Y1S3 XMQs and MS

(Total: 31 marks)

1. P31(AS)_2018 Q4 . 8 marks - Y1S1 Data collection

2. P31(AS)_2020 Q1 . 4 marks - Y1S3 Representations of data

3. P31(AS)_2021 Q2 . 9 marks - Y1S3 Representations of data

4. P31(AS)_2022 Q3 . 8 marks - Y1S3 Representations of data

5. P31(AS)_2022 Q4 . 2 marks - Y1S3 Representations of data

4. Helen is studying the daily mean wind speed for Camborne using the large data set from 1987. The data for one month are summarised in Table 1 below.

Windspeed	n/a	6	7	8	9	11	12	13	14	16
Frequency	13	2	3	2	2	3	1	2	1	2

Table 1

(a) Calculate the mean for these data.

(1)

(b) Calculate the standard deviation for these data and state the units.

(2)

The means and standard deviations of the daily mean wind speed for the other months from the large data set for Camborne in 1987 are given in Table 2 below. The data are not in month order.

Month	*A*	*B*	*C*	*D*	*E*
Mean	7.58	8.26	8.57	8.57	11.57
Standard Deviation	2.93	3.89	3.46	3.87	4.64

Table 2

(c) Using your knowledge of the large data set, suggest, giving a reason, which month had a mean of 11.57

(2)

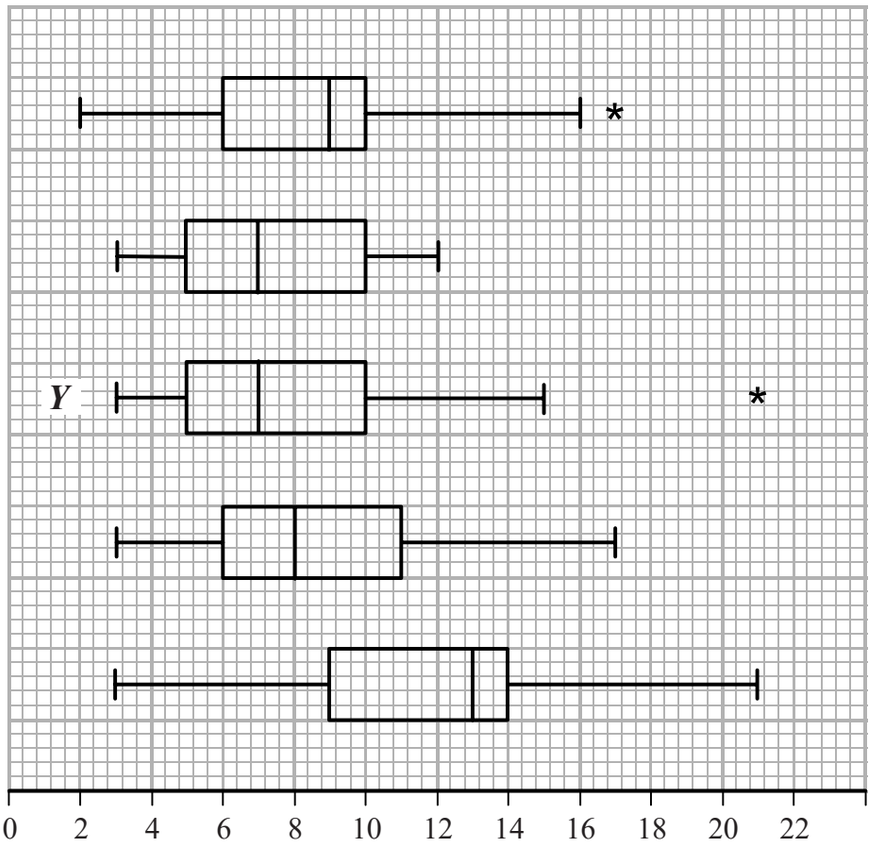
The data for these months are summarised in the box plots on the opposite page.
They are not in month order or the same order as in Table 2.

(d) (i) State the meaning of the * symbol on some of the box plots.

(ii) Suggest, giving your reasons, which of the months in Table 2 is most likely to be summarised in the box plot marked *Y*.

(3)

Question 4 continued



(Total for Question 4 is 8 marks)

Qu	Scheme	Marks	AO
4 (a)	$\bar{x} = 10.2\,(2222\ldots)$ awrt **10.2**	B1 (1)	1.1b
(b)	$\sigma_x = 3.17\,(20227\ldots)$ awrt **3.17**	B1ft	1.1b
	Sight of "knots" or "kn" (condone knots/s etc)	B1 (2)	1.2
(c)	October ….. since	B1	2.2b
	it is windier in the autumn or month of the hurricane or latest month in the year	B1 (2)	2.4
(d)(i)	They represent outliers	B1	1.2
(ii)	*Y* has low median so expect lowish mean (but outlier so > 7) and *Y* has big range/IQR or spread so expect larger st.dev	M1	2.4
	Suggests *B*	A1 (3)	2.2b
		(8 marks)	

	Notes
NB	$\bar{x} = \frac{184}{18}$ and $\sigma_x = \sqrt{\frac{2062}{18} - \bar{x}^2}$
(a)	B1 for $\bar{x} = 10.2$ (allow exact fraction) [This is an LDS mark]
(b)	1st B1ft allow 3.2 from a correct expr' accept s = 3.26(3984…) [ft use of n/a] Treating n/a as 0 May see n = 31 or $\bar{x} = 5.9354...$ which is B0 in (a) but here in (b) it gives σ_x = 5.59(34…) or s = 5.6858…(awrt 5.69) and scores 1st B1 2nd B1 accept kn accept in (a) or (b) (allow nautical miles/hour) [This is an LDS mark]
(c)	1st B1 choosing October but accept September. [This is an LDS mark] 2nd B1 for stating that (Camborne) is windier in autumn/winter months "because it is winter/autumn/windier/colder in "month" " Sep ⩽ "month" ⩽ Mar scores B1B1 for "month" = Sep or Oct and B0B1 for other months in range
(d)(i)	B1 for outlier or the idea of an extreme value allow "anomaly"
(ii)	M1 for a comment relating to location that mentions both median and mean and a comment relating to spread that mentions both range/IQR and standard deviation and leads to choosing *B*, *C* or *D* **Choosing *A* or *E* is M0** Incorrect/false statements score M0 e.g. Q_3 = (mean + σ) or identify Q_2 = mean or *Y* has small spread
ALT	**Use of outliers:** outlier is (mean + 3σ) (*B* = 19.9), (*C* = 18.95), (*D* = 20.2) Must see at least one of these values and compare to *Y*'s outlier[leads to *D* or *B*]
	A1 for suitable inference i.e. *B* (accept *D* or *B* or *D*) M1 **must** be scored

1.

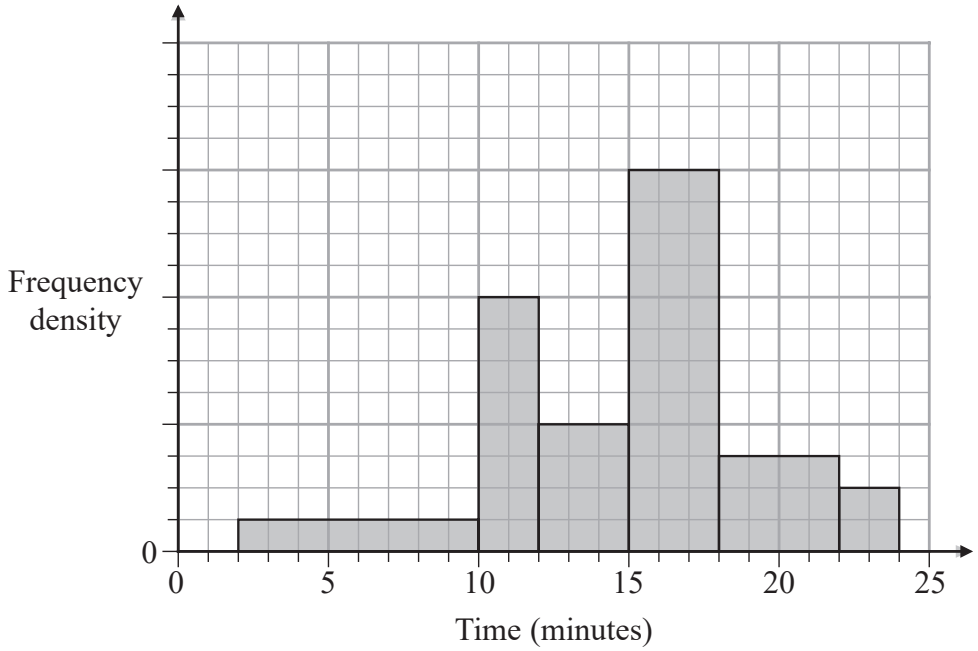


Figure 1

The histogram in Figure 1 shows the times taken to complete a crossword by a random sample of students.

The number of students who completed the crossword in more than 15 minutes is 78

Estimate the percentage of students who took less than 11 minutes to complete the crossword.

(4)

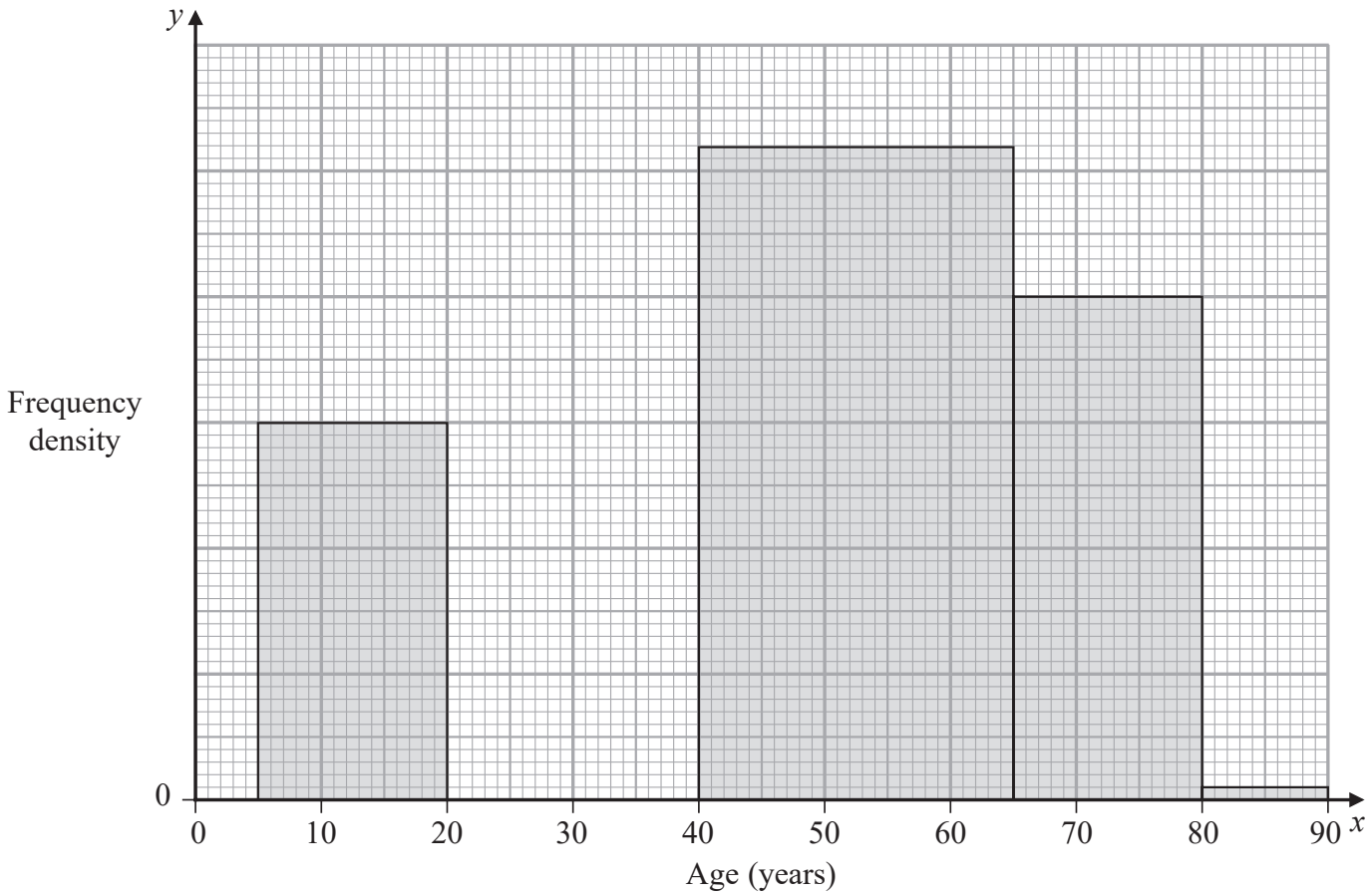
Question	Scheme	Marks	AOs
1	1 square is $\frac{78}{12\times3+3\times4+2\times2}=\left[\frac{78}{52}=1.5\right]$ **and** $(8\times1+1\times8)\times"1.5"$	M1	3.1a
	24 students took less than 11 minutes	A1	1.1b
	Percentage of students = $\frac{"24"}{78+"24"+1\times8\times"1.5"+3\times4\times"1.5"}\times100$	M1	3.1b
	= 18.18… awrt 18%	A1	1.1b
		(4)	
			Total 4

Notes		
1	**M1:**	For clear use of frequency density to establish the fd scale and then use the area to find frequency of <11 minutes. Allow maximum of 3 errors in either the heights or widths in total if working shown. They may calculate the area using other size squares. Allow for realising they need to find the total number of squares (88) maximum of 4 errors in either the heights or widths and number < 11 minutes(16) - must have a maximum of 1 error in either the heights or widths (and not use the 78 as part of calulation)
	A1:	For correct values seen. Allow for 88 and 16
	M1:	For realising the need to find the total and calculating a percentage. (with "their 24" as the numerator). Allow $(8\times1+2\times8)\times"1.5"$ instead of $"24"+1\times8\times"1.5"$ If working shown can allow maximum of 2 errors in either the heights or widths in the calculation of the total. Allow "their 24" / 132 oe
	A1:	awrt 18

2. The partially completed table and partially completed histogram give information about the ages of passengers on an airline.

There were no passengers aged 90 or over.

Age (x years)	$0 \leqslant x < 5$	$5 \leqslant x < 20$	$20 \leqslant x < 40$	$40 \leqslant x < 65$	$65 \leqslant x < 80$	$80 \leqslant x < 90$
Frequency	5	45	90			1



(a) Complete the histogram.

(3)

(b) Use linear interpolation to estimate the median age.

(4)

An outlier is defined as a value greater than $Q_3 + 1.5 \times$ interquartile range.

Given that $Q_1 = 27.3$ and $Q_3 = 58.9$

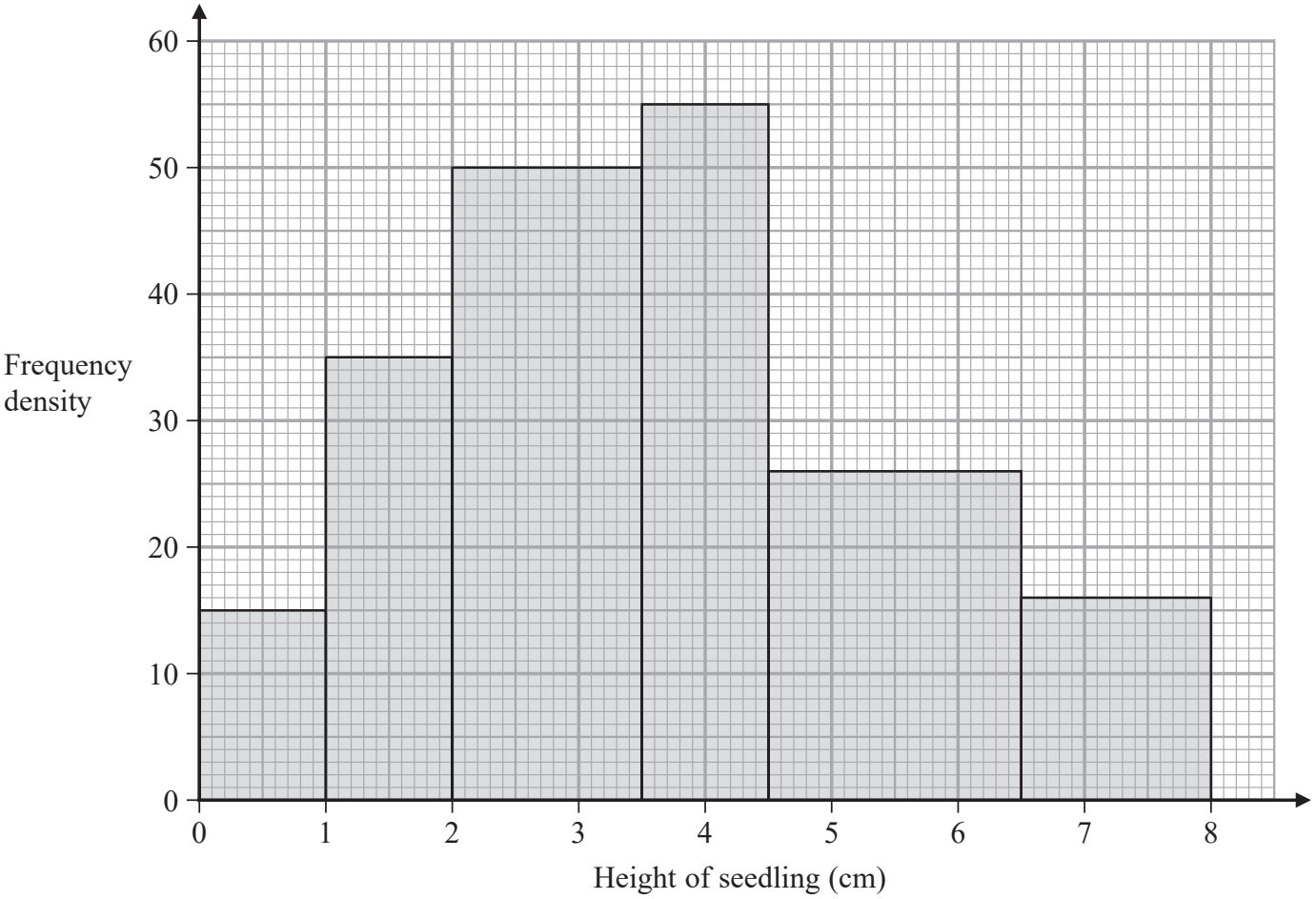
(c) determine, giving a reason, whether or not the oldest passenger could be considered as an outlier.

(2)

Qu	Scheme	Marks	AO
2. (a)	From [5,20) fd = 3 or 1 large square = 2.5 passengers o.e.	M1	2.2a
	Correct bar above [0, 5)	A1	1.1b
	Correct bar above [20, 40)	A1	1.1b
		(3)	
(b)	For [40, 65) **130** passengers or for [65, 80) **60** passengers	M1	2.1
	For attempt to find total number of passengers = **331**	A1ft	1.1b
	[Median =] $40+\frac{\frac{1}{2}("331")-140}{"130"}\times 25$ or $65-\frac{270-\frac{1}{2}("331")}{"130"}\times 25$ (o.e.)	M1	1.1b
	= 44.9038… = awrt **44.9**	A1	1.1b
		(4)	
(c)	Upper outlier limit = 58.9 + 1.5×(58.9 – 27.3) = 106 (.3) > 90	M1	2.4
	So oldest passenger is not an outlier	A1	2.2a
		(2)	
		(9 marks)	

	Notes
(a)	M1 for attempt at fd or a suitable method to deduce the scale for the histogram May be implied by one correct bar. 1st A1 for first bar [0, 5) with fd = 1 or 2 large squares high 2nd A1 for third bar with fd = 4.5 or 9 large squares high
(b)	1st M1 for an attempt using their fd to find the missing frequencies. May be in table 1st A1ft for a clear attempt to find the total number of passengers (ft their 130 and 60) 2nd M1 for any expression/equation leading to correct Q_2 Must be using 40-65 class 2nd A1 for awrt 44.9 (allow (n + 1) leading to 45)
(c)	M1 for finding the upper outlier limit (expression or awrt 106) and stating or implying > 90 A1 dep on M1 seen for deducing NOT an outlier

3. The histogram summarises the heights of 256 seedlings two weeks after they were planted.



(a) Use linear interpolation to estimate the median height of the seedlings.

(4)

Chris decides to model the **frequency density** for these 256 seedlings by a curve with equation

$$y = kx(8 - x) \qquad 0 \leqslant x \leqslant 8$$

where k is a constant.

(b) Find the value of k

(3)

Using this model,

(c) write down the median height of the seedlings.

(1)

Qu	Scheme	Mark	AO
3. (a)			
		M1	2.1
		A1	1.1b
	$[Q_2 =](3.5)+\frac{\frac{256}{2}-"125"}{"55"}\times(4.5-3.5)$ or $(4.5)-\frac{"180"-\frac{256}{2}}{"55"}\times 1$	M1	2.1
	$= 3.5545\ldots\ldots$ awrt **3.55**	A1	1.1b
		(4)	
(b)	Need area under curve to be 256 so $\int_{(0)}^{(8)} kx(8-x)\,dx = 256$	M1	3.1a
	$k\left[4x^2-\frac{x^3}{3}\right]_{(0)}^{(8)} = 256$	M1	1.1b
	$\left\{k\left[4\times 8^2-\frac{8}{3}\times 8^2\right]=256\Rightarrow\right\}$ **k = 3**	A1	1.1b
		(3)	
(c)	[By symmetry median =] **4**	B1	2.2a
		(1)	
		(8 marks)	

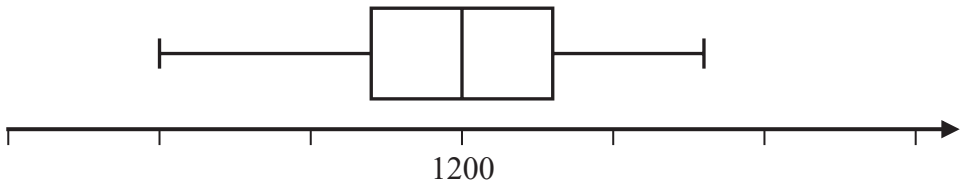
	Notes
(a)	1st M1 for an attempt to form frequency table (at least 1st 4 rows and freq or cum freq seen must have the frequency of 75 correct and can condone one error/omission in 15, 35, 55) Frequencies or cum freq may be seen on bars of the histogram 1st A1 for identifying class, freq and cum freq (i.e. highlighted values from the table) or sight of 3.5-4.5, freq of 55 and "128" – 125 or 180 – "128" or diagram with 125, "128", 180, 3.5 & 4.5 May be implied by values in 2nd M1expression 2nd M1 for a correct calculation for Q_2 (condone error in end point e.g. 3.45 or 3.49 etc) Can ft their "125" (provided > 100) and their "55" Allow use of $(n + 1)$, usually see 128.5 – … leading to 3.5636… or awrt 3.56 2nd A1 awrt 3.55 but 3.555 is fine (allow 3.56 if $(n + 1)$ being used …need sight of $\frac{257}{2}$ etc) Correct answer with no incorrect working scores 4/4
(b)	1st M1 for identifying the need to find the area under the curve by integrating 2nd M1 for correct integration and = 256 (condone missing limits) A1 for $k = 3$ [May see use of calculator for the integration so score 2nd M1A1 together]
(c)	**NB The answer to part (c) may be written within the question.** B1 for 4 (Independent of their value of k but must be their "x" value) NB when $k = 0.25$ and $x = 4$ gives $y = 4$ so must be clear they intend median = 4 The statement in part (c) "$k = 4$" is B0

	Scheme	Marks	AO

4. Jiang is studying the variable Daily Mean Pressure from the large data set.

He drew the following box and whisker plot for these data for one of the months for one location using a linear scale but

- he failed to label all the values on the scale
- he gave an incorrect value for the median



Daily Mean Pressure (hPa)

Using your knowledge of the large data set, suggest a suitable value for

(a) the median,

(1)

(b) the range.

(1)

(*You are not expected to have memorised values from the large data set. The question is simply looking for sensible answers*.)

(Total for Question 4 is 2 marks)

4. (a)	Accept 990 to 1030 inclusive	B1 **(1)**	1.1b
(b)	Any range between 10 and 50 inclusive	B1 **(1)**	1.1b
		(2 marks)	

	Notes
(a)	B1 (Median pressures usually around 1000~1020) [LDS mark]
(b)	B1 Any answer in this range [LDS mark] Allow answers in the form $a \sim b$ where $\lvert b-a \rvert$ is between 10 and 50 Also allow the case where <u>both</u> a and b are in [10, 50]