



GCSE Biology

Adaptation

Question Paper

Time available: 55 minutes

Marks available: 50 marks

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1.

The limpet is a snail-like animal that lives attached to a rock on the seashore.

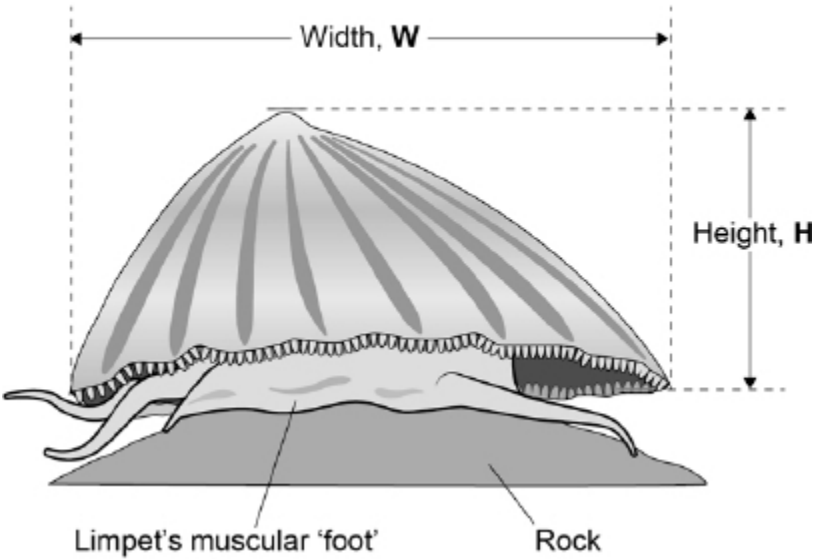
Some students investigated variation in the size of limpets living on two seashores:

- one shore was in a sheltered bay
- the other shore was exposed to the full force of the sea.

The students measured the heights (**H**) and widths (**W**) of 60 limpets on each shore.

Figure 1 shows a limpet and the measurements made by the students.

Figure 1



(a) On each shore, the students measured a large number of limpets at random locations.

Explain why the students did this.

Large number of limpets: _____

Random locations: _____

(2)

The students calculated $\frac{H}{W}$ for each limpet.

The table below shows the students' results.

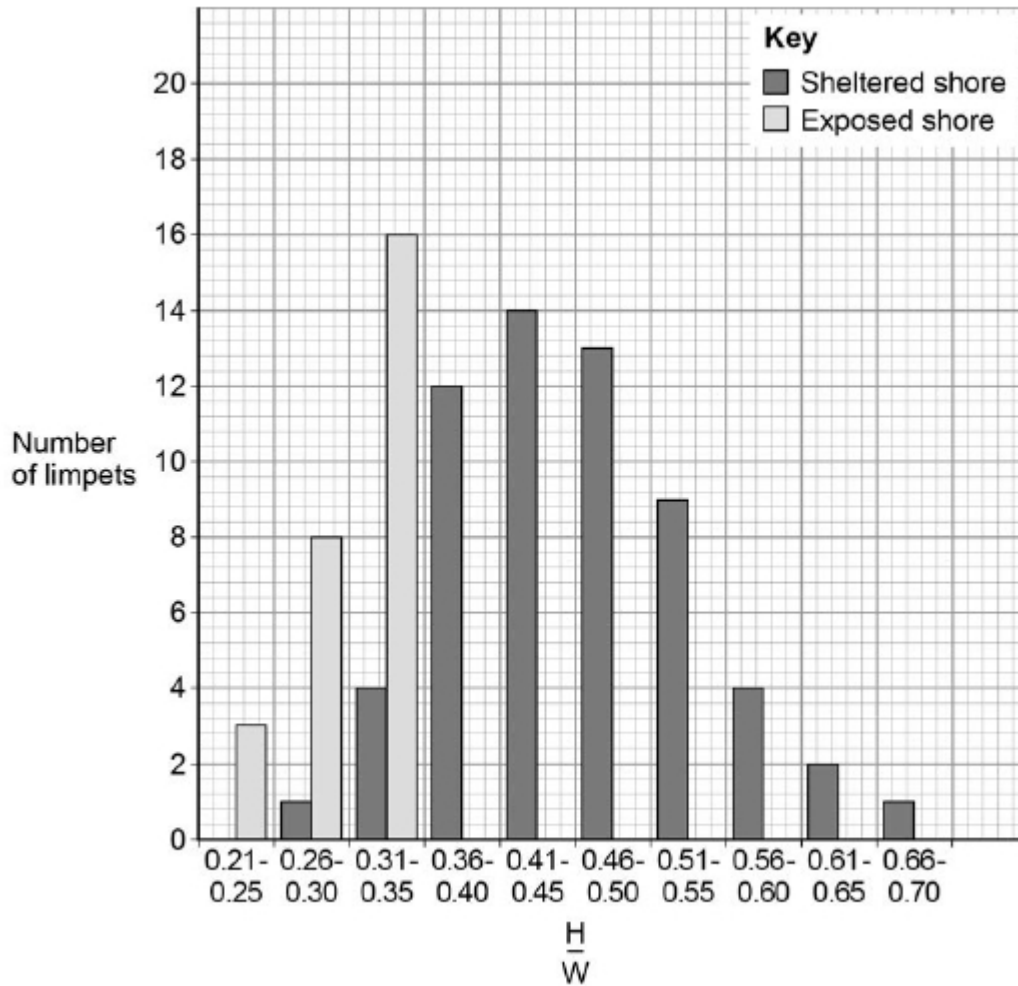
$\frac{H}{W}$	Sheltered shore		Exposed shore	
	Score	Number	Score	Number
0.21 – 0.25				3
0.26 – 0.30		1		8
0.31 – 0.35		4		16
0.36 – 0.40		12		
0.41 – 0.45		14		
0.46 – 0.50		13		
0.51 – 0.55		9		
0.56 – 0.60		4		
0.61 – 0.65		2		
0.66 – 0.70		1		

(b) Complete the table above.

(1)

Figure 2 shows some of the results.

Figure 2



(c) Complete **Figure 2**.

(1)

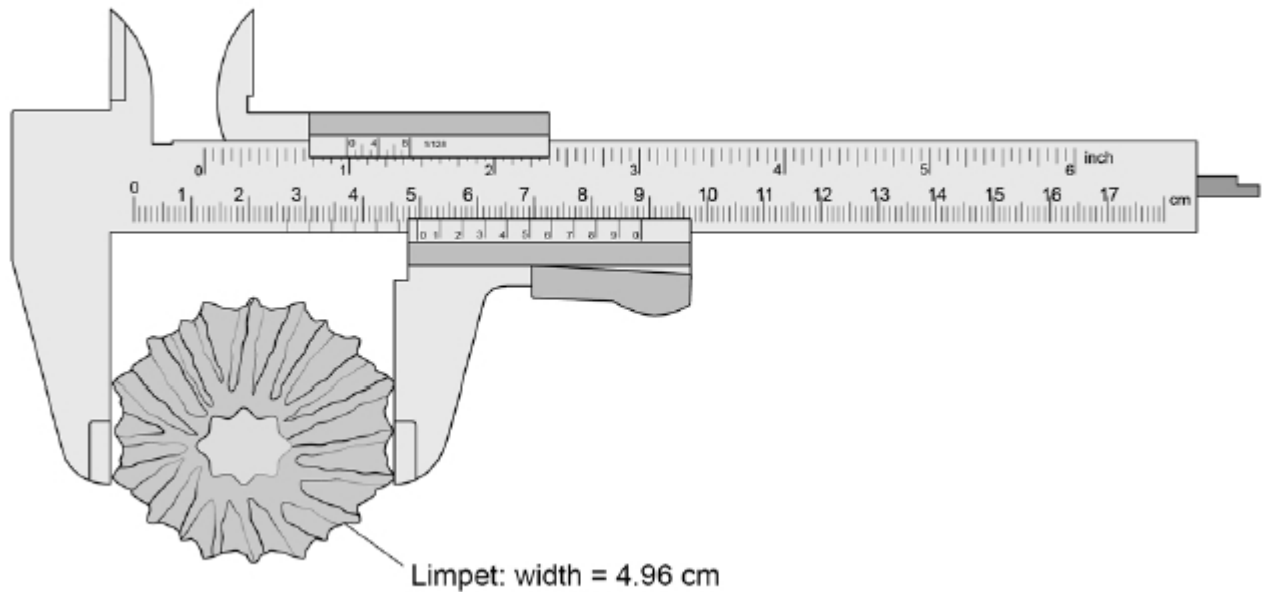
(d) Compare the patterns in the results for the exposed shore and the sheltered shore.

Use information from **Figure 2**.

(3)

Figure 3 shows how the students measured the width of a limpet with a vernier calliper.

Figure 3



(e) One student recorded

- sheltered shore: mean $\frac{H}{W} = 0.4659182$
- exposed shore: mean $\frac{H}{W} = 0.3542183$

The student's teacher stated that the data did **not** justify such a high number of decimal places.

Give the **two** mean values corrected to an appropriate number of decimal places.

Sheltered shore: mean $\frac{H}{W} =$ _____

Exposed shore: mean $\frac{H}{W} =$ _____

(2)

(f) A limpet clings to a rock on the sea shore using its muscular 'foot', as shown in **Figure 1**.

Scientists have found that limpets can exert a force of 2 newtons / cm² of 'foot'.

To remain attached to its rock, a limpet must exert a force at least as large as the force of the waves.

Calculate the maximum wave force the limpet shown in **Figure 3** could withstand without being knocked off its rock.

Assume that the surface of the foot is a circle.

The area of a circle is πr^2 .

Take the value of π to be 3.14.

Maximum wave force = _____ newtons

(3)

(g) Suggest **two** reasons why your answer to Question (e) might **not** be very accurate.

1. _____

2. _____

(2)

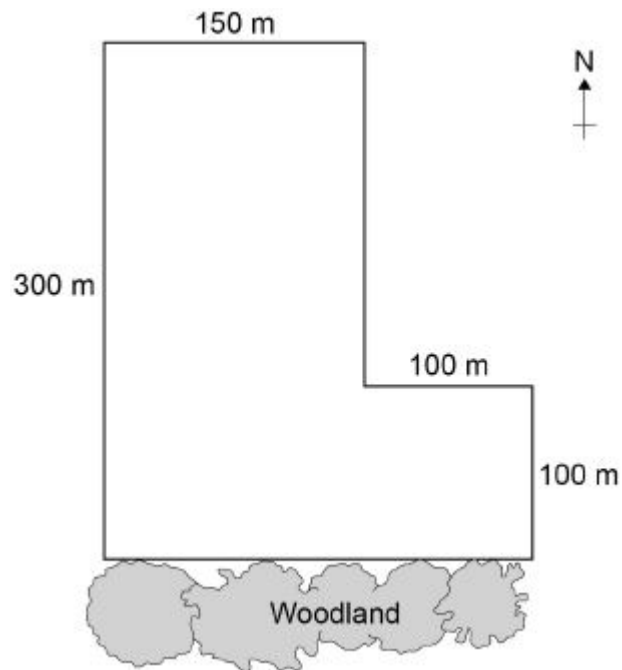
(h) Suggest biological reasons for the lower mean $\frac{H}{W}$ values for limpets on the exposed shore.

(3)
(Total 17 marks)

2.

Some students investigated the size of a population of dandelion plants in a field.

The diagram below shows the field.



The students:

- placed a 1 m × 1 m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.

The table below shows the students' results.

Quadrat number	Number of dandelion plants
1	6
2	9
3	5
4	8
5	0
6	10
7	2
8	1
9	8
10	11

(a) Why did the students place the quadrats at random positions?

(1)

(b) Estimate the total number of dandelion plants in the field.

Calculate your answer using information from the diagram and the table above.

Give your answer in standard form.

Total number of dandelion plants = _____

(5)

(d) Light is an environmental factor that affects the growth of dandelion plants.

Give **two** other environmental factors that affect the growth of dandelion plants.

1. _____

2. _____

(2)

(Total 14 marks)

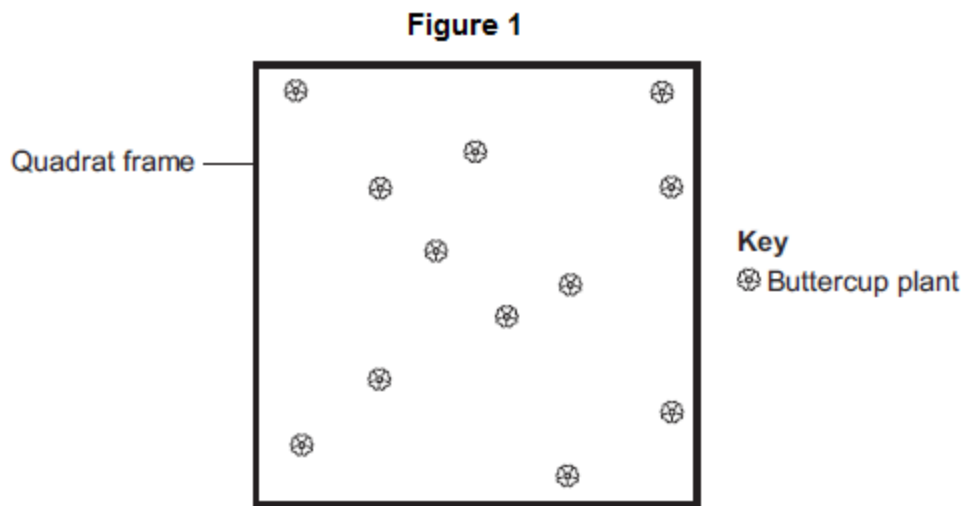
3.

A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

Figure 1 shows the buttercup plants in the quadrat.



The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

(2)

- (ii) The student's estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

(2)

- (b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

- (i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1. _____

2. _____

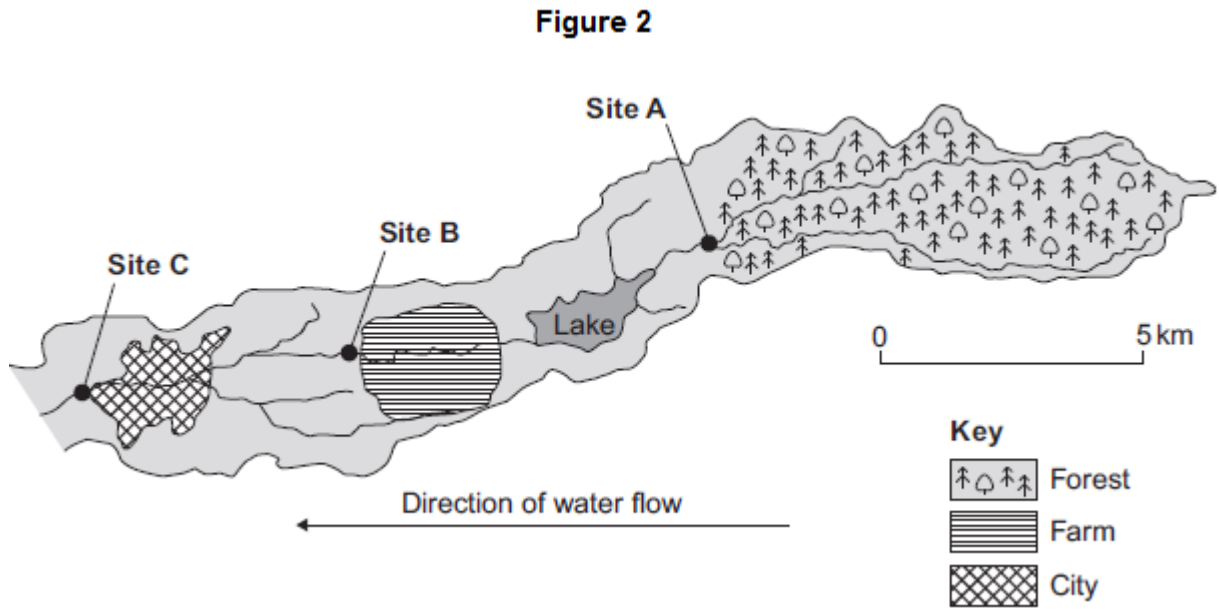
3. _____

(3)

- (ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

(3)

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.



Every year, the farmer puts fertiliser containing mineral ions on some of his fields. When there is a lot of rain, some of the fertiliser is washed into the river.

- (i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

(5)

- (ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

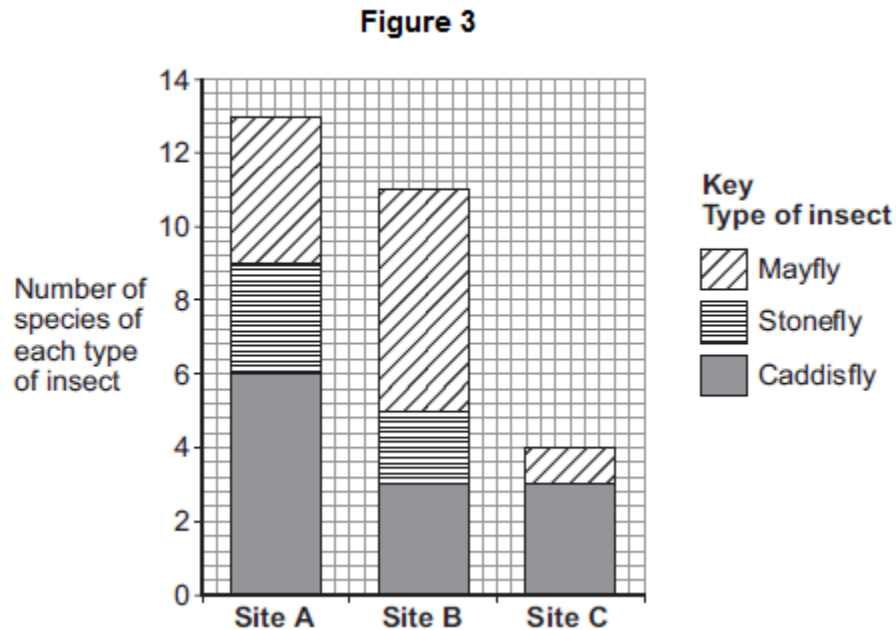
- (d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

Figure 3 shows the scientists' results.



- (i) How many more species of mayfly were there at Site **B** than at Site **A**?

(1)

- (ii) Suggest what caused this increase in the number of species of mayfly.

(1)

- (iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

(1)

(Total 19 marks)