1 There are many different types of microorganisms that live in soil.

The table gives the average number of each type of microorganism in one gram of soil.

Type of microorganism	Average number of microorganisms in one gram of soil
viruses	150 000 000
bacteria	3 000 000
fungi	1 000 000

Lucy knows that bacteria are important in soil.

She wants to find out if the soil in her garden contains the average number of bacteria.

She reads about a way of estimating the number.

It involves taking one gram of soil, mixing it with water and spreading the mixture on an agar plate.

Each single bacterium reproduces many times and makes a colony.

(a) When Lucy incubates this **first** agar plate the whole surface of the agar is covered and it is impossible to see individual colonies.

Explain why.

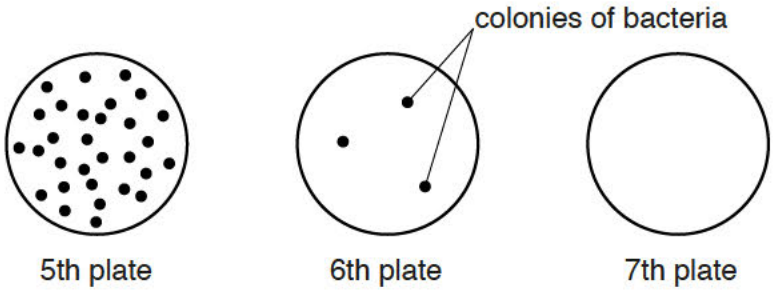
..... **[1]**

(b) Lucy then makes a series of agar plates by diluting the mixture.

The second plate receives 10 times fewer bacteria than in the soil sample.

The third plate receives 100 times fewer bacteria and so on.

The diagram shows some of her results.



Do the results show that Lucy's soil contains the average number of bacteria?

Use her results and the data in the table to work out your answer.

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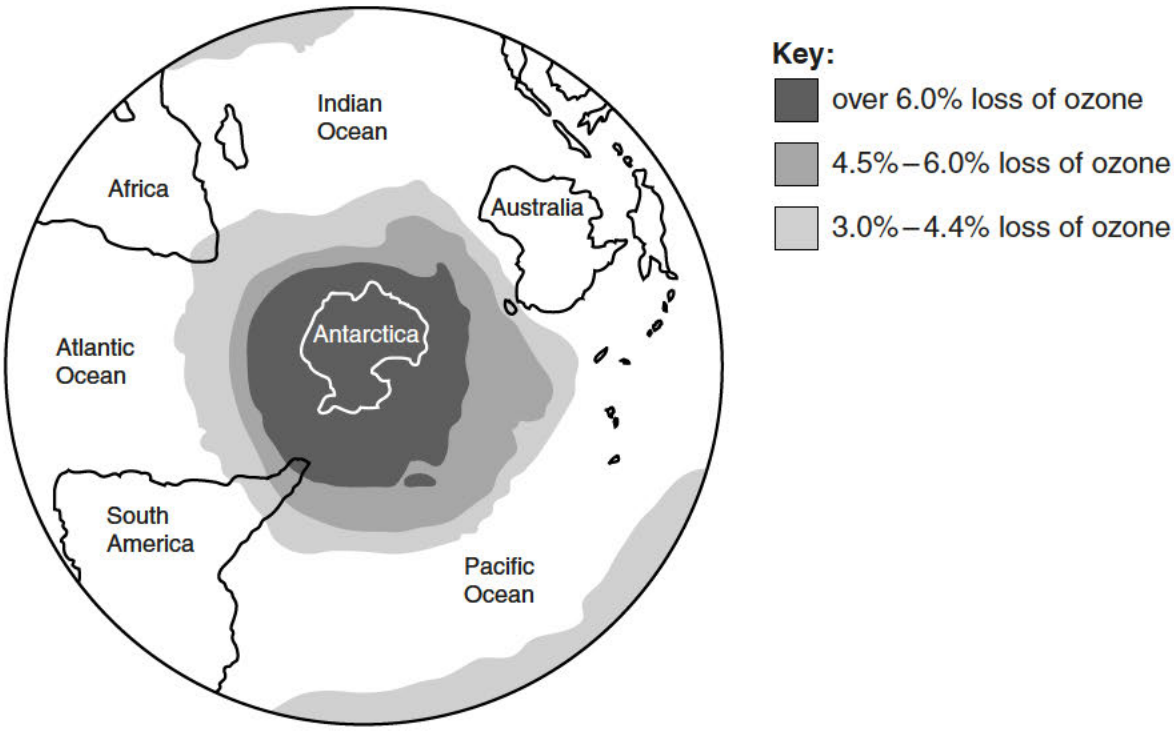
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..... **[2]**

2 This question is about pollution.

(a) Look at the picture.

It shows the loss of ozone from the Earth's atmosphere.



(i) Write about the reasons why ozone is being lost from the atmosphere.

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

(ii) People live in Africa, South America and Australia.

Parts of each of these continents are affected by the loss of ozone.

People in one of these three continents will be **most** affected by the loss of ozone.

Use the diagram to decide which continent this is **and** explain how the people will be affected.

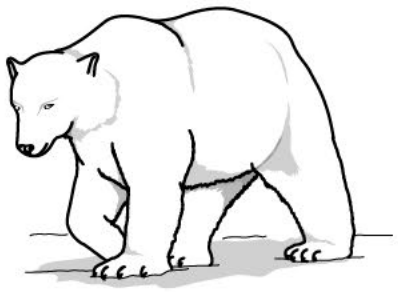
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(b) Global warming has been linked to the melting of the Arctic ice cap.

Polar bears live in the Arctic regions.



Polar bears and killer whales feed on seals.

Polar bears compete with other polar bears for seals.

They also compete with killer whales for seals.

What is the main difference between these two types of competition and if the ice cap continues to melt, explain which type of competition will be most significant for polar bears.

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

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

[Total: 10]

3 This question is about pollution.

(a) The name of one type of mayfly larva that lives in streams is **Ephemera danica**.

(i) What does this name indicate about the classification of this animal?

Write **1** in the box next to the classification indicated by the name **Ephemera**.
Write **2** in the box next to the classification indicated by the name **danica**.

class	
family	
genus	
kingdom	
order	
species	

[1]

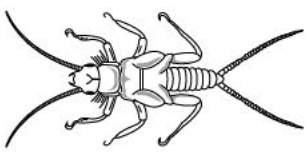
(ii) The **binomial system** is used to name **Ephemera danica**.

Why is the binomial system important when scientists name organisms?

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

(b) Look at the picture of a stonefly larva.



This is an indicator species used to show levels of water pollution.

Stonefly larvae live underneath stones in fast-flowing streams.

Stonefly larvae have adapted legs that end in small hooks and the body is flattened.

Explain why stonefly larvae are described as **specialists**.

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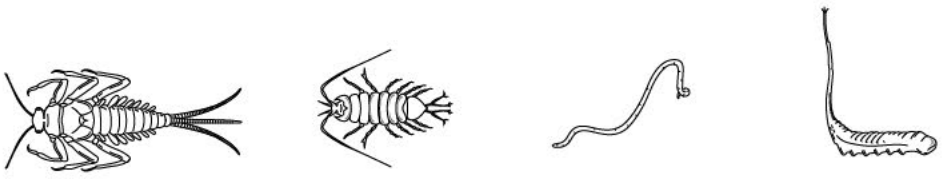
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(c) Look at the diagrams.

They are indicator species used to show levels of water pollution.



mayfly larva | water louse | sludgeworm | rat-tailed maggot

low pollution ⟶ high pollution

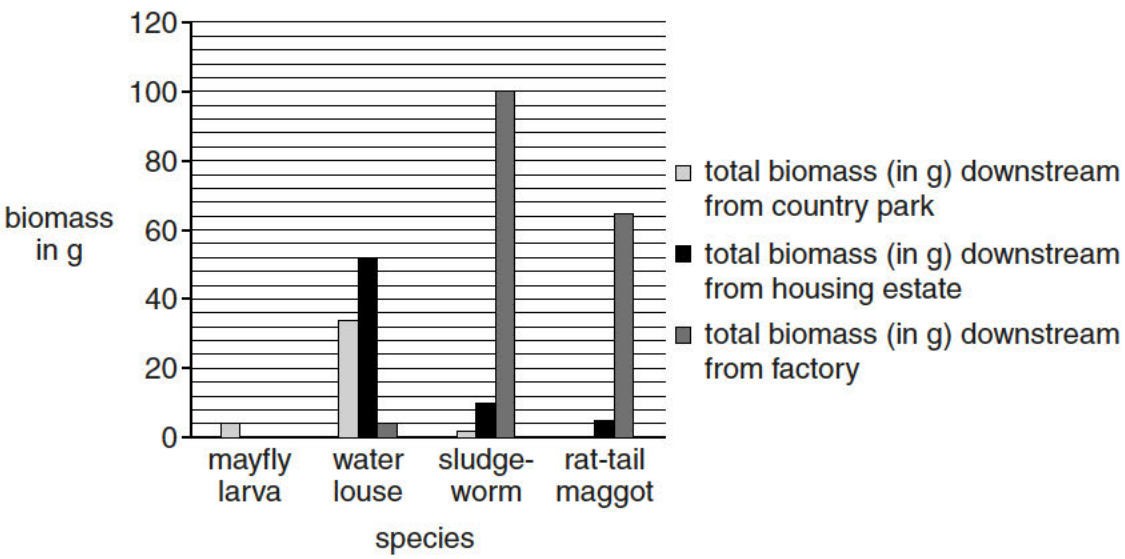
The County Council want to find out pollution levels in a local stream.

Water samples were taken downstream from three different places:

- a country park
- a housing estate
- a factory.

The indicator species were measured in each sample.

Results were plotted on a graph.



What conclusion should the County Council come to about the levels of pollution in the stream?

Use evidence from the graph and your knowledge of indicator species in your answer.



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

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[Total: 10]

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

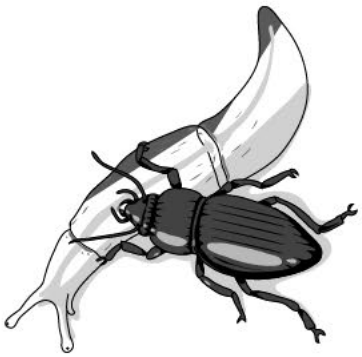
He is growing swedes in a field.

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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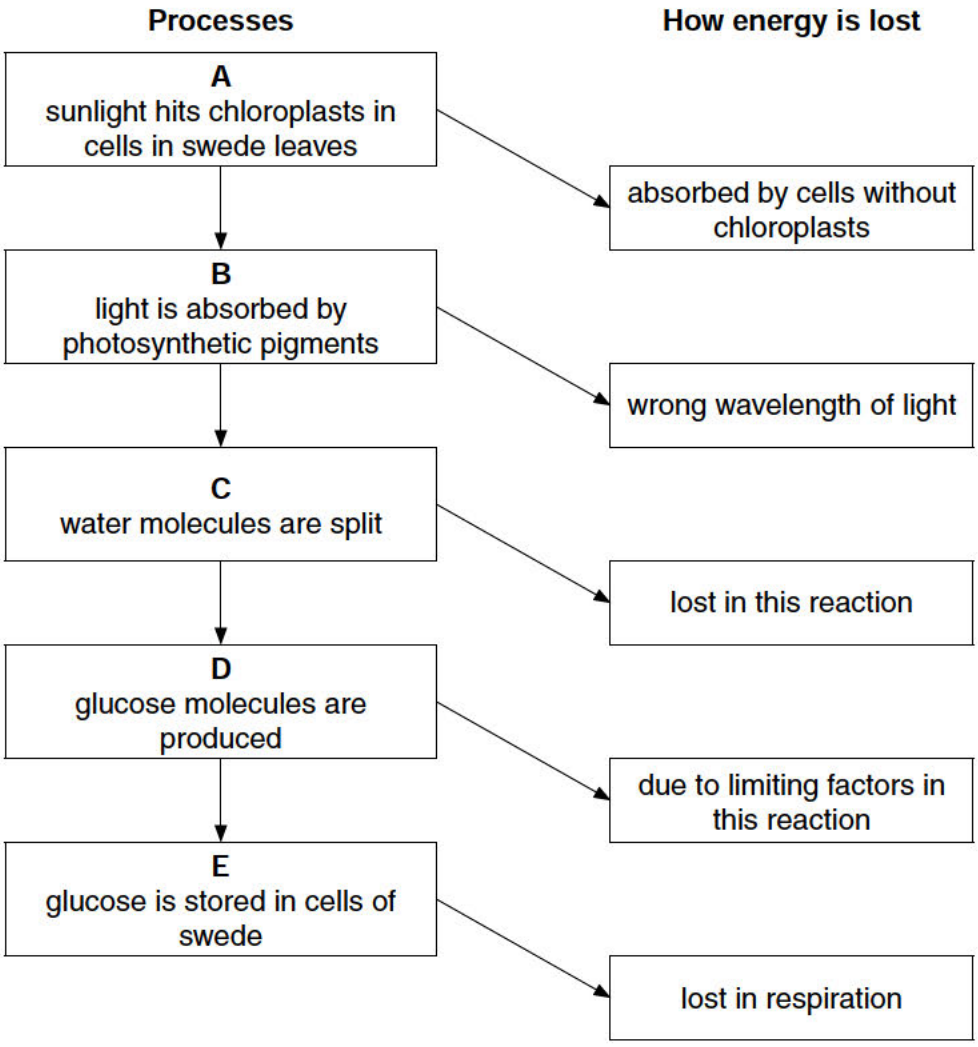
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..... [6]

(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]