

Question 1: N/A

**2** Different substances are involved in coordinating responses in animals.

**2 (a)** Hormones are different from local chemical mediators such as histamine in the cells they affect.

**2 (a) (i)** Describe how hormones are different in the cells they affect.

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*(1 mark)*

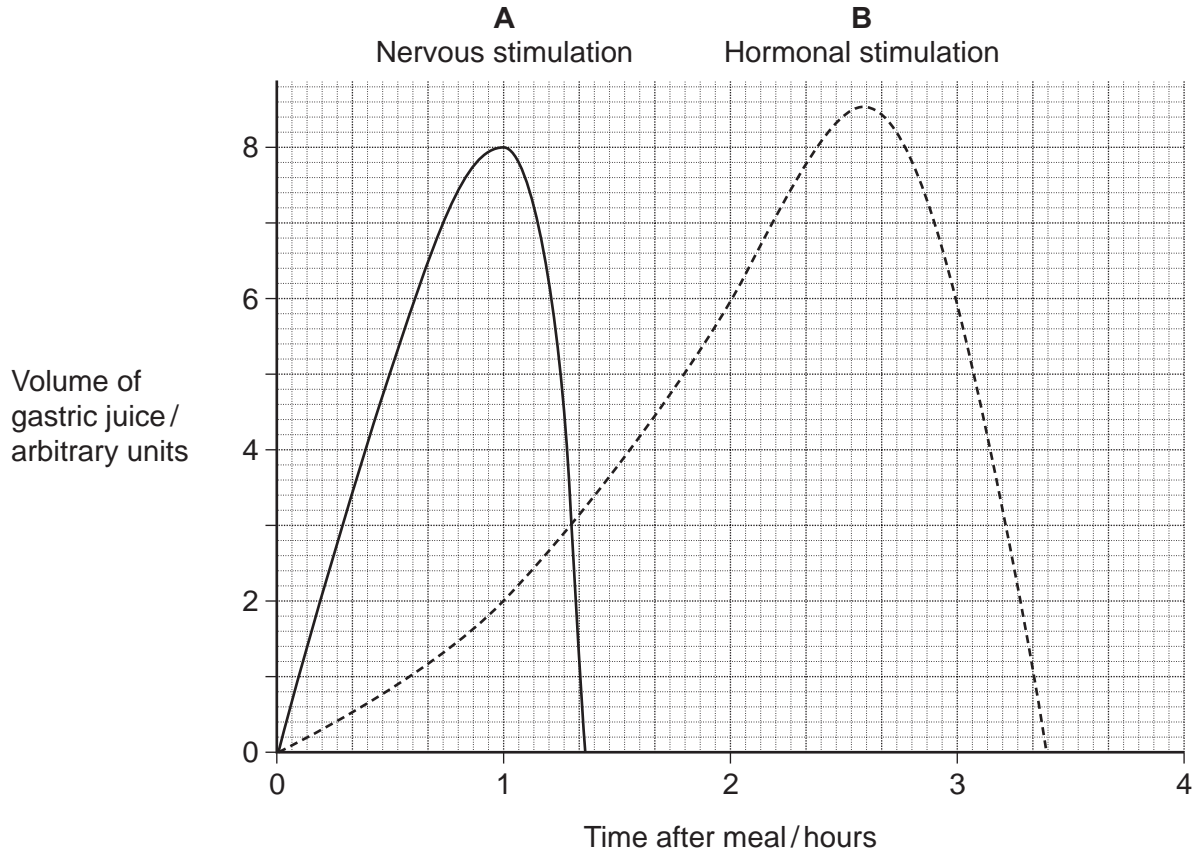
**2 (a) (ii)** Describe how hormones and local chemical mediators reach the cells they affect.

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*(2 marks)*

**2 (b)** Synapses are unidirectional. Explain how acetylcholine contributes to a synapse being unidirectional.

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*(2 marks)*

**2 (c)** Cells in the stomach wall release gastric juice after a meal. The graph shows how the volumes of gastric juice produced by nervous stimulation and by hormonal stimulation change after a meal.



**2 (c) (i)** Describe the evidence from the graph that curve **A** represents the volume of gastric juice produced by nervous stimulation.

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(2 marks)

**2 (c) (ii)** Complete the table to show the percentage of gastric juice produced by nervous stimulation at the times shown.

	Time after meal / hours		
	1	2	3
Percentage of gastric juice produced by nervous stimulation			

(1 mark)

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Turn over ►

**3** IAA is a specific growth factor.

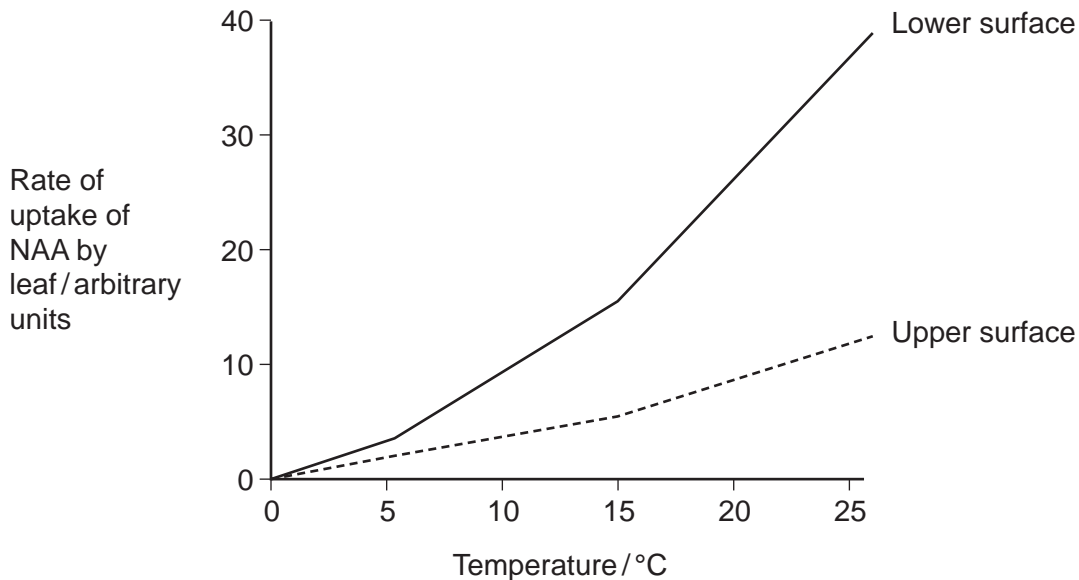
**3 (a)** Name the process by which IAA moves from the growing regions of a plant shoot to other tissues.

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(1 mark)

**3 (b)** When a young shoot is illuminated from one side, IAA stimulates growth on the shaded side. Explain why growth on the shaded side helps to maintain the leaves in a favourable environment.

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(2 marks)

NAA is a similar substance to IAA. It is used to control the growth of cultivated plants. Plant physiologists investigated the effect of temperature on the uptake of NAA by leaves. They sprayed a solution containing NAA on the upper and lower surfaces of a leaf. The graph shows their results.



**3 (c)** Explain the effect of temperature on the rate at which NAA is taken up by the lower surface of the leaf.

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(2 marks)

**3 (d)** There are differences in the properties of the cuticle on the upper and lower surfaces of leaves.

**3 (d) (i)** Suggest how these differences in the cuticle might explain the differences in rates of uptake of NAA by the two surfaces.

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(2 marks)

**3 (d) (ii)** In this investigation, the physiologists investigated the leaves of pear trees. Explain why the results might be different for other species.

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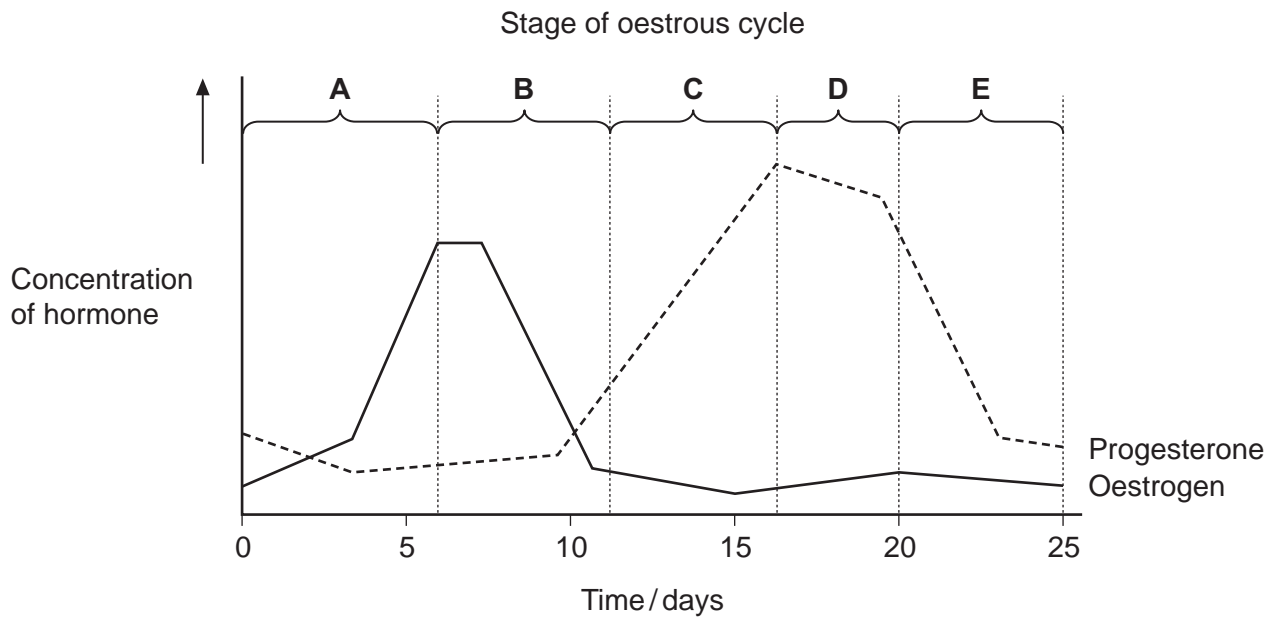
(1 mark)

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Turn over ►



- 4 The graph shows the concentrations of two hormones in the blood of an adult female pig over 25 days.



- 4 (a) (i) Use the graph to give the letter of the stage where ovulation occurred.

(1 mark)

- 4 (a) (ii) Give **one** piece of evidence from the graph that this pig was **not** pregnant at 25 days.

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(1 mark)

**4 (b)** The relationship between oestrogen and LH is an example of positive feedback.  
Explain how.

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(2 marks)

**4 (c)** Farmers sometimes give progesterone to sheep to prevent ovulation.  
Explain how progesterone prevents ovulation.

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(2 marks)

**Turn over for the next question**

Question 5: N/A

6

**Turn over ►**

- 6** Plant physiologists attempted to produce papaya plants using tissue culture. They investigated the effects of different concentrations of two plant growth factors on small pieces of the stem tip from a papaya plant. Their results are shown in the table.

Concentration of auxin / $\mu\text{mol dm}^{-3}$	Concentration of cytokinin / $\mu\text{mol dm}^{-3}$		
	5	25	50
0	No effect	No effect	Leaves produced
1	No effect	Leaves produced	Leaves produced
5	No effect	Leaves produced	Leaves and some plantlets produced
10	Callus produced	Leaves and some plantlets produced	Plantlets produced
15	Callus produced	Callus and some leaves produced	Callus and some leaves produced

Callus is a mass of undifferentiated plant cells.  
Plantlets are small plants.

- 6 (a)** Explain the evidence from the table that cells from the stem tip are totipotent.

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(2 marks)

- 6 (b)** Calculate the ratio of cytokinin : auxin that you would recommend to grow papaya plants by this method.

Answer .....

(2 marks)

**6 (c) (i)** Papaya plants reproduce sexually by means of seeds. Papaya plants grown from seeds are very variable in their yield. Explain why.

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(2 marks)

**6 (c) (ii)** Explain the advantage of growing papaya plants from tissue culture rather than from seeds.

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(1 mark)

**Turn over for the next question**

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**Turn over ►**



- 7 (a) Desert iguanas are lizards that live in hot, dry conditions. Scientists measured the rate of oxygen consumption of desert iguanas at different body temperatures. Some of their results are shown in the table.

Body temperature / °C	Mean rate of oxygen consumption at rest / $\text{cm}^3 \text{g}^{-1} \text{h}^{-1}$
25	0.4
30	0.7
35	1.2
40	1.5

- 7 (a) (i) Explain how an increase in the iguana's body temperature affects its oxygen consumption when it is at rest.

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(3 marks)

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- 7 (a) (ii) The units in the table allowed the scientists to compare the oxygen consumptions of different iguanas. Explain how.

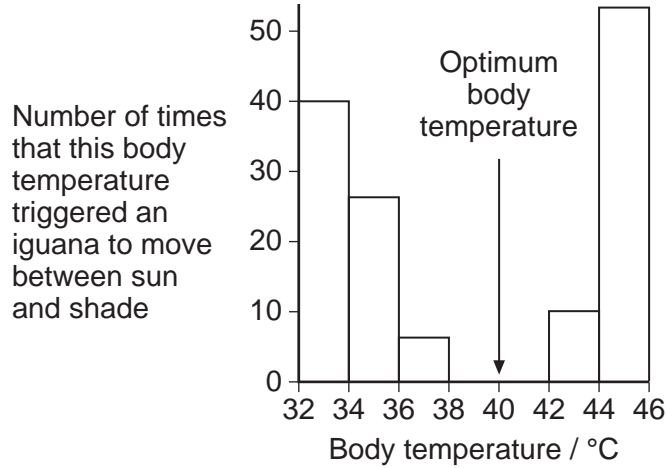
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**7 (b)** The scientists then investigated how body temperature affected the behaviour of desert iguanas. They kept the iguanas in cages. Half of each cage was in the sun and half was covered to provide shade. The scientists continuously measured the body temperature of each iguana. They also recorded the body temperature when the iguana moved between sun and shade. Their results are shown in the graph.



**7 (b) (i)** Describe how the movements of the iguanas between sun and shade are related to body temperature.

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 (1 mark)

**7 (b) (ii)** The behaviour of the desert iguanas keeps their body temperatures within a narrow range. Explain how.

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 (2 marks)

**7 (c)** At high temperatures, a desert iguana keeps its mouth wide open and breathes in and out rapidly. This is called panting. Explain how panting helps to reduce the body temperature of an iguana.

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 (2 marks)

Answer **all** questions in the spaces provided.

8 Nitrogenase catalyses the reduction of nitrogen during nitrogen fixation. The reaction requires 16 molecules of ATP for each molecule of nitrogen that is reduced.

(a) Nitrogen gas is the usual substrate for this enzyme. Name the product.

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(1 mark)

(b) Nitrogenase also catalyses reactions involving other substances. Explain what this suggests about the shapes of the molecules of these other substances.

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(2 marks)

(c) (i) *Azotobacter* is a nitrogen-fixing bacterium. It produces the enzyme nitrogenase. The enzyme only works in the absence of oxygen.

*Azotobacter* has a very high rate of aerobic respiration compared with bacteria that do not fix nitrogen. Suggest **two** advantages of the very high rate of aerobic respiration.

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(2 marks)



**c) (ii)** If scientists could transfer the gene that codes for nitrogenase to cereal plants, these cereal plants would be able to fix nitrogen. However, the scientists would expect these genetically engineered cereal plants to grow more slowly than cereal plants that get their nitrogen from fertiliser. Explain why they would grow more slowly.

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(2 marks)

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**Turn over for the next question**

**Turn over ►**

9 (a) Describe the part played by the inner membrane of a mitochondrion in producing ATP.

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(3 marks)

(Extra space) .....

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**(b)** A scientist investigated ATP production in a preparation of isolated mitochondria. He suspended the mitochondria in an isotonic solution and added a suitable respiratory substrate together with ADP and phosphate. He bubbled oxygen through the preparation.

**(b) (i)** Why was the solution in which the mitochondria were suspended isotonic?

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(1 mark)

**(b) (ii)** Explain why the scientist did **not** use glucose as the respiratory substrate.

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(2 marks)

**(b) (iii)** Explain why the oxygen concentration would change during this investigation.

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(1 mark)

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**Turn over for the next question**

**Turn over ►**

10 A Sri Lankan scientist investigated the effect of human disturbance on the organisms living on a rocky seashore. He chose three areas for the study. These areas had different amounts of human disturbance.

The scientist measured human disturbance by walking from one end of the beach to the other. He recorded the number of people he encountered.

**Figure 1** shows his results.

**Figure 1**

	Site <b>R</b>	Site <b>G</b>	Site <b>U</b>
Mean number of people encountered per hour ( $\pm$ standard deviation)	2.2 ( $\pm$ 2.1)	17.6 ( $\pm$ 9.6)	34.6 ( $\pm$ 11.6)

**(a) (i)** What conclusions can you draw about the number of people visiting Site **R** compared with the number of people visiting the other two sites? Give evidence from **Figure 1** to support your answer.

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(2 marks)

**(a) (ii)** The scientist reported that the difference between the number of people visiting Site **R** and the number visiting the other two sites differed significantly ( $p < 0.05$ ).

Use the words probability and chance to explain the meaning of *differed significantly* ( $p < 0.05$ ).

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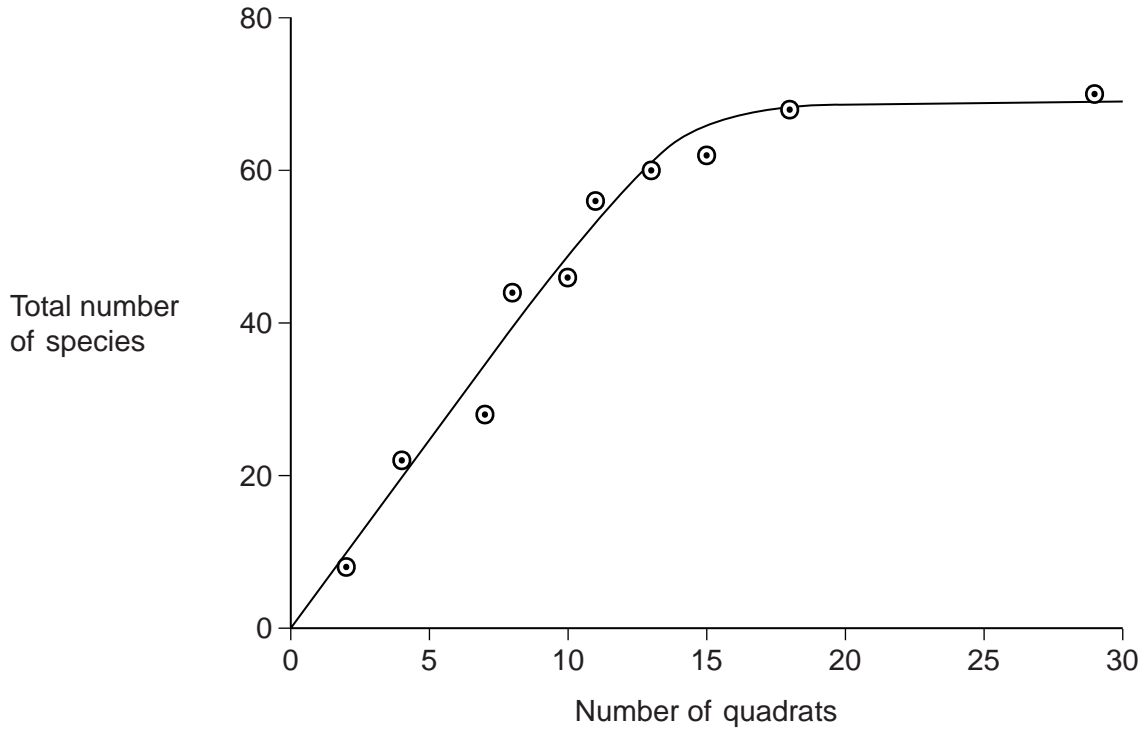
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(2 marks)

- (b) The scientist used quadrats to find the number of species at each of the three sites. He carried out a preliminary investigation and recorded the total number of species in an increasing number of quadrats. **Figure 2** shows the results.

**Figure 2**



- (b) (i) Use **Figure 2** to explain why 10 would **not** be an appropriate number of quadrats to use.

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(1 mark)

- (b) (ii) Use **Figure 2** to explain why 25 would **not** be an appropriate number of quadrats to use.

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(1 mark)

**Question 7 continues on the next page**

**Turn over ►**



The scientist measured the dry biomass of seaweeds at each of sites **R**, **G** and **U**. He collected all the organisms of a particular species in a quadrat and incubated them in an oven at a temperature of 80 °C.

- (c) The scientist incubated the seaweeds at 80 °C. Suggest why incubating them at a higher temperature would **not** produce valid results.

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(1 mark)

As well as measuring the dry biomass of the seaweeds, the scientist measured the dry mass of the animals present. He also measured the abundance of each species. **Figure 3** shows the data he collected.

**Figure 3**

	Site <b>R</b>	Site <b>G</b>	Site <b>U</b>
Mean number of people per hour	2.2	17.6	34.6
Mean number of species of seaweed per quadrat	4.2	2.1	1.3
Ratio of dry biomass of animals to dry biomass of seaweeds	0.15	0.06	0.03
Ratio of dry biomass of animals to abundance of animals	0.20	0.10	0.09
Ratio of dry biomass of seaweeds to abundance of seaweeds	0.79	1.57	3.24

- (d) The ratio of the dry biomass of animals to the dry biomass of seaweeds is always a lot less than one. Explain why.

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(2 marks)

**(e) (i)** Conservation officers were working on the beaches used in this investigation. They noticed that there were fewer larger seaweeds on beaches used by a large number of people than on beaches visited by only a few people. Explain how the data in **Figure 3** support this.

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(2 marks)

**(e) (ii)** What conclusions can you draw from the data in **Figure 3** about the effect of human disturbance on the animals living on the seashore? Explain your answer.

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11 (a) The concentrations of carbon dioxide in the air at different heights above ground in a forest changes over a period of 24 hours. Use your knowledge of photosynthesis to describe these changes and explain why they occur.

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**(b)** In the light-independent reaction of photosynthesis, the carbon in carbon dioxide becomes carbon in triose phosphate. Describe how.

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(c) Microorganisms make the carbon in polymers in a dead worm available to cells in a leaf. Describe how.

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**END OF QUESTIONS**