The heights, in centimetres, of a sample of 80 men were measured. For each man, his height **in excess of 175 cm** was recorded. The results are summarised in the table.

Height (cm)	Number of men
0 – 2	5
2 – 4	9
4 – 6	11
6 – 8	21
8 – 10	17
10 – 12	10
12 – 14	7
Total	**80**

(a) Calculate estimates for the mean and the variance of the heights in the table.

[4 marks]

(b) Hence find estimates for the mean and the variance of the actual heights of the 80 men.

[2 marks]

(c) Given that 1 foot is equal to 30.48 cm, find, in **feet**, estimates for the mean and the variance of the actual heights of the 80 men. Give your answers to three significant figures.

[3 marks]

Before going on holiday to *Seapron*, Tania records the weekly rainfall (x mm) at *Seapron* for 8 weeks during the summer. Her results are summarised as

$$\sum x = 86.8 \qquad \sum x^2 = 985.88$$

(a) Find the standard deviation, σ_x, for these data.

(3)

Q	Solution	Marks	Total	Comments
3 (a)	Mean = <u>7.35</u>	B2		CAO $\left(\sum x = 588\right)$
	= <u>7.3 to 7.4</u>	(B1)		AWFW
	Var (n) = <u>10.5</u> or Var(n–1) = <u>10.6</u>	B2		AWRT (10.47750 or 10.61013) $\left(\sum x^2 = 5160\right)$
	Var (n or n–1) = <u>10.4 to 10.7</u>	(B1)	4	AWFW
(b)	Mean = <u>182 to 182.4</u>	B1		AWFW; **irrespective** of value quoted/stated as mean in (a)
	or			
	Mean = <u>175 + (mean in (a))</u>	(Bdep1)		**Evaluated** (at least 3sf) using value quoted/stated as mean in (a) and dep on **6** < **Mean** < **9** in (a)
	Var (n or n–1) = <u>10.4 to 10.7</u>	B1		AWFW; **irrespective** of value quoted/stated as variance in (a)
	or			
	Var (n or n–1) = <u>value of Var stated in (a)</u>	(Bdep1)	2	Must be **identical** (at least 3 sf) to value quoted/stated as variance in (a) and dep on **9** < **Var** < **12** in (a)
(c)	Mean = <u>5.97 or 5.98 or 5.99</u>	B1		CAO (5.98261)
	$\text{Var} = \dfrac{(\text{Var(b) or Var(a)})}{30.48^2 \text{ or } 929}$ or $\text{Var} = \left(\dfrac{(\text{Sd(a) or Sd(b)})}{30.48}\right)^2$	Mdep1		Dep on **9** < **Var** < **12** in (a) or (b) $(30.48^2 = 929.0304)$ Dep on **3** < **Sd** < **3.5** in (a) or (b)
	Var (n or n–1) = <u>0.0112 or 0.0113 or 0.0114 or 0.0115</u>	A1	3	CAO (0.0113 or 0.0114)

3 .(a)	$[\sigma_x^2 =] \dfrac{985.88}{8} - \left(\dfrac{86.8}{8}\right)^2 = \dfrac{985.88}{8} - 10.85^2$	M1	
	$\sigma_x = \sqrt{\dfrac{985.88}{8} - \left(\dfrac{86.8}{8}\right)^2} = \sqrt{123.235 - 117.7225} = \sqrt{5.5125}$ <u>or</u> $\sqrt{\dfrac{44.1}{8}}$	A1	
	= 2.3478… = awrt **<u>2.35</u>**	A1	(3)

A company sells sugar in bags which are labelled as containing 450 grams.

Although the mean weight of sugar in a bag is more than 450 grams, there is concern that too many bags are underweight. The company can adjust the mean or the standard deviation of the weight of sugar in a bag.

(i) State two adjustments the company could make. [2]

The weights, x grams, of a random sample of 25 bags are now recorded.

(ii) Given that $\sum x = 11\,409$ and $\sum x^2 = 5206937$, calculate the sample mean and sample standard deviation of these weights. [3]

A midwife records the weights, in kg, of a sample of 50 babies born at a hospital. Her results are given in the table below.

Weight (w kg)	**Frequency (f)**	**Weight midpoint (x)**
$0 \leqslant w < 2$	1	1
$2 \leqslant w < 3$	8	2.5
$3 \leqslant w < 3.5$	17	3.25
$3.5 \leqslant w < 4$	17	3.75
$4 \leqslant w < 5$	7	4.5

(c) (i) Show that an estimate of the mean weight of these babies is 3.43 kg.

(ii) Find an estimate of the standard deviation of the weights of these babies.

(3)

A newborn baby weighing 3.43 kg is born at the hospital.

(f) Without carrying out any further calculations, state, giving a reason, what effect the addition of this newborn baby to the sample would have on your estimate of the

(i) mean,

(ii) standard deviation.

(3)

4 **(i)**	The company could increase the mean weight. The company could decrease the standard deviation.	B1 CAO B1	**2**
(ii)	Sample mean = 11409/25 = 456.36 $S_{xx} = 5206937 - \frac{11409^2}{25} = 325.76$ Sample s.d = $\sqrt{\frac{325.76}{24}}$ =3.68	B1 M1 for S_{xx} A1	**3**
		TOTAL	**5**

(c)(i)	$\sum fx = 1\times1 + 2.5\times8 + 3.25\times17 + 3.75\times17 + 4.5\times7 = 171.5$, $\bar{x} = \frac{171.5}{50} = (3.43)$ (*)	B1cso
(ii)	$\sqrt{\frac{611.375}{50} - 3.43^2}$,= 0.680147… = awrt **<u>0.680</u>** (Accept 0.68)	M1, A1 (3)
(f)(i) **(ii)**	No change in mean (since weight is the same) s.d. will decrease (Extra value is at "centre" so data more concentrated) Both statements correct <u>and</u> correct reasons for <u>each</u>	B1 B1 dB1 (3)

At East Cornwall College, the mean GCSE score of each student is calculated. This is done by allocating a number of points to each GCSE grade in the following way.

Grade	A*	A	B	C	D	E	F	G	U
Points	8	7	6	5	4	3	2	1	0

(i) Calculate the mean GCSE score, X, of a student who has the following GCSE grades:

A*, A*, A, A, A, B, B, B, B, C, D. [2]

60 students study AS Mathematics at the college. The mean GCSE scores of these students are summarised in the table below.

Mean GCSE score	Number of students
$4.5 \leqslant X < 5.5$	8
$5.5 \leqslant X < 6.0$	14
$6.0 \leqslant X < 6.5$	19
$6.5 \leqslant X < 7.0$	13
$7.0 \leqslant X \leqslant 8.0$	6

(ii) Draw a histogram to illustrate this information. [3]

(iii) Calculate estimates of the sample mean and the sample standard deviation. [5]

The scoring system for AS grades is shown in the table below.

AS Grade	A	B	C	D	E	U
Score	60	50	40	30	20	0

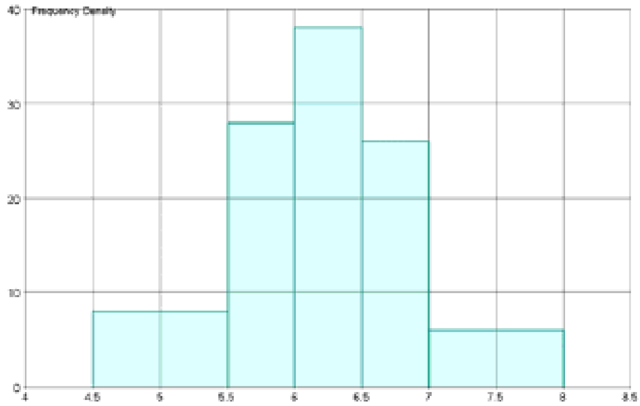
The Mathematics department at the college predicts each student's AS score, Y, using the formula $Y = 13X - 46$, where X is the student's average GCSE score.

(iv) What AS grade would the department predict for a student with an average GCSE score of 7.4? [2]

(v) What do you think the prediction should be for a student with an average GCSE score of 5.5? Give a reason for your answer. [3]

(vi) Using your answers to part **(iii)**, estimate the sample mean and sample standard deviation of the predicted AS scores of the 60 students in the department. [3]

<table>
<tr><td>7
(i)</td><td>Mean score = (2x8 + 3x7 + 4x6 + 5 + 4)/11 =

6.36</td><td>M1 for $\sum fx/11$
A1 CAO</td><td>2</td></tr>
<tr><td>(ii)</td><td>

Mean GCSE Score</td><td>G1 Linear sensible scales

G1 fds of 8, 28, 38, 26, 6 or 4k, 14k, 19k, 13k, 3k for sensible values of k either on script or on graph.

G1 (dep on reasonable attempt at fd) Appropriate label for vertical scale eg 'Frequency density', 'frequency per ½ unit', 'students per mean GCSE score'. (allow Key)</td><td>3</td></tr>
<tr><td>(iii)</td><td>
<table>
<tr><th>Mid point, x</th><th>f</th><th>fx</th><th>fx²</th></tr>
<tr><td>5</td><td>8</td><td>40</td><td>200</td></tr>
<tr><td>5.75</td><td>14</td><td>80.5</td><td>462.875</td></tr>
<tr><td>6.25</td><td>19</td><td>118.75</td><td>742.1875</td></tr>
<tr><td>6.75</td><td>13</td><td>87.75</td><td>592.3125</td></tr>
<tr><td>7.5</td><td>6</td><td>45</td><td>337.5</td></tr>
<tr><td></td><td>60</td><td>372</td><td>2334.875</td></tr>
</table>

Sample mean = 372/60 = 6.2

$S_{xx} = 2334.875 - \frac{372^2}{60} = 28.475$

Sample s.d = $\sqrt{\frac{28.475}{59}} = 0.695$</td><td>B1 mid points

B1FT $\sum fx$ and $\sum fx^2$

B1 CAO

M1 for their S_{xx}

A1 CAO</td><td>5</td></tr>
<tr><td>(iv)</td><td>Prediction of score = 13 x 7.4 – 46 = 50.2
So predicted AS grade would be B</td><td>M1 For 13 x 7.4 – 46
A1 dep on 50.2 (or 50) seen</td><td>2</td></tr>
<tr><td>(v)</td><td>Prediction of score = 13 x 5.5 – 46 = 25.5

So predicted grade would be D/E
(allow D or E)
Because score roughly halfway from 20 to 30,
OR (for D) closer to D than E
OR (for E) past E but not up to D boundary</td><td>M1 For 13 x 5.5 – 46

A1 dep on 25.5 (or 26 or 25) seen
E1 For explanation of conversion – logical statement/argument that supports their choice.</td><td>3</td></tr>
<tr><td>(vi)</td><td>Mean = 13 x 6.2 – 46 = 34.6
Standard deviation = 13 x 0.695 = 9.035</td><td>B1 FT their 6.2
M1 for 13 x their 0.695
A1 FT</td><td>3</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>18</td></tr>
</table>

The total annual emissions of carbon dioxide, x tonnes per person, for 13 European countries are given below.

6.2 6.7 6.8 8.1 8.1 8.5 8.6 9.0 9.9 10.1 11.0 11.8 22.8

(i) Find the mean, median and midrange of these data. [4]

(ii) Comment on how useful each of these is as a measure of central tendency for these data, giving a brief reason for each of your answers. [3]

The numbers of absentees per day from Mrs Smith's reception class over a period of 50 days are summarised below.

Number of absentees	0	1	2	3	4	5	6	>6
Frequency	8	15	11	8	3	4	1	0

(i) Illustrate these data by means of a vertical line chart. [2]

(ii) Calculate the mean and root mean square deviation of these data. [3]

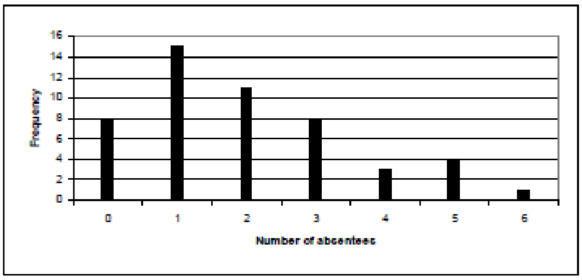
(iii) There are 30 children in Mrs Smith's class altogether. Find the mean and root mean square deviation of the number of children who are present during the 50 days. [2]

1 The results of 14 observations of a random variable V are summarised by

$$n = 14, \qquad \Sigma v = 3752, \qquad \Sigma v^2 = 1\,007\,448.$$

Calculate unbiased estimates of $\mathrm{E}(V)$ and $\mathrm{Var}(V)$. **[4]**

Q 1 (i)	Mean = 127.6/13 = 9.8 Median = 8.6 Midrange = 14.5	M1 for 127.6/13 soi A1 CAO B1 CAO B1 CAO	**4**
(ii)	Mean slightly inflated due to the outlier Median good since it is not affected by the outlier Midrange poor as it is highly inflated due to the outlier	B1 B1 B1	**3**
		TOTAL	**7**

Q 2 (i)	 	G1 labelled linear scales on both axes G1 heights	**2**
(ii)	Mean = $\frac{99}{50}$ = 1.98 S_{xx} = $315 - \frac{99^2}{50}$ (= 118.98) *rmsd* = $\sqrt{\frac{118.98}{50}}$ = 1.54 *NB full marks for correct results from recommended method which is use of calculator functions*	B1 for mean M1 for attempt at S_{xx} A1 CAO	**3**
(iii)	New mean = 30 – 1.98 = 28.02 New rmsd = 1.54 (unchanged)	B1 FT their mean B1 FT their rmsd	**2**
		TOTAL	**7**

Question		Answer/Indicative content	Marks		Guidance
1		$\hat{\mu} = \bar{x} = \frac{3752}{14}$ = **268**	B1		268 only, must be stated separately, *not* isw
		$\frac{1007448}{14} - \bar{x}^2$ [= 136.57...]	M1		If single formula used, give M1 for divisor 13 anywhere
		$\times\frac{14}{13}$; = **147**(.07...)	M1		Multiply by 14/13
			A1	4	Answer, a.r.t. 147, or $\frac{1912}{13} = 147\frac{1}{13}$ MR 3572: 255.14, 7390.6 gets B0M1M1A1

A nursery has 16 staff and 40 children on its records. In preparation for an outing the manager needs an estimate of the mean weight of the people on its records and decides to take a stratified sample of size 14.

(a) Describe how this stratified sample should be taken.

(3)

The weights, x kg, of each of the 14 people selected are summarised as

$$\sum x = 437 \text{ and } \sum x^2 = 26983$$

(b) Find unbiased estimates of the mean and the variance of the weights of all the people on the nursery's records.

(4)

(c) Estimate the standard error of the mean.

(2)

The estimates of the standard error of the mean for the staff and for the children are 5.11 and 1.10 respectively.

(d) Comment on these values with reference to your answer to part (c) and give a reason for any differences.

(2)

Keith records the amount of rainfall, in mm, at his school, each day for a week. The results are given below.

2.8	5.6	2.3	9.4	0.0	0.5	1.8

Jenny then records the amount of rainfall, x mm, at the school each day for the following 21 days. The results for the 21 days are summarised below.

$$\sum x = 84.6$$

(a) Calculate the mean amount of rainfall during the whole 28 days.

(2)

Keith realises that he has transposed two of his figures. The number 9.4 should have been 4.9 and the number 0.5 should have been 5.0
Keith corrects these figures.

(b) State, giving your reason, the effect this will have on the mean.

(2)

3.	**(a)**	Label staff (from 1 – 16) and children (from 1 – 40) Use random numbers to select 4 staff and 10 children	B1 B1 B1 (3)
	(b)	$\bar{x} = \hat{\mu} = 31.2142\ldots$ **awrt** <u>**31.2**</u> $s^2 = \dfrac{26983 - 14 \times "31.2..."^2}{13}$ $= 1026.33\ldots$ **awrt** <u>**1030**</u>	B1 M1 A1ft A1 (4)
	(c)	$\dfrac{"\sqrt{1026.33...}"}{\sqrt{14}}$, $= 8.562..$ **awrt** <u>**8.56**</u>	M1, A1 (2)
	(d)	The variation within each stratum is quite small (o.e.) **The difference in the means will be quite large**, (so variations from the overall mean will be large giving a larger overall s.e.)	B1 B1 (2) **Total 11**

2.	**(a)**	$2.8 + 5.6 + 2.3 + 9.4 + 0.5 + 1.8 + 84.6 = 107$ mean = 107 / 28 (= 3.821…) **(awrt 3.8)**	M1 A1 (2)
	(b)	It will have no effect since one is 4.5 under what it should be and the other is 4.5 above what it should be.	B1 dB1 (2) [4]

The mark, x, scored by each student who sat a statistics examination is coded using

$$y = 1.4x - 20$$

The coded marks have mean 60.8 and standard deviation 6.60

Find the mean and the standard deviation of x.

(4)

Given that x denotes the midpoint of each group in the table and

$$\sum fx = 6460 \qquad \sum fx^2 = 529\ 400$$

(c) calculate an estimate for

(i) the mean,

(ii) the standard deviation,

for the above data.

(3)

Bernie recorded the durations, to the nearest minute, of 23 telephone calls made from his landline. The recorded durations, in numerical order, are as follows.

5 5 5 5 10 10 10 13 14 15 16 17 18 19 20 21 22 22 23 30 30 35 95

(a) For these data, give a reason why:

(i) the mode is **not** a suitable measure of average;

(ii) the range is **not** a suitable measure of spread.

[2 marks]

(b) Determine values for the median and the interquartile range of the 23 durations.

[2 marks]

(c) Calculate values for the mean and the standard deviation of the 23 durations.

[3 marks]

(d) Give **two** reasons why the measures determined in part **(b)** might be more appropriate than those calculated in part **(c)** for summarising the 23 durations.

[2 marks]

2	mean $= \dfrac{60.8+20}{1.4}$ <u>or</u> $60.8 = 1.4x - 20$ (o.e.)	M1
	$= 57.7142\ldots$ awrt **57.7**	A1
	standard deviation $= \dfrac{6.60}{1.4}$ <u>or</u> $6.60 = 1.4x$	M1
	$= 4.7142\ldots$ awrt **4.71**	A1
		(4)
		Total 4

(c)	$\left[\text{Mean } = \dfrac{6460}{85}\right] = $ **76**	B1
	$\sigma = \sqrt{\dfrac{529400}{85} - 76^2}$	M1
	$= 21.2658\ldots\ldots$ $(s = 21.3920)$ awrt **21.3**	A1
		(3)

(a)(i)	<u>Mode</u>: **5** is **minimum/smallest/lowest** value	B1		
(ii)	<u>Range</u>: is **affected/skewed/distorted/increased /large/wide/big/high** due to value of **95**	B1	**2**	
(b)	Median = **<u>17</u>**	B1		CAO; ignore method
	Interquartile range (22 − 10) = **<u>12</u>**	B1	**2**	CAO; ignore method
(c)	Mean = **<u>20</u>**	B1		CAO; see Note 2 $(\sum x = 460)$ & $(\sum x^2 = 16608)$
	Standard deviation (n) = **<u>17.9 to 18.0</u>**			AWFW (17.94678)
	or	B2		Do not ignore method; see Note 3
	Standard deviation (n–1) = **<u>18.3 to 18.4</u>**			AWFW (18.35013)
	or			
	Standard deviation (n or n–1) = **<u>17 to 19</u>**	(B1)	**3**	AWFW
(d)	Data is **not symmetrical** **or** data is (positively) skewed	B1		Reference only to 'normal' ⇒ B0
	Median and IQR or measures/results in (b) or "they" **ARE NOT affected/skewed/distorted/influenced/changed** by **95/maximum/outlying/extreme/large** value **OR** Mean and SD or measures/results in (c) **ARE affected/skewed/distorted/influenced/changed** by **95/maximum/outlying/extreme/large** value	B1	**2**	

The marks, x, of 45 students randomly selected from those students who sat a mathematics examination are shown in the stem and leaf diagram below.

Mark		Totals
3	6 9 9	(3)
4	0 1 2 2 3 4	(6)
4	5 6 6 6 8	(5)
5	0 2 3 3 4 4	(6)
5	5 5 6 7 7 9	(6)
6	0 0 0 0 1 3 4 4 4	(9)
6	5 5 6 7 8 9	(6)
7	1 2 3 3	(4)

Key	(3|6 means 36)

(a) Write down the modal mark of these students.

(1)

(b) Find the values of the lower quartile, the median and the upper quartile.

(3)

For these students $\sum x = 2497$ and $\sum x^2 = 143\ 369$

(c) Find the mean and the standard deviation of the marks of these students.

(3)

The mean and standard deviation of the marks of all the students who sat the examination were 55 and 10 respectively. The examiners decided that the total mark of each student should be scaled by subtracting 5 marks and then reducing the mark by a further 10 %.

(e) Find the mean and standard deviation of the scaled marks of all the students.

(4)

Giles, a keen gardener, rents a council allotment.

During early April 2011, he planted 27 seed potatoes.

When he harvested his potato crop during the following August, he counted the number of new potatoes that he obtained from each seed potato.

He recorded his results as follows.

Number of new potatoes	$\leqslant 6$	7	8	9	10	11	$\geqslant 12$
Frequency	2	2	1	4	8	6	4

(a) Calculate values for the median and the interquartile range of these data. *(3 marks)*

(b) Advise Giles on how to record his corresponding data for 2012 so that it would then be possible to calculate the mean number of new potatoes per seed potato. *(1 mark)*

4 (a)	60	B1 (1)
(b)	$Q_1 = 46$ $Q_2 = 56$ $Q_3 = 64$	B1 B1 B1 (3)
(c)	mean = 55.48…. or $\frac{2497}{45}$ awrt 55.5	B1
	$\text{sd} = \sqrt{\frac{143369}{45} - \left(\frac{2497}{45}\right)^2}$	M1
	= 10.342… (s = 10.459..) anything which rounds to 10.3 (or s = 10.5)	A1 (3)
(d)	Mean < median < mode or $Q_2 - Q_1 > Q_3 - Q_2$ with or without their numbers or median closer to upper quartile (than lower quartile) or (mean-median)/sd <0;	B1
	negative skew;	B1dep (2)
(e)	$\text{mean} = (55 - 5) \times 0.9$	M1
	= 45	A1
	$\text{sd} = 10 \times 0.9$	M1
	= 9	A1 (4)
		Total 13

1 (a)	Median = 10	B1		CAO
	Upper quartile = 11 Lower quartile = 9	B1		CAO; either May be implied by IQR = 2
	Interquartile range = 2	B1	3	CAO; do not award if seen to be not based on 11 and 9
(b)	Do not group results **Illustrations for B1:** Use all values Replace ≤6 by or use (0), 1, ..., 6 Replace ≥12 by or use 12, 13, ... Record exact values/frequencies	B1	1	OE statement that implies non grouping or recording of all separate observed values **Illustrations for B0:** Record max and/or min values Construct frequency table Use 1, 2 or 12, 13

A small chapel was open to visitors for 55 days during the summer of 2015. The table summarises the daily numbers of visitors.

Number of visitors	Number of days
20 or fewer	1
21	2
22	3
23	6
24	8
25	10
26	13
27	7
28	2
29	1
30 or more	2
Total	**55**

(a) For these data:

(i) state the modal value;

[1 mark]

(ii) find values for the median and the interquartile range.

[2 marks]

(b) Name one measure of average **and** one measure of spread that cannot be calculated exactly from the data in the table.

[2 marks]

(c) Reference to the raw data revealed that the 3 unknown exact values in the table were 13, 37 and 58.

Making use of this additional information, together with the data in the table, calculate the value of **each** of the two measures that you named in part **(b)**.

[3 marks]

2 (a)(i)	Mode = **26**	B1	**1**	CAO
Notes	1 "Mode is 26 (visitors) because largest frequency/number of days is 13" (OE) $\Rightarrow$ B1 2 "Modes are 13 and 26" (OE) $\Rightarrow$ B0			
(ii)	x: ≤ 20 21 22 23 24 25 26 27 28 29 ≥ 30 F: 1 3 6 12 20 30 43 50 52 53 55 Median = **25**	B1		CAO
	IQR = 26 − 24 = **2**	B1	**2**	CAO
Notes	1 Median is at CF = 27 to 28, UQ is at CF = 41 to 42 and LQ is at CF = 13 to 14 2 An answer of 25 or/and 2 with clearly shown incorrect method(s) $\Rightarrow$ B1 B0 or B0 B1 or B0 B0			
(b)	**Mean**	B1		CAO; accept nothing else
	Range or **Standard deviation** or **Variance**	B1	**2**	CAO; accept naming of **only one** of these three measures; nothing else
(c)	Mean = **25.6**	Bdep2		CAO $\sum fx = 1408$ Dependent on 1st B1 in (b)
	Mean = **25 to 26**	(B1dep)		AWFW
	Range = **45**	↑		CAO
	or	Bdep1		Dependent on 2nd B1 in (b)
	Sd(n) = **5.26** or Sd(n–1) = **5.31**	|		AWRT (5.26256 or 5.31106) $\sum fx^2 = 37568$
	or Var(n) = **27.7** or Var(n–1) = **28.2**	↓	**3**	AWRT (27.6945 or 28.2074)

The table summarises the diameters, d millimetres, of a random sample of 60 new cricket balls to be used in junior cricket.

Diameter (d mm)	Number of cricket balls
$65 < d \leqslant 66$	5
$66 < d \leqslant 67$	9
$67 < d \leqslant 68$	12
$68 < d \leqslant 69$	15
$69 < d \leqslant 70$	10
$70 < d \leqslant 71$	7
$71 < d \leqslant 72$	2
Total	**60**

(a) Calculate estimates of the mean and the variance of these 60 diameters.

[4 marks]

(b) David, a retired professional cricketer, requests that the values calculated in part **(a)** are expressed in inches, rather than in millimetres.

Given that 1 inch is equivalent to approximately 25.4 mm, calculate new values for the mean and the variance in response to David's request.

[2 marks]

1 The average maximum monthly temperatures, u degrees Fahrenheit, and the average minimum monthly temperatures, v degrees Fahrenheit, in New York City are as follows.

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Maximum (u)	39	40	48	61	71	81	85	83	77	67	54	41
Minimum (v)	26	27	34	44	53	63	68	66	60	51	41	30

(a) (i) Calculate, to one decimal place, the mean and the standard deviation of the 12 values of the average **maximum** monthly temperature. *(2 marks)*

(ii) For comparative purposes with a UK city, it was necessary to convert the temperatures from degrees Fahrenheit (°F) to degrees Celsius (°C). The formula used to convert f °F to c °C is:

$$c = \frac{5}{9}(f - 32)$$

Use this formula and your answers in part **(a)(i)** to calculate, **in** °C, the mean and the standard deviation of the 12 values of the average maximum monthly temperature.

(3 marks)

	Mean = **68.2 to 68.3**	A1		AWFW (68.25)
	Var(n) = **2.42**	B2		AWRT (2.42083) $\left(\sum fd^2 = 279629\right)$
	or Var(n–1) = **2.46**			(2.46186)
	or Var(n) or Var(n–1) = **2.4 to 2.5**	(B1)	4	AWFW
Notes	1 Value of variance stated as 1.55^2 to 1.57^2 and not evaluated ⇒ B1 2 Value of variance or standard deviation stated as 1.55 to 1.57 ⇒ B0 3 If, and only if, M0 A0 B0, then award M1 for seen attempt at $\sum f \times (d / LCB / UCB) \div 60$ or $(4095/4065/4125) \div 60$			
(b)	Mean = $\dfrac{(68.2 \text{ to } 68.3)}{25.4}$			
	= **2.68 to 2.69**	B1		AWFW (2.68701)
	Var(n) or Var(n–1) = $\dfrac{(2.4 \text{ to } 2.5)}{25.4^2}$			
	= **0.0037 to 0.0039**	B1	2	AWFW (0.0037523 or 0.0038159) Accept (3.7 to 3.9) × 10^{-3} (see GN6)

1(a)(i)	Mean = **62.2 to 62.3**	B1		AWFW (62.25)
	SD = **17.4 to 17.6** or **16.7 to 16.9**	B1	2	AWFW (17.519 or 16.774)
(ii)	Mean = **16.77 to 16.84**	BF1		AWFW (16.806) F on (a)(i) only providing **45 < mean < 65**
	SD = **9.66 to 9.78** or **9.27 to 9.39**	BF2	3	AWFW (9.733 or 9.319) F on (a)(i) only providing **10 < SD < 20**

Henrietta lives on a small farm where she keeps some hens.

For a period of 35 weeks during the hens' first laying season, she records, **each week**, the total number of eggs laid by the hens.

Her records are shown in the table.

Total number of eggs laid in a week (x)	**Number of weeks (f)**
66	1
67	2
68	3
69	5
70	7
71	8
72	4
73	2
74	2
75	1
Total	**35**

(a) For these data:

(i) state values for the mode and the range;

[2 marks]

(ii) find values for the median and the interquartile range;

[3 marks]

(iii) calculate values for the mean and the standard deviation.

[4 marks]

(b) Each week, for the 35 weeks, Henrietta sells 60 eggs to a local shop, keeping the remainder for her own use.

State values for the mean and the standard deviation of the number of eggs that she keeps.

[2 marks]

1	No MR or MC in this question			Ignore units throughout this question
(a) (i)	Mode = <u>71</u>	B1		CAO; ignore any reference to 8
	Range = <u>9</u>	B1	2	CAO
Note	1 If answers are not identified, then assume that order of values is mode, range			
(ii)	Median = <u>70</u>	B1		CAO
	IQR = <u>3</u>	B2		CAO; providing not from incorrect working eg see Note 1
	UQ = <u>72</u> LQ = <u>69</u>	(B1)	3	Both values CAO; ignore labels
Notes	1 Ordering of weeks (1, 1, 2, 2, 2, 3, 4, 5, 7, 8) ⇒ median = 2.5 ⇒ B0 B0 even if IQR = 3 (5 – 2) 2 If answers are not identified, then assume that order of values is median, IQR			
(iii)	Mean = <u>70.4</u>	B2		CAO
	Mean = <u>70.1 to 70.7</u>	(B1)		AWFW; but exclude 70.5 unless with a **correct method** (see **Note 2**)
	SD = <u>2.03 or 2.06</u>	B2		Either AWRT (2.0312 or 2.0608)
	SD = <u>2 to 2.1</u>	(B1)	4	AWFW
(b)	Henrietta keeps $(x - 60)$ so:			
	Mean = <u>10.4</u>	BF1		FT on any mean > 60 from (a)(iii) but must **subtract 60** and state **numerical** value > 0
	SD = <u>2.03 or 2.06</u>	BF1	2	FT on any SD > 0 from (a)(iii) but must state **unchanged numerical** value > 0

Katy works as a clerical assistant for a small company. Each morning, she collects the company's post from a secure box in the nearby Royal Mail sorting office.

Katy's supervisor asks her to keep a daily record of the number of letters that she collects.

Her records for a period of 175 days are summarised in the table.

Daily number of letters (x)	**Number of days** (f)
0–9	5
10–19	16
20	23
21	27
22	31
23	34
24	16
25–29	10
30–34	5
35–39	3
40–49	4
50 or more	1
Total	175

(a) For these data:

(i) state the modal value; *(1 mark)*

(ii) determine values for the median and the interquartile range. *(3 marks)*

(b) The most letters that Katy collected on any of the 175 days was 54. Calculate estimates of the mean and the standard deviation of the daily number of letters collected by Katy. *(4 marks)*

(c) During the same period, a total of 280 letters was also delivered to the company by private courier firms.

Calculate an estimate of the mean daily number of **all** letters received by the company during the 175 days. *(2 marks)*

2 (a)(i)	Mode = **23**	B1	1	CAO
(ii)	Median (88th value) = **22**	B1		CAO
	Upper quartile (132nd value) = **23** Lower quartile (44th value) = **20**	B1		CAO; either May be implied by IQR = 3
	Interquartile range = **3**	B1	3	CAO; do **not** award if seen to be not based on 23 and 20
(b)	Mean = **22.3** Mean = **21 to 23**	B2 (B1)		CAO; but only award B1 (22.3) if incorrect mid-points or Σfx seen AWFW (Σfx = 3902.5)
	Standard deviation = **6.37 or 6.39** Standard deviation = **5 to 7**	B2 (B1)	4	AWRT (s = 6.391 σ = 6.372) AWFW (Σfx^2 = 94132.25)
SC	Only if B0 B0 or B1 B0 then award as follows but only up to a **maximum total part mark of 2** **1** At least 2 correct mid-points 4.5, 14.5, 27, 32, 37, 44.5, 54 seen ⇒ M1 2 Clear use of $\Sigma fx/(175$ or $174)$ ⇒ M1			
(c)	Mean = (c's mean from (b)) + $\frac{280}{175}$ = 22.3 + 1.6	M1		Adding (1.6 or equivalent) CAO to (c's mean from (b)) **or** to (c's new mean)
	Mean = **23.9**	AF1	2	F on (c's mean from (b)) **or** on (c's new mean)