Living together – food and ecosystems – 2021/20 GCSE 21st GCSE Biology B

1. Nov/2021/Paper_J257_03/No.1

(a) Plants and animals use small organic molecules to make larger organic molecules.

Draw lines to connect the small organic molecules with the large organic molecules that they are used to make.

Small organic molecules	Large organic molecules
Amino acids	Fats
Fatty acids	Long-chain carbohydrates
Glycerol	Proteins
Sugar	

[2]

(b) Plants obtain important substances from their environment.

Which list of elements must plants obtain from the environment?

Tick (✓) **one** box.

- Carbon, hydrogen, and oxygen ☐
- Carbon, hydrogen, nitrogen, and oxygen ☐
- Nitrogen and carbon ☐
- Only carbon ☐

[1]

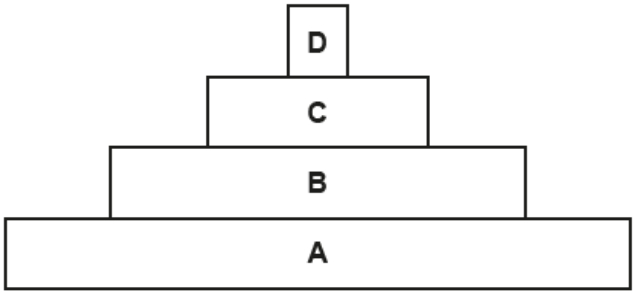
2. Nov/2021/Paper_J257_03/No.3

The diagram shows a pyramid of biomass for the following food chain.

Food chain

Tree → Insect → Sparrow → Kestrel

Pyramid of biomass



Dry weight (g/m^2)
1.5
11
37
809

(a) Which organism in the food chain would you place in **bar A** of the pyramid of biomass?

..... **[1]**

(b) Describe the general change in biomass that occurs between the trophic levels shown in the pyramid **and** give **two** reasons for this change.

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..... **[3]**

(c) The percentage efficiency of the biomass transfer between trophic levels can be calculated using the efficiency equation:

$$\textbf{Percentage efficiency} = \frac{\textbf{average biomass in higher trophic level } (g/m^2)}{\textbf{average biomass in lower trophic level } (g/m^2)} \times 100\,\%$$

Calculate the percentage efficiency of the biomass transfer between trophic levels 2 and 3.

Give your answer to **1** significant figure.

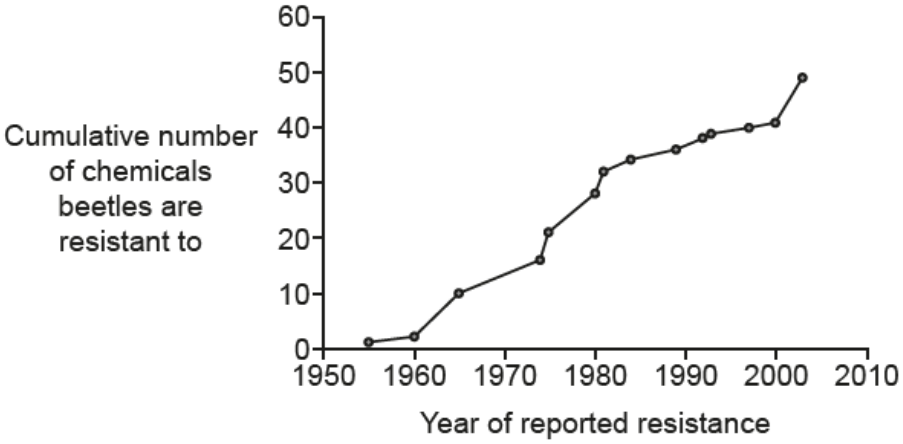
Efficiency = ... % **[3]**

3. Nov/2021/Paper_J257_03/No.8

The Colorado potato beetle feeds on potato crops.

Farmers can use different chemical compounds to kill the beetle. The beetle has developed resistance to these chemicals over time.

The graph shows the cumulative number of chemicals that Colorado potato beetles have become resistant to, from 1955 to 2003.



(a) Explain why farmers are worried about the effect that Colorado potato beetles may have on potato crops in the future.

Use data from the graph to support your answer.

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..... **[3]**

(b) Using insecticides is one method of controlling insect pests.

Suggest **one** alternative method that could be used to control insect pests.

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..... **[1]**

(c) The evolution of new pests is one example of a biological threat to food security.

Identify **two** additional threats to food security.

1 .....

2 .....

[2]

4. Nov/2021/Paper_J257_03/No.10

Reactions catalysed by enzymes are affected by temperature changes.

(a) Describe how body temperature affects the rate of reactions catalysed by enzymes.

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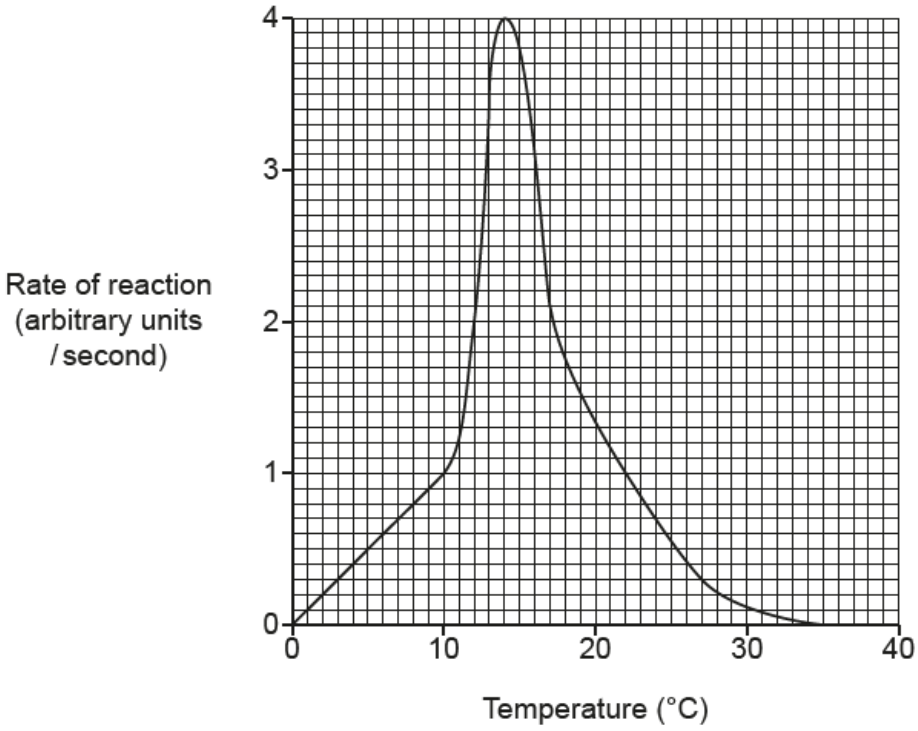
..... **[3]**

(b) The graph shows the effect of temperature on the rate of reaction for the enzyme catalase.



The table shows the optimum temperature for catalase in three different organisms.

Organism	Optimum temperature for catalase (°C)
E. coli bacterium	22
Potato	35
Toad	15

Which organism from the table was used to produce the data shown in the graph?

Explain your answer.

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..... **[2]**

5. Nov/2021/Paper_J257_03/No.13

This question is about photosynthesis.

(a) Write the balanced symbol equation for photosynthesis.

..... + ... → ..... + ...

[2]

(b) A student investigates the effect of light intensity on the rate of photosynthesis.

They set up a test tube containing pond weed in water at different distances from a lamp.

Their results are shown in the table.

Distance of lamp from pond weed (cm)	Number of bubbles produced in 1 minute
10	122
15	54
20	31
25	18
30	13

The student writes down the relationship between light intensity and the distance, d, of the pond weed from the lamp.

$$\text{light intensity} \propto \frac{1}{d^2}$$

Explain why the rate of photosynthesis was lower at 20 cm than at 10 cm.

Use the inverse square law and data from the table to support your answer.

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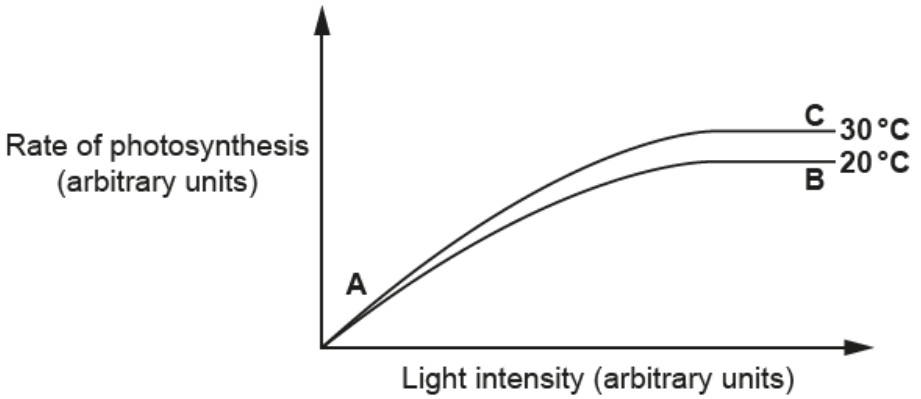
..... **[2]**

(c) The graph shows how different factors affect the rate of photosynthesis.



Which factors are limiting the rate of photosynthesis at points **A**, **B** and **C**?

Explain your answers.

Limiting factor at point **A** .....

Limiting factor at point **B** .....

Limiting factor at point **C** .....

A .....

.....

B .....

.....

C .....

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[4]

6. Nov/2020/Paper_J257_03/No.8

(a) The graph shows how temperature can affect the rate of photosynthesis for three different plant types, **A**, **B** and **C**.

Key
—— Plant type **A**
---- Plant type **B**
—·— Plant type **C**

(i) Which **three** conclusions can be drawn from the graph?

Tick (✓) **three** boxes.

All plant types can photosynthesise over the same range of temperatures. ☐

For all plant types, as temperature increases the rate of photosynthesis increases, peaks and then decreases. ☐

The highest rate of photosynthesis for plant type **B** is at 25 °C. ☐

The highest rate of photosynthesis for plant type **C** and **A** is the same. ☐

The lowest rate of photosynthesis for plant type **C** is at 25 °C. ☐

Plant type **C** is less tolerant of high temperatures. ☐

[3]

(ii) Explain why temperature affects the rate of photosynthesis.

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..... **[2]**

(b) Describe the **two** main stages of photosynthesis and the role of chloroplasts in this process.

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..... **[4]**

7. Nov/2021/Paper_J257_01/No.3

This question is about plants.

Select the correct word from the list to match each statement.

You can use each word once, more than once, or not at all.

auxin **gravitropism** **meiosis** **meristem** **mitosis**

photosynthesis **phototropism** **stomata**

(a) The name of a plant hormone. ..... **[1]**

(b) A growth response to gravity. ..... **[1]**

(c) A growth response to light. ..... **[1]**

(d) Unspecialised plant cells. ..... **[1]**

(e) Cell division that results in the formation of gametes. ..... **[1]**

8. Nov/2021/Paper_J257_01/No.8

As the human population is increasing, we need to provide more food.

(a) Explain how farmers selectively breed cows that produce more meat.

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..... **[3]**

(b) Humans use technology to help increase food production.

Draw lines to connect each technology with the statement which explains how this improves food production.

Technology	Improved food production
Fertilisers	Fewer crops are eaten by insects.
Genetic engineering	It gives plants the ability to survive disease and drought.
Pesticides	Plants obtain more essential nutrients so grow more.

[2]

(c) Give **one** way in which pesticides can reduce biodiversity.

.....

..... **[1]**

(d) Biofuel is now used in some vehicles as a fuel. It is made from plants.

Burning biofuel releases carbon dioxide. However, biofuel is described as carbon neutral.

Suggest why biofuel is described as carbon neutral.

Use ideas about photosynthesis in your answer.

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..... **[2]**

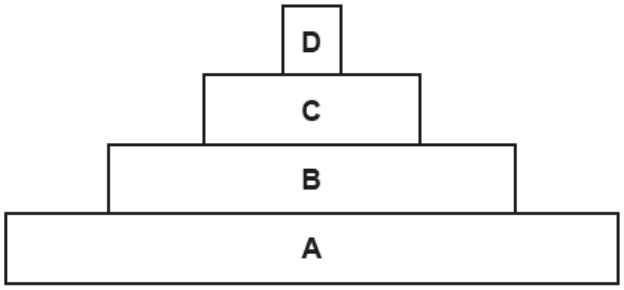
9. Nov/2021/Paper_J257_01/No.12

The diagram shows a pyramid of biomass for the following food chain.

Food chain

Tree → Insect → Sparrow → Kestrel

Pyramid of biomass



Dry weight (g/m^2)

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(a) Which organism in the food chain would you place in **bar A** of the pyramid of biomass?

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(c) The percentage efficiency of the biomass transfer between trophic levels can be calculated using the efficiency equation:

$$\textbf{Percentage efficiency} = \frac{\textbf{average biomass in higher trophic level } (g/m^2)}{\textbf{average biomass in lower trophic level } (g/m^2)} \times 100\,\%$$

Calculate the percentage efficiency of the biomass transfer between trophic levels 2 and 3.

Give your answer to **1** significant figure.

Efficiency = ... % **[3]**

10. Nov/2021/Paper_J257_02/No.2

An albatross is a large sea bird.

(a) Fish and squid are eaten by the albatross.
Albatross chicks are eaten by large mice.

Draw a food web for this community of organisms.

[2]

(b) Read the article.

> The albatross chicks on the island are hunted and eaten by large mice.
>
> There were no mice on the island originally. They were brought to the island by human visitors in the 1800s. Since then, the average size of the mice has gradually increased, and most are now giants!
>
> These albatross are now a critically endangered species.

(i) The mice that were brought to the island were a new predator for the albatross. The new predator has caused the size of the albatross population to decrease.

Describe **two other** factors that could cause a decrease in the size of the albatross population.

1. .....

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2. .....

.....

[2]

(ii) Statements **A** to **D** explain how natural selection caused the mice to become larger.

They are **not** in the correct order.

A These mice got more food, so were more likely to survive to reproduce.

B Big mice had an advantage when competing to eat albatross chicks.

C More mice in each generation inherited genes that allowed them to grow larger.

D When mice were brought to the island, some were large and some were small.

Write the letters in the boxes to show the correct order.

[3]

(iii) The table shows how many albatross were counted on the island in five squares measuring 1 km^2 each, in 2020.

Square	**1**	**2**	**3**	**4**	**5**
Number of albatross	32	64	50	79	60

Calculate the mean number of albatross per km^2 in 2020 on the island.

Mean = ... **[2]**

(iv) Scientists have estimated that:

- In 1980, the mean number of albatross per km^2 of the island was 1429.
- In 2000, the mean number of albatross per km^2 of the island was 159.

Scientists plan to kill all of the large mice on the island by poisoning them.

Suggest **two** reasons that could be used to justify the scientists' plan.

1. .....

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2. .....

.....

[2]

11. Nov/2021/Paper_J257_02/No.6

Plants take up water from soil.

(a) A scientist compared how much water was taken up by two plants.

The scientist set up the plants as shown in **Fig. 6.1**.

Plant A

- Bright light
- Plenty of air
- Given 200 ml of water each time the soil has dried out

Plant B

- Dim light
- Plenty of air
- Given 200 ml of water each time the soil has dried out

Fig. 6.1

(i) Identify **two** other factors that the scientist should have tried to keep the same for both plants.

1. .....

2. .....

[2]

(ii) Photosynthesis took place in the two plants.

Fig. 6.2 shows a summary of photosynthesis.

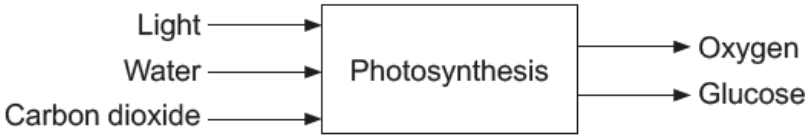

Fig. 6.2

The scientist found that plant **A** took up more water than plant **B**.

Explain the scientist's finding.

Use **Fig. 6.1** and **Fig. 6.2** to support your answer.

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..... **[3]**

(b) **Fig. 6.3** shows an experiment that a class did, which involved growing a plant in a pot for one year.

Start of the year End of the year

Fig. 6.3

(i) Water was added to the soil in the pot several times each week. The total amount of water added to the soil in each 7-day week was 280 ml.

Calculate the rate at which water was added to the soil, in **ml / day**.

Rate = ... ml / day **[2]**

(ii) The rate at which water is added to the soil is **not** an accurate measurement of the rate at which the plant takes up the water.

Which piece of apparatus could be used to accurately measure the rate at which the plant takes up water?

Put a (ring) around the correct answer.

Balance **Measuring cylinder** **Potometer** **Thermometer**

[1]

(c) The class recorded the mass of the pot and soil at the start of the year and again at the end of the year. They also recorded the mass of the plant on its own.
The results are shown in **Fig. 6.4**.

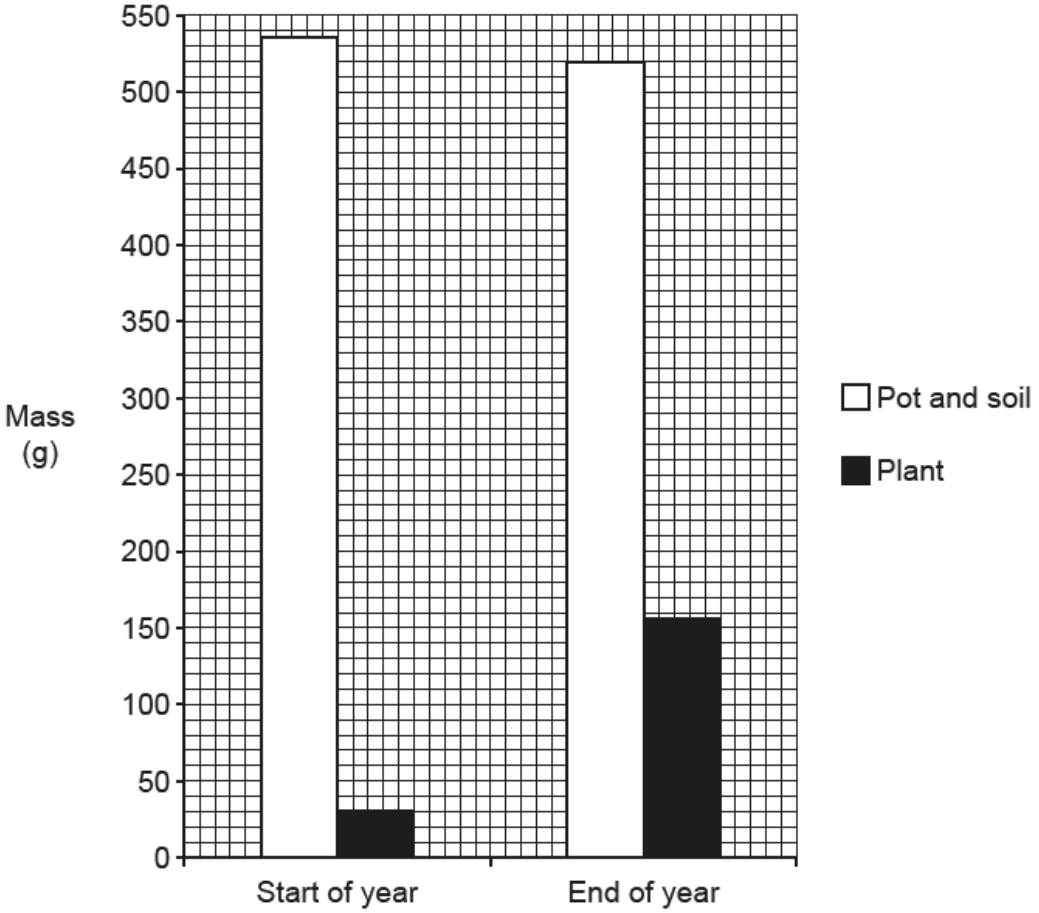

Fig. 6.4

(i) What was the mass of the pot and soil at the end of the year, using **Fig. 6.4**?

Mass = ... g **[1]**

(ii) The mass of the plant was 30 g at the start of the year.
The mass of the plant was 156 g at the end of the year.

Calculate the percentage change in the mass of the plant.

Use the equation: Percentage change = $\frac{\text{difference}}{\text{original}} \times 100$

Percentage change = ... % **[2]**

(iii) Jamal suggests a conclusion for the class experiment.

Explain why Jamal is wrong.

Use data from **Fig. 6.4** to support your answer.

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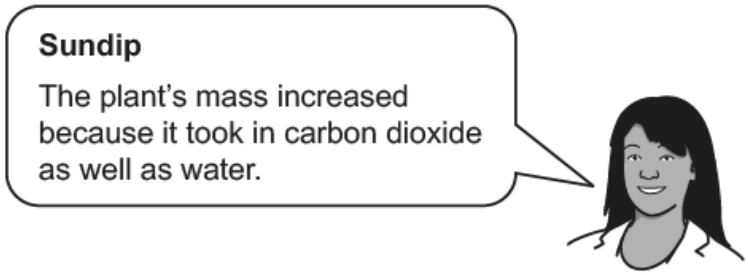
[2]

(iv) Sundip suggests a different conclusion.



Suggest why Sundip's conclusion is **not** supported by the data collected by the class.

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[2]

12. Nov/2020/Paper_J257_02/No.5

Mistletoe is a very unusual plant. Instead of growing in the ground, mistletoe grows on another plant such as a tree, as shown in **Fig. 5.1**.

Fig. 5.1

(a) Mistletoe takes most of the sugar it needs from a tissue in the tree. This tissue transports sugars around the tree.

A diagram of the tissue in the tree is shown in **Fig. 5.2**.

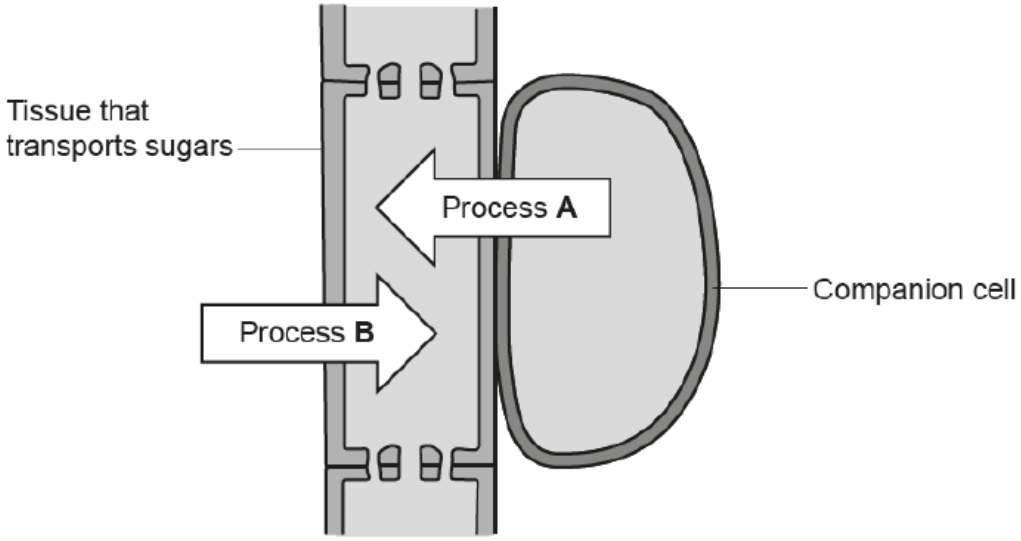

Fig. 5.2

(i) What is the name of the tissue in the tree that the mistletoe takes sugars from?

..... **[1]**

(ii) Process **A** transports sugars into the tissue in the tree.

What is the name of process **A**?

Put a (ring) around the correct answer.

active transport **osmosis** **translocation** **transpiration** **[1]**

(iii) Process **B** transports water into the tissue in the tree.

What is the name of process **B**?

Put a (ring) around the correct answer.

active transport **osmosis** **translocation** **transpiration** **[1]**

(b) Mistletoe does not have roots in the soil.

Mistletoe takes all the water it needs from a **different** tissue in the tree. This tissue transports water from the tree's roots to the tree's leaves.

A diagram of this tissue in the tree is shown in **Fig. 5.3**.

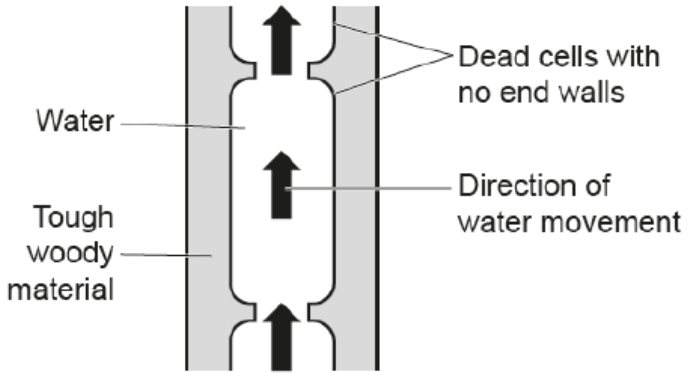

Fig. 5.3

(i) What is the name of the tissue in the tree that the mistletoe takes water from?

..... **[1]**

(ii) Explain why water moves through this tissue from the roots to the leaves in a normal tree.

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..... **[4]**

(c) Mistletoe can catch diseases from the tree it is growing on.

Sarah collects some microorganisms from a piece of mistletoe. She wants to use a light microscope, as shown in **Fig. 5.4**, to look at the microorganisms.

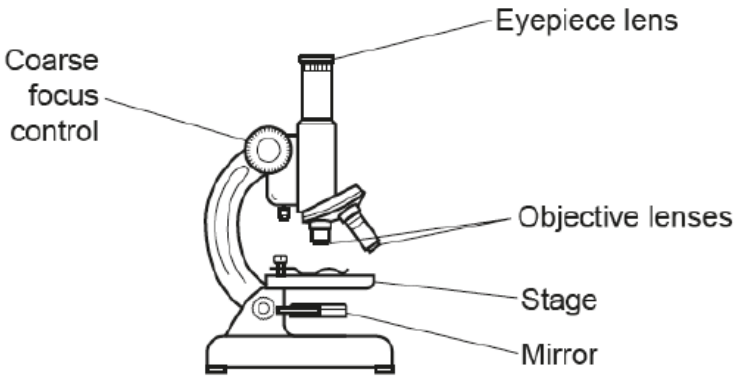

Fig. 5.4

(i) Sarah puts a slide with a sample of the microorganisms on the microscope stage.

She plans to use the microscope's mirror to reflect direct sunlight through the slide so she can see the microorganisms.

Explain why this is dangerous, and suggest what Sarah could do instead to be safer.

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..... **[2]**

(ii) Sarah looks into the eyepiece lens and turns the coarse focus control to move the objective lens towards the slide.

Explain why this is dangerous, and suggest what Sarah could do instead to be safer.

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..... **[2]**