	Standard Deviation	
1	The heights, in centimetres, of 7 netball players are given below. $173, \quad 176, \quad 168, \quad 166, \quad 170, \quad 180, \quad 171$ Calculate the mean and standard deviation for these heights.	4
2	In a bakery a sample of six fruit loaves is selected and their weights in grams are recorded. $395 \quad 400 \quad 408 \quad 390 \quad 405 \quad 402$ Calculate the mean and standard deviation for these weights. New methods are introduced to ensure more consistent weights. A second sample is weighed where the mean is 400 grams and the standard deviation is 5.8 grams. Have the new methods been successful?	4 1
3	The results for a group of students who sat tests in Physics and Chemistry are shown below Physics (%) | 10 | 18 | 26 | 32 | 49 Chemistry (%) | 25 | 35 | 30 | 40 | 41 (a) Calculate the mean and standard deviation for the physics test. (b) In the chemistry test the standard deviation was 6.8%. Make an appropriate comment on the distribution of marks in the two tests.	4 1
4	A rugby team scored the following points in a series of seven matches $13, \quad 7, \quad 0, \quad 9, \quad 7, \quad 8, \quad 5$ (a) Calculate the mean and standard deviation for this data sample. The team appoint a new coach and their next season produces a mean of 27 and a standard deviation of 3.25. (b) Make two comparisons about the performance of the team under the new coach.	4 2

5	A new central heating system is installed in a house. Sample temperatures in degrees Celsius are recorded below. 19 21 23 21 19 20 (c) Calculate the mean and standard deviation for these temperatures. (d) For the greenhouse to be operating effectively the target temperature should be 20 ± 0.6℃ and the standard deviation should be less than 2℃. Is this greenhouse operating effectively?	 4 2
	26 marks	

	Standard Deviation - Answers	26
1	Mark 1 Find the mean $\bar{x} = \frac{1204}{7} = 172$ Mark 2 Complete the table of values for either formula x | $x - \bar{x}$ | $(x - \bar{x})^2$ 173 | 1 | 1 176 | 4 | 16 168 | -4 | 16 166 | -6 | 36 170 | -2 | 4 180 | 8 | 64 171 | -1 | 1 $\sum x = 1204$ | $\sum (x - \bar{x}) = 0$ | $\sum (x - \bar{x})^2 = 138$ x | x^2 173 | 29929 176 | 30976 168 | 28224 166 | 27556 170 | 28900 180 | 32400 171 | 29241 $\sum x = 1204$ | $\sum x^2 = 207226$ Mark 3 Substitute into the formulae $s = \sqrt{\frac{138}{6}}$ $s = \sqrt{\frac{207226 - \frac{1204^2}{7}}{6}}$ Mark 4 Calculate the standard deviation $\boldsymbol{s = \sqrt{23} = 4.8}$	4
2	Mark 1 Find the mean $\bar{x} = \frac{2400}{6} = 400$ Mark 2 Complete the table of values for either formula x | $x - \bar{x}$ | $(x - \bar{x})^2$ 395 | -5 | 25 400 | 0 | 0 408 | 8 | 64 390 | -10 | 100 405 | 5 | 25 402 | 2 | 4 $\sum x = 2400$ | $\sum (x - \bar{x}) = 0$ | $\sum (x - \bar{x})^2 = 218$ x | x^2 395 | 156025 400 | 160000 408 | 166464 390 | 152100 405 | 164025 402 | 161604 $\sum x = 2400$ | $\sum x^2 = 960218$ Mark 3 Substitute into the formulae $s = \sqrt{\frac{218}{5}}$ $s = \sqrt{\frac{960218 - \frac{2400^2}{6}}{5}}$ Mark 4 Calculate the standard deviation $\boldsymbol{s = 6.6}$ ... Mark 5 Compare standard deviation $(5.8 < 6.6)$ The weights are **more consistent (less varied)** in the second sample so the new methods are successful	5

3	Mark 1 Find the mean $\bar{x} = \frac{135}{5} = 27$ Mark 2 Complete the table of values for either formula x | $x - \bar{x}$ | $(x - \bar{x})^2$ 10 | -17 | 289 18 | -9 | 81 26 | -1 | 1 32 | 5 | 25 49 | 22 | 484 $\sum x = 135$ | $\sum (x - \bar{x}) = 0$ | $\sum (x - \bar{x})^2 = 880$ x | x^2 10 | 100 18 | 324 26 | 676 32 | 1024 49 | 2401 $\sum x = 135$ | $\sum x^2 = 4525$ Mark 3 Substitute into the formulae $s = \sqrt{\frac{880}{4}}$ $s = \sqrt{\frac{4525 - \frac{135^2}{5}}{4}}$ Mark 4 Calculate the standard deviation $\boldsymbol{s = 14.83}$ … Mark 5 Compare the standard deviation - $(6.8 < 14.8)$. In the chemistry tests marks were **more consistent (less varied)** than in the physics tests.	5
4	Mark 1 Find the mean $\bar{x} = \frac{49}{7} = 7$ Mark 2 Complete the table of values for either formula x | $x - \bar{x}$ | $(x - \bar{x})^2$ 13 | 6 | 36 7 | 0 | 0 0 | -7 | 49 9 | 2 | 4 7 | 0 | 0 8 | 1 | 1 5 | -2 | 4 $\sum x = 49$ | $\sum (x - \bar{x}) = 0$ | $\sum (x - \bar{x})^2 = 94$ x | x^2 13 | 169 7 | 49 0 | 0 9 | 81 7 | 49 8 | 64 5 | 25 $\sum x = 49$ | $\sum x^2 = 437$ Mark 3 Substitute into the correct formulae $s = \sqrt{\frac{94}{7-1}}$ $s = \sqrt{\frac{437 - \frac{49^2}{7}}{7-1}}$ Mark 4 Calculate the standard deviation $\boldsymbol{s = 3.958}$ Mark 5 Compare the mean - $(27 > 7)$. **On average** more points were scored under the new coach. Mark 6 Compare the standard deviation - $(3.25 < 3.958)$. The points scored in the matches were **less varied (or more consistent)** under the new coach.	6

5	Mark 1 Find the mean $\bar{x} = \frac{123}{6} = 20.5$ Mark 2 Complete the table of values for either formula x | $x - \bar{x}$ | $(x - \bar{x})^2$ 19 | -1.5 | 2.25 21 | 0.5 | 0.25 23 | 2.5 | 6.25 21 | 0.5 | 0.25 19 | -1.5 | 2.25 20 | -0.5 | 0.25 $\sum x = 123$ | $\sum (x - \bar{x}) = 0$ | $\sum (x - \bar{x})^2 = 11.5$ x | x^2 19 | 361 21 | 441 23 | 529 21 | 441 19 | 361 20 | 400 $\sum x = 123$ | $\sum x^2 = 2533$ Mark 3 Substitute into the formulae $s = \sqrt{\frac{11.5}{5}}$ $s = \sqrt{\frac{2533 - \frac{123^2}{6}}{5}}$ Mark 4 Calculate the standard deviation $\boldsymbol{s = 1.516}$ … Mark 5 Statement about the mean The mean temperature lies within the target range which is $19.4℃ < 20.5℃ < 20.6℃$ Mark 6 Statement about the standard deviation The standard deviation is less than $2℃$ so the greenhouse **is operating successfully.**	6