.

[2 marks]

4c. On k days, Stephen practiced exactly 24 minutes. *[3 marks]*

Find the possible values of k.

Markscheme

$0,\ 2,\ 3,\ 4,\ \ldots,\ 15$ ***(A1)(A1)(A1)*** ***(C3)***

Note: Award ***(A1)(A1)*** for each correct endpoint of the interval, ***(A1)*** for indication of integer values, except 1, between *their* endpoints.

[3 marks]

The following box-and-whisker plot shows the number of text messages sent by students in a school on a particular day.

5a. Find the value of the interquartile range. *[2 marks]*

Markscheme

* This question is from an exam for a previous syllabus, and may contain minor differences in marking or structure.

recognizing Q_1 or Q_3 (seen anywhere) ***(M1)***

eg 4,11 , indicated on diagram

IQR = 7 ***A1 N2***

[2 marks]

5b. One student sent k text messages, where $k > 11$. Given that k is an outlier, find the least value of k. *[4 marks]*

Markscheme

recognizing the need to find 1.5 IQR ***(M1)***

eg 1.5 × IQR, 1.5 × 7

valid approach to find k ***(M1)***

eg 10.5 + 11, 1.5 × IQR + Q_3

21.5 ***(A1)***

$k = 22$ ***A1 N3***

Note: If no working shown, award ***N2*** for an answer of 21.5.

[4 marks]

A group of 20 students travelled to a gymnastics tournament together. Their ages, in years, are given in the following table.

Age (years)	14	15	16	17	18	19	20	22
Frequency	1	2	7	1	4	1	1	3

6a. For the students in this group write down the median age. *[1 mark]*

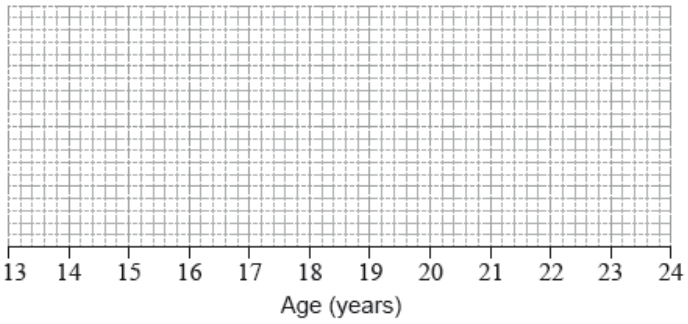
Markscheme

16.5 ***(A1)*** ***(C1)***

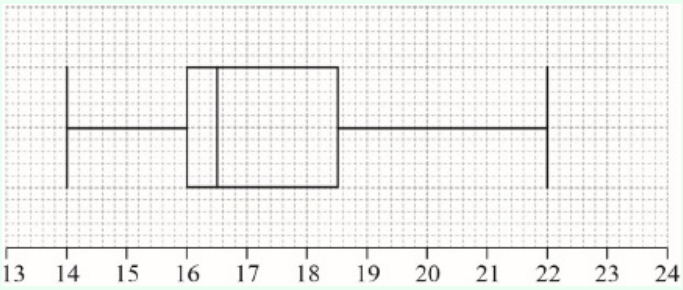
[1 mark]

The lower quartile of the ages is 16 and the upper quartile is 18.5.

6b. Draw a box-and-whisker diagram, for these students' ages, on the following grid. *[3 marks]*



Markscheme



(A1)(A1)(A1)*(ft)** ***(C3)

Note: Award ***(A1)*** for correct endpoints, ***(A1)*** for correct quartiles, ***(A1)*(ft)** for their median. Follow through from part (a)(ii), but only if median is between 16 and 18.5. If a horizontal line goes through the box, award at most ***(A1)(A1)(A0)***. Award at most ***(A0)(A1)(A1)*** if a ruler has not been used.

[3 marks]