1 Wilson grows tomatoes in a glasshouse.

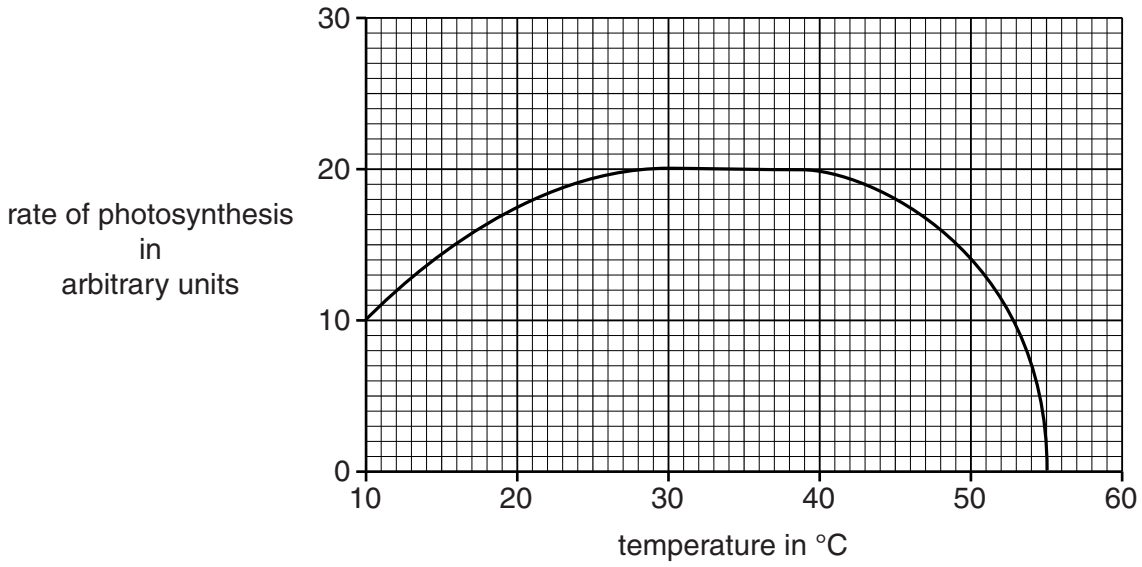
The more the tomato plants photosynthesise, the bigger the crop of tomatoes.

Wilson knows that the rate of photosynthesis depends on temperature.

He wants to use heaters in his glasshouse to make his tomato plants photosynthesise faster.

(a) He wants to find out the best temperature to have in his glasshouse.

Look at the graph.



(i) **Describe** what the graph shows. Use data in your answer.

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

(ii) **Explain** the shape of the graph.

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

(iii) According to the graph, what is the best temperature for Wilson to have in his glasshouse?

.....°C

Explain your answer.

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

(b) Before Wilson decides to use heaters in his glasshouse, suggest what else he should consider, apart from the increased rate of photosynthesis.

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

2 Green plants contain chlorophyll.

The molecular formula of chlorophyll is $C_{55}H_{72}O_5N_4Mg$.

Plants get the magnesium (Mg) they need in the form of compounds, such as magnesium sulfate, through their roots.

(a) How do plants get the carbon (C) they need to make chlorophyll?

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

(b) How do plants get the hydrogen (H) they need to make chlorophyll?

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

(c) How do plants get the oxygen (O) they need to make chlorophyll?

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

(d) How do plants get the nitrogen (N) they need to make chlorophyll?

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

[Total: 4]

3 Carbon dioxide and water are needed for photosynthesis.

(a) Finish the **balanced symbol equation** for photosynthesis.

$6CO_2$ + $_2O$ → ..... + ... **[1]**

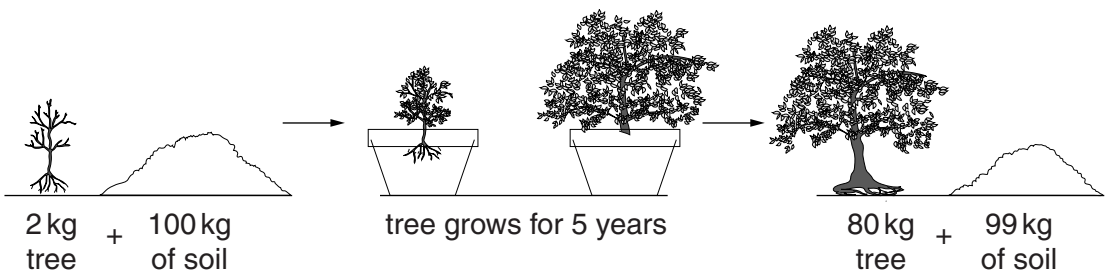
(b) In 1649, scientists thought that plants grew by **only** taking in solid materials from the soil.

A scientist called van Helmont did an experiment to test this idea.

He grew a tree in a large pot of soil.

He measured the mass of the soil and the tree before the experiment.

He measured them again, five years later.



Explain how van Helmont's experiment proved the scientists wrong.

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

(c) Van Helmont wanted to find out if the tree gained mass from water.

He watered the soil during the experiment.

He covered the soil so that water could not evaporate from the soil.

(i) The mass of the water that he added during the five years, was **much more** than the increase in mass of the plant.

Suggest why.

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

(ii) He needed to water the soil much more on windy days.

Explain why.

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

[Total: 7]

4 **(a)** Chris is a farmer.

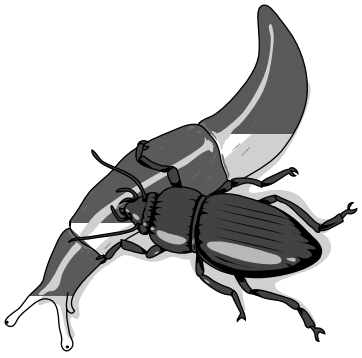
He is growing swedes in a field.

There are many slugs in the field.

The slugs move over the surface of the soil and eat his swede plants.

Chris decides to buy some beetles to release into the field.

These beetles eat slugs.



Before releasing the beetles, Chris wants to know how many slugs are in the field.

He does a capture-recapture experiment.

Chris catches some slugs, marks them and releases them.

A few days later, he catches some slugs again.

Chris works out that there are about **900** slugs in the field.

He does the experiment again, several weeks **after** releasing the beetles.

Here are the results of his second experiment:

Number of slugs in 1st sample	**Number of slugs in 2nd sample**	**Number of marked slugs in 2nd sample**
50	45	5

This is the formula he uses to analyse the results.

$$\text{population size} = \frac{\text{number in 1st sample} \times \text{umber in 2nd sample}}{\text{number in 2nd sample previously marked}}$$

Write about the assumptions Chris has to make in estimating the number of slugs and what his results tell him about how successful his control method has been.

The quality of written communication will be assessed in your answer to this question.

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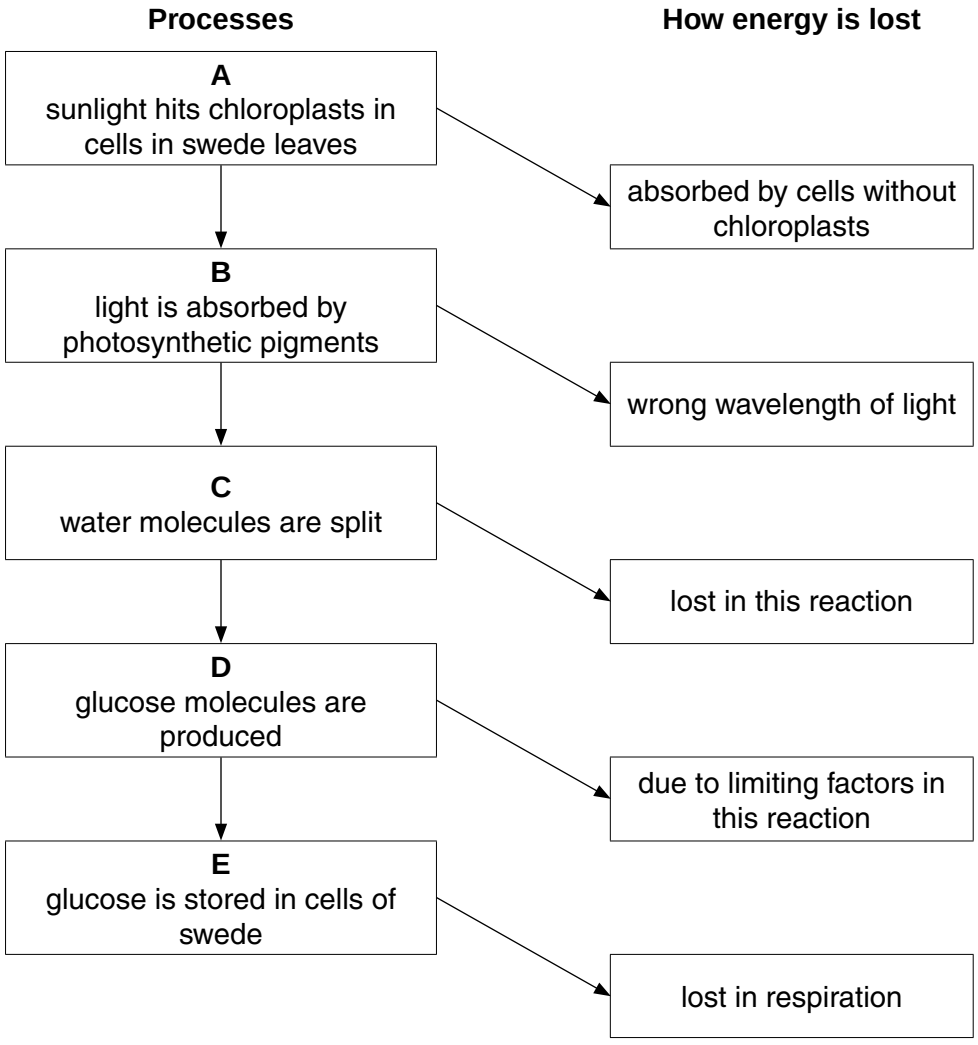
..... **[6]**

(b) A scientist investigates glucose production in swede plants.

He looks at five processes, **A** to **E**, that are involved in sugar production.

He finds out how energy is lost in each process.



(i) Which process, **A**, **B**, **C**, **D** or **E**, produces oxygen gas?

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

(ii) How does the structure of a plant leaf help to reduce the loss in process **A**?

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

(iii) Carotene and xanthophyll help to reduce the energy lost in process **B**.

Explain how they do this.

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

[Total: 10]