

- 1 The light-independent reactions of photosynthesis use the products of the light-dependent reactions to produce simple sugars.
- (a) (i) Which row of the table shows the products of the light-dependent reactions that are used in the light-independent reactions?

(1)

	ATP produced by	NADP
☐ A	cyclic photophosphorylation	oxidised
☐ B	cyclic photophosphorylation	reduced
☐ C	non-cyclic photophosphorylation	oxidised
☐ D	non-cyclic photophosphorylation	reduced

- (ii) Simple sugars have the formula $C_nH_{2n}O_n$.
- Name the inorganic molecule that provides each element in a simple sugar.

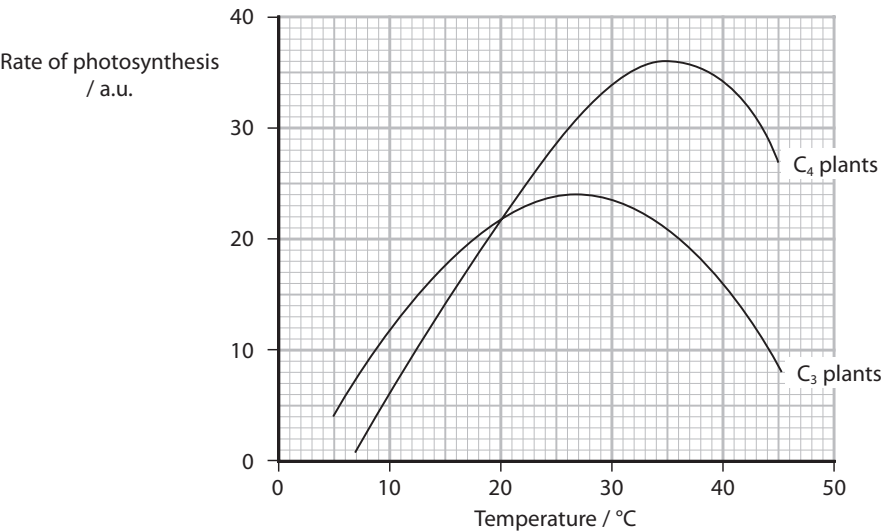
(2)

C

H

O

- (b) Two types of plant, C_3 and C_4 , have slightly different pathways of light-independent reactions.
- The graph shows how the rate of photosynthesis is affected by temperature in these two types of plant.



①

- (i) Describe **three** conclusions that can be made about the differences in the effect of temperature on the rate of photosynthesis in these two types of plant.
- (3)

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- (ii) Calculate the Q_{10} for the enzymes in C_4 plants.
- Use the formula:

$$Q_{10} = \frac{R_{t+10}}{R_t}$$

where R_t is the initial rate of reaction at 10 °C.

Give your answer as a whole number.

(2)

Answer

(Total for Question 1 = 8 marks)

②

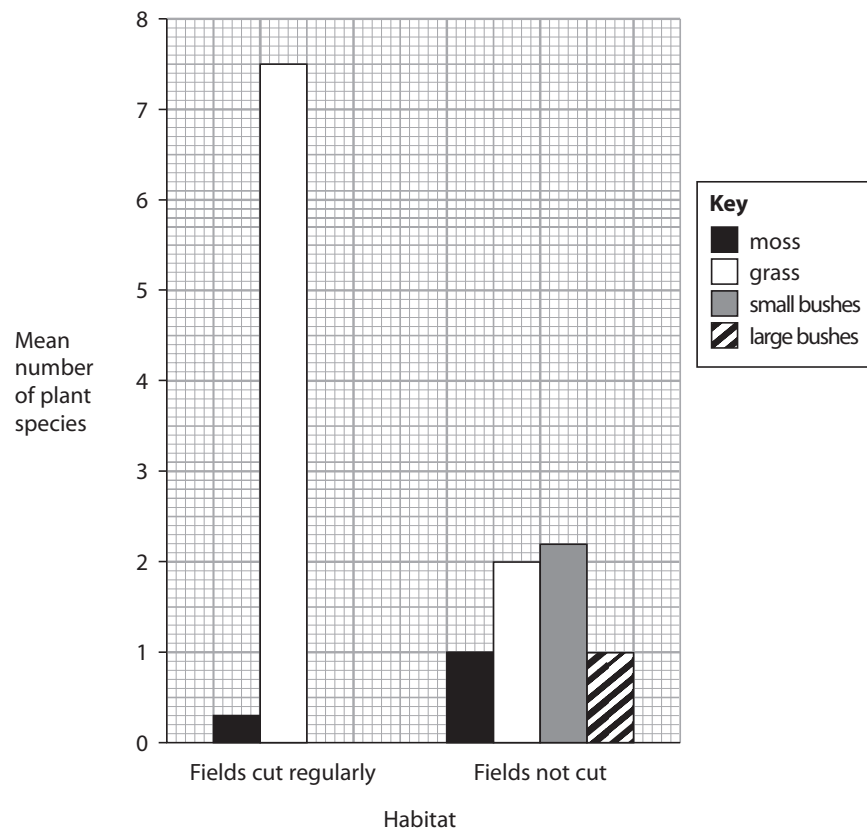
2 Mosses are species of plants that have genomes that enable them to survive in their habitats.

(a) A group of students investigated the mean number of plant species in four habitats.

The habitats that they investigated were:

- fields that were cut regularly
- fields that were not cut
- the middle of woods
- the edge of woods.

The graph shows some of the results from this investigation.



(i) Which row of the table shows the type of factor that affected the plant species in two of these habitats?

(1)

	Cutting the field regularly	Competition with trees for water
☐ A	abiotic factor	abiotic factor
☐ B	abiotic factor	biotic factor
☐ C	biotic factor	abiotic factor
☐ D	biotic factor	biotic factor

(ii) What is the percentage increase in the number of species of moss between the fields cut regularly and the fields not cut?

(1)

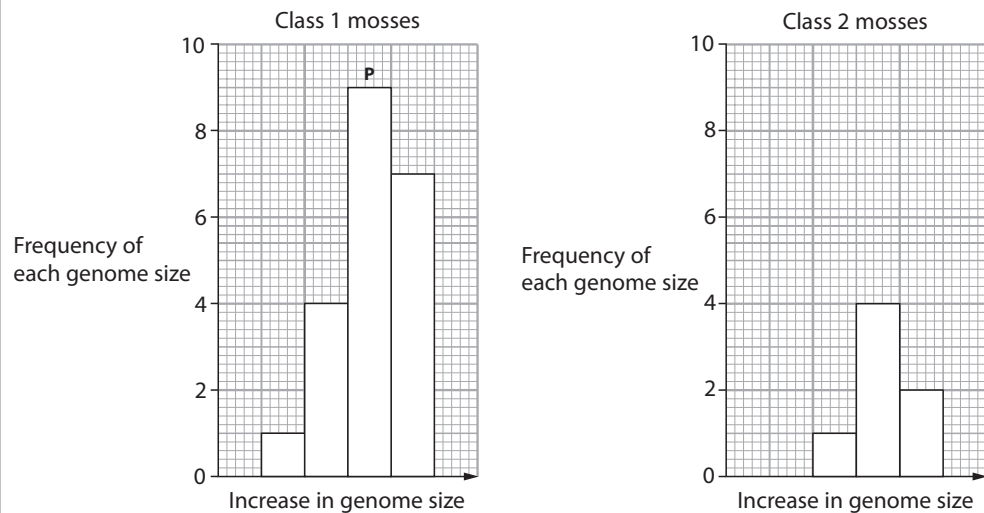
- ☐ A 23.3
- ☐ B 70.0
- ☐ C 233.3
- ☐ D 333.3

(iii) Suggest reasons for the differences in the mean number of plant species in fields cut regularly and in fields not cut.

(2)

- (b) In another investigation, the genome size of 30 species of moss was determined. Each species of moss belonged to one of two classes of moss.

The graphs show the frequency of each genome size in the class 1 mosses and some of the class 2 mosses.



- (i) Which does **P** represent?

(1)

- ☒ **A** the maximum genome size on a bar chart
- ☒ **B** the maximum genome size on a histogram
- ☒ **C** mode genome size on a bar chart
- ☒ **D** mode genome size on a histogram

- (ii) One genome size is missing from the graph for class 2 mosses.

Calculate the frequency of this genome size.

(1)

Answer.....

- (iii) The mean value for the genome size of class 1 mosses was 0.449 a.u. and the mean value for class 2 mosses was 0.920 a.u.

Calculate the ratio of the genome size of class 1 mosses to the genome size of class 2 mosses.

(1)

Answer.....

- (iv) It was suggested that the chromosomes in class 2 mosses were found in pairs.

Give the evidence that supports this suggestion.

(1)

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(Total for Question 2 = 8 marks)

- 3 Redwood trees are the tallest living organisms on Earth. Some of the older trees are more than 2000 years old.

Dendrochronology can be used to work out how old a tree is and how much it has grown each year.

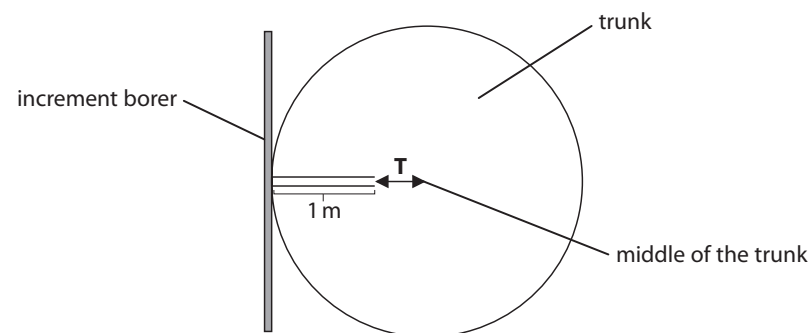
A sample of the tree trunk core can be taken using an increment borer.

The photograph shows an increment borer being used to take a sample of a tree trunk core.



(Source: © Custom Life Science Images / Alamy Stock Photo)

- (a) The diagram shows an increment borer pushed into the trunk of a large Redwood tree.



An increment borer 1 m long was inserted into a Redwood tree. The borer did not reach the middle of the trunk. The distance from the end of the borer to the middle of the trunk is **T** cm.

- (i) Calculate the radius (r) of a tree with a circumference (C) of 8 m.

Use the formula: $r = \frac{C}{2\pi}$

Give your answer to **two** decimal places.

(1)

Answer m

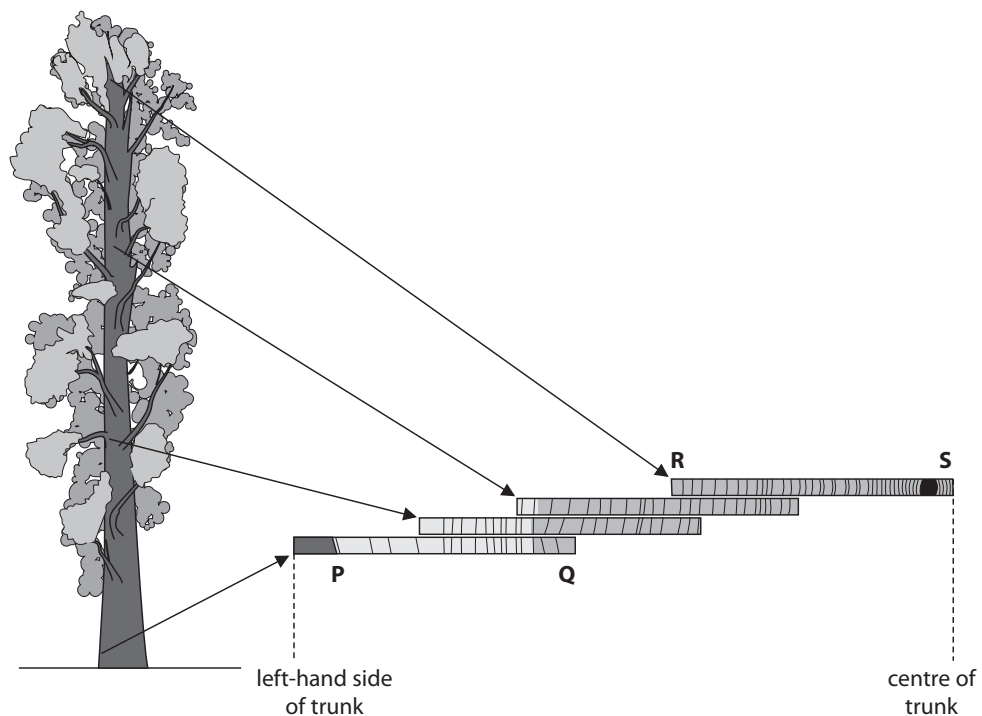
- (ii) Calculate the distance **T** as a percentage of this radius.

(1)

Answer %

- (b) To calculate how old a tree is and how much it has grown, core samples are taken at different heights up the tree.

These core samples are then aligned by matching the rings, as shown in the diagram.



- (i) Which row of the table shows the newest and oldest rings in this tree?

(1)

	newest ring	oldest ring
☐ A	P	Q
☐ B	P	S
☐ C	S	R
☐ D	S	P

- (ii) Explain how these core samples can be used to calculate the age of this tree.

Use the information in the question and the diagram to support your answer.

(3)

- (iii) Describe how the growth rate of this tree can be calculated.

(2)

(Total for Question 3 = 8 marks)

4 Cultivation of seaweed for food is well-established in Asia.

- (a) In 2017, the global harvest of seaweed was 32.9 million tonnes. Of this, 96.6% was cultivated.

Calculate the mass of cultivated seaweed.

Give your answer in standard form.

(1)

Answer..... tonnes

- (b) Seaweeds are photosynthetic organisms.

Photosynthesis can be described as a reaction requiring light to split apart the strong bonds in water molecules, storing the hydrogen in a fuel by combining it with carbon dioxide and releasing oxygen into the atmosphere.

- (i) Which type of bond is broken in a water molecule?

(1)

- ☐ **A** covalent
☐ **B** glycosidic
☐ **C** hydrogen
☐ **D** ionic

- (ii) Which is a fuel that stores hydrogen in plants and seaweeds?

(1)

- ☐ **A** ATP
☐ **B** glucose
☐ **C** glycogen
☐ **D** RUBISCO

- (iii) Which row of the table shows the reactions that combine hydrogen with carbon dioxide and release oxygen into the atmosphere?

(1)

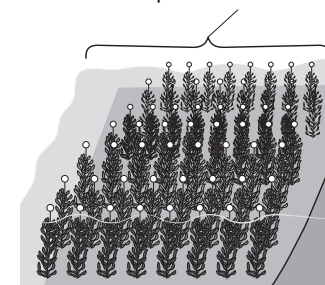
	Hydrogen is combined with carbon dioxide	Oxygen is released into the atmosphere
☐ A	light-dependent reactions	light-dependent reactions
☐ B	light-dependent reactions	light-independent reactions
☐ C	light-independent reactions	light-dependent reactions
☐ D	light-independent reactions	light-independent reactions

- *(c) In Europe, cultivation of seaweed takes place on a small scale. Large-scale cultivation of seaweed is now being considered.

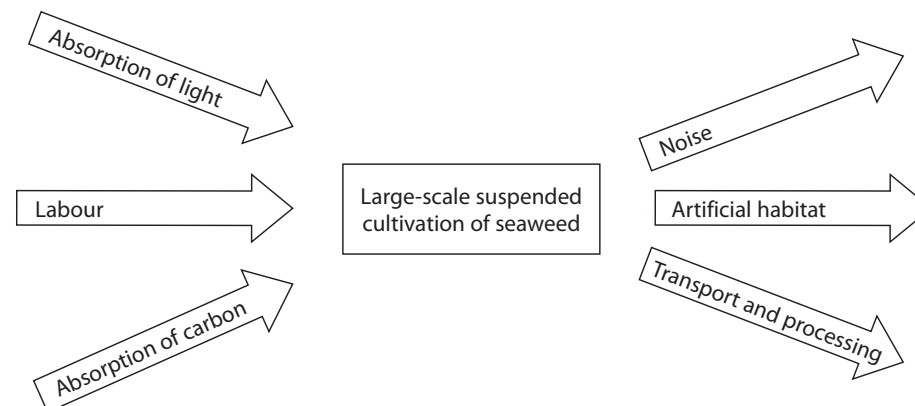
Effective management of the conflict between human needs and conservation is necessary before large-scale cultivation can be used.

The diagram shows seaweed grown by suspended cultivation, a method used in Asia.

Rows of seaweed suspended on wires in the sea



The diagram shows some of the factors that have to be considered when managing the conflict between human needs and conservation.



Discuss the considerations that need to be taken into account when deciding whether or not large-scale seaweed production is suitable in Europe.

Use the information in the two diagrams and your own knowledge to support your answer.

(6)

(Total for Question 4 = 10 marks)