Question 4 **(If you answer this question do not answer Question 3)**

0 4

A group of students carried out an investigation into the direction of longshore drift on a shingle beach in South Devon. Their aim was to test the hypothesis that:

'Shingle size will be smaller at the eastern end of the beach than at the western end.'

Their theory was that the prevailing south-westerly winds would mean that the waves arrive at an angle, therefore transporting sediment along the beach. Shingle will get smaller due to the process of attrition (shingle crashing into each other, breaking off fragments) as it is moved along the beach.

The students collected one shingle sample from 10 different locations at each end of the beach and measured the long axis of the shingle using callipers.

Figure 8 shows the table of data that they produced.

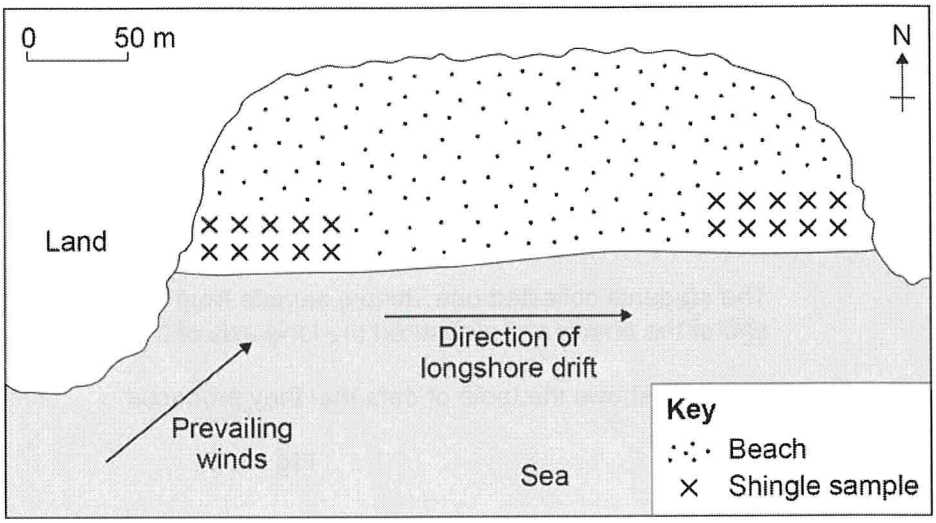
Figure 8

Shingle size (mm) Western end	Shingle size (mm) Eastern end
23	3
56	4
21	34
18	14
3	17
17	11
12	21
22	16
21	25
32	8

Question 4 continues on the next page

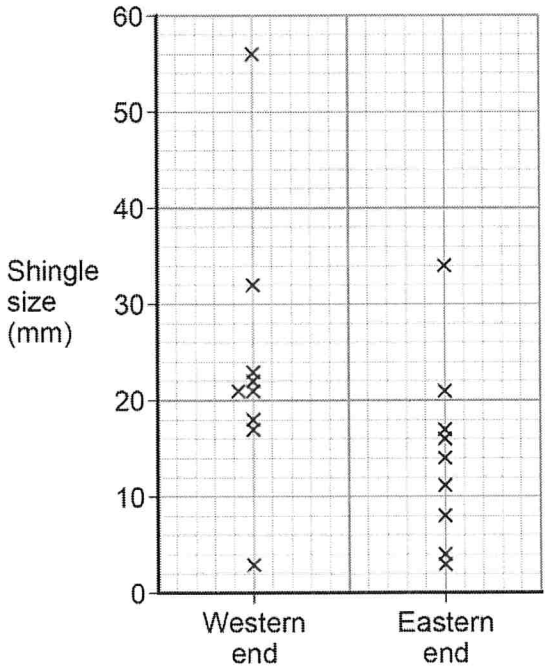
Figure 9 is a basic sketch map showing the locations of the shingle sample sites.

Figure 9



One of the students decided to present the data on a dispersion diagram to show the spread of shingle size at each location. This is shown in **Figure 10**.

Figure 10



0 4 . 1 Two of the shingle sizes are missing from the dispersion diagram in **Figure 10**.

Plot the data from the table below on to **Figure 10**.

[2 marks]

	Shingle size (mm)
Western end	12
Eastern end	25

Question 4 continues on the next page

To analyse the data one student decided to calculate the mean size for each end of the beach. The student then decided to calculate the standard deviation for the western end. **Figure 11** shows how he set out the data and started his calculations.

Figure 11

Shingle size in mm (x)	$x - \bar{x}$	$(x - \bar{x})^2$
23	0.50	0.25
56	33.50	1122.25
21	−1.50	2.25
18		
3	−19.50	380.25
17	−5.50	30.25
12	−10.50	110.25
22	−0.50	0.25
21	−1.50	2.25
32	9.50	90.25
$\sum x = 225$		$\sum(x - \bar{x})^2 = 1758.50$
$\bar{x} = 22.50$		

Key

x = Individual value

$\sum$ = Sum of

$\bar{x}$ = Mean

σ = Standard deviation

n = Number in the sample

Standard deviation formula $\sigma = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$

Show your working:

$\sigma =$

0 4 . 2 Complete **Figure 11** and calculate the standard deviation to **two** decimal places. Show your working in the space provided.

[4 marks]

The student then repeated the standard deviation calculation for the eastern end of beach. The result is shown below.

Standard deviation for the eastern end of the beach	9.12