

- 1 Researchers investigated the effect of adding cattle manure (cattle faeces) to fields where snap bean plants, *Phaseolus vulgaris*, were grown. Cattle manure contains some protein.

Explain how protein in the cattle manure is converted to the type of ions that plants can absorb.

[illegible]

[Total: 6]

- 2 In many parts of the world dairy cattle are kept in large barns and reared intensively, as shown in the photograph.



Food for cattle that are reared intensively includes cereals, such as maize and barley.

Ecologists have calculated that it is more energy efficient to grow crops for human consumption than for food for livestock.

Explain why intensive rearing of livestock is **not** an efficient use of crops.

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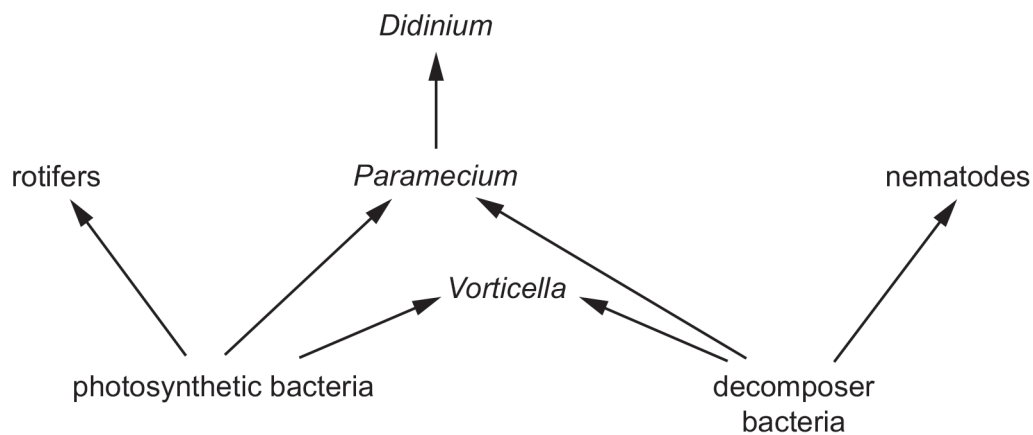
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[3]

[Total: 3]

- 3 This is a food web for some of the microorganisms in a sewage treatment works.



The water that passed out of the sewage works was often cloudy with suspended matter.

Scientists discovered that ciliates reduce the cloudiness of water during sewage treatment.

Suggest how the ciliates reduce the cloudiness of the water using the information in the food web.

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[Total: 2]

- 4 Researchers have devised a process of artificial photosynthesis. They use gold nanoparticles as a catalyst to utilise green light to convert carbon dioxide to fuels, such as propane.

Suggest the advantages to the environment of using artificial photosynthesis on a large scale.

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[Total: 2]

- 5 The seeds of many endangered tree species are kept in seed banks.

Suggest why it is important to collect seeds from many individual trees of each species rather than just one tree.

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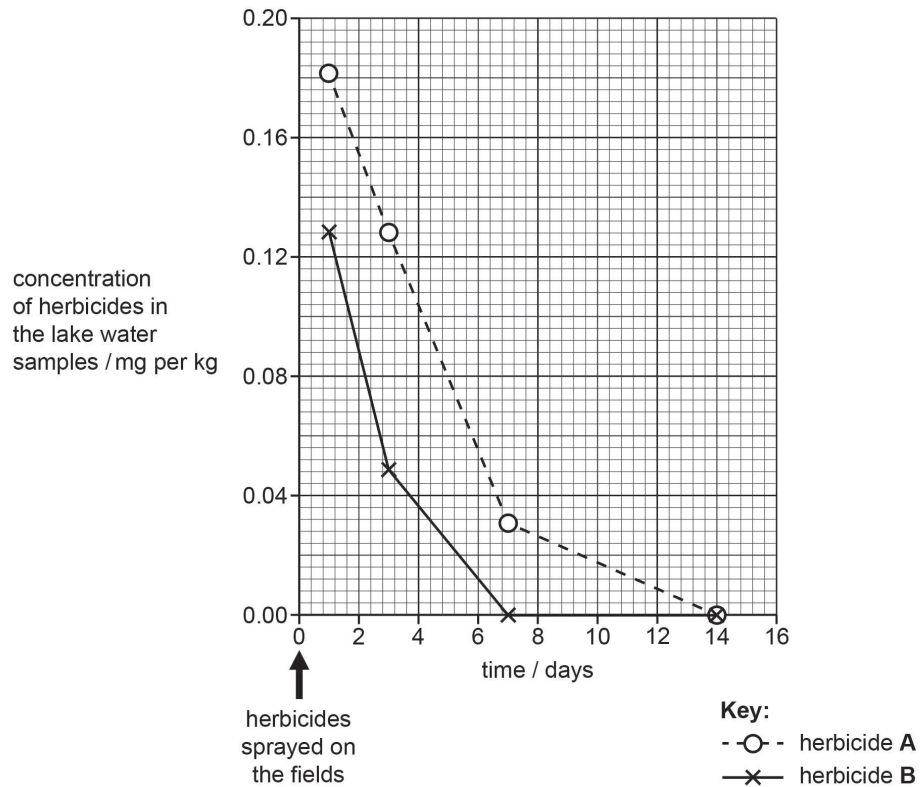
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- 6 Fields of crop plants were sprayed with two herbicides. A farmer measured the concentration of the two herbicides, **A** and **B**, in a lake near the fields.

The water in the lake was sampled at intervals for two weeks.

The graph shows the results.



Compare the concentrations of herbicide **A** and herbicide **B** in the lake.

Use the information in the graph to support your answer.

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[Total: 3]

- 7 Forest ecosystems are threatened by many human activities.

Describe reasons why people cut down forests.

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[3]

[Total: 3]

- 8 Wheat is an important crop plant in many countries. Wheat can be infected by diseases leading to total loss of the crop which results in famine.

Outline factors, **other than** plant diseases, that can cause famines.

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- 9 Look at the flow diagram for the production of lactose-free milk.

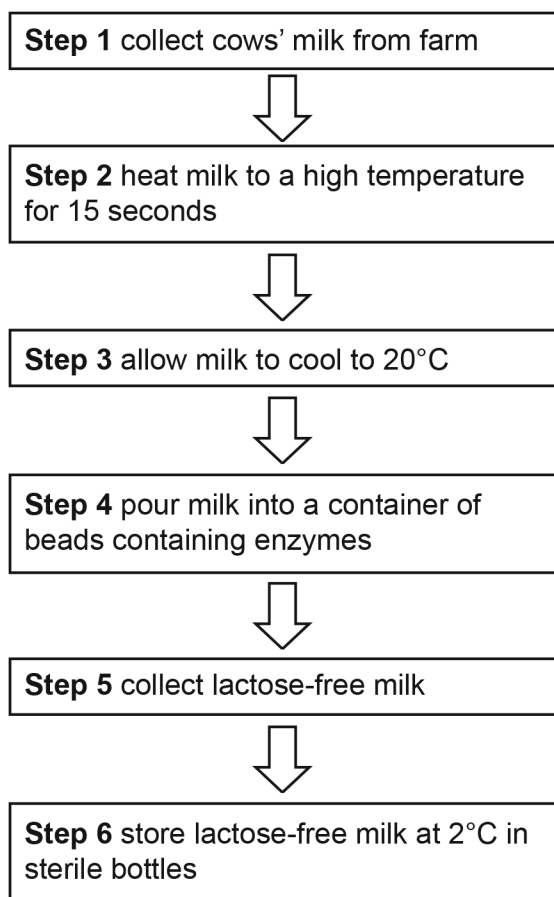
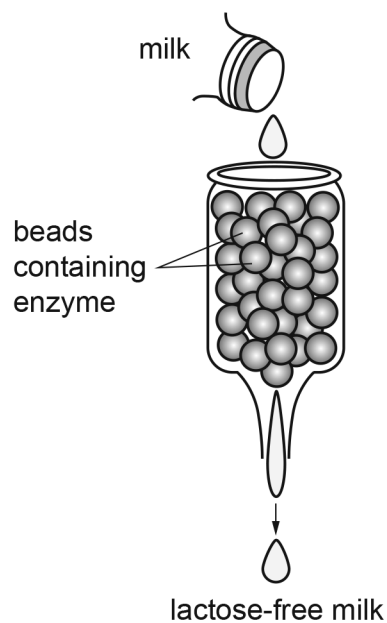


diagram of Step 4



Explain how heating the milk in **step 2** in the flow diagram ensures the hygienic preparation of lactose-free milk.

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[Total: 1]

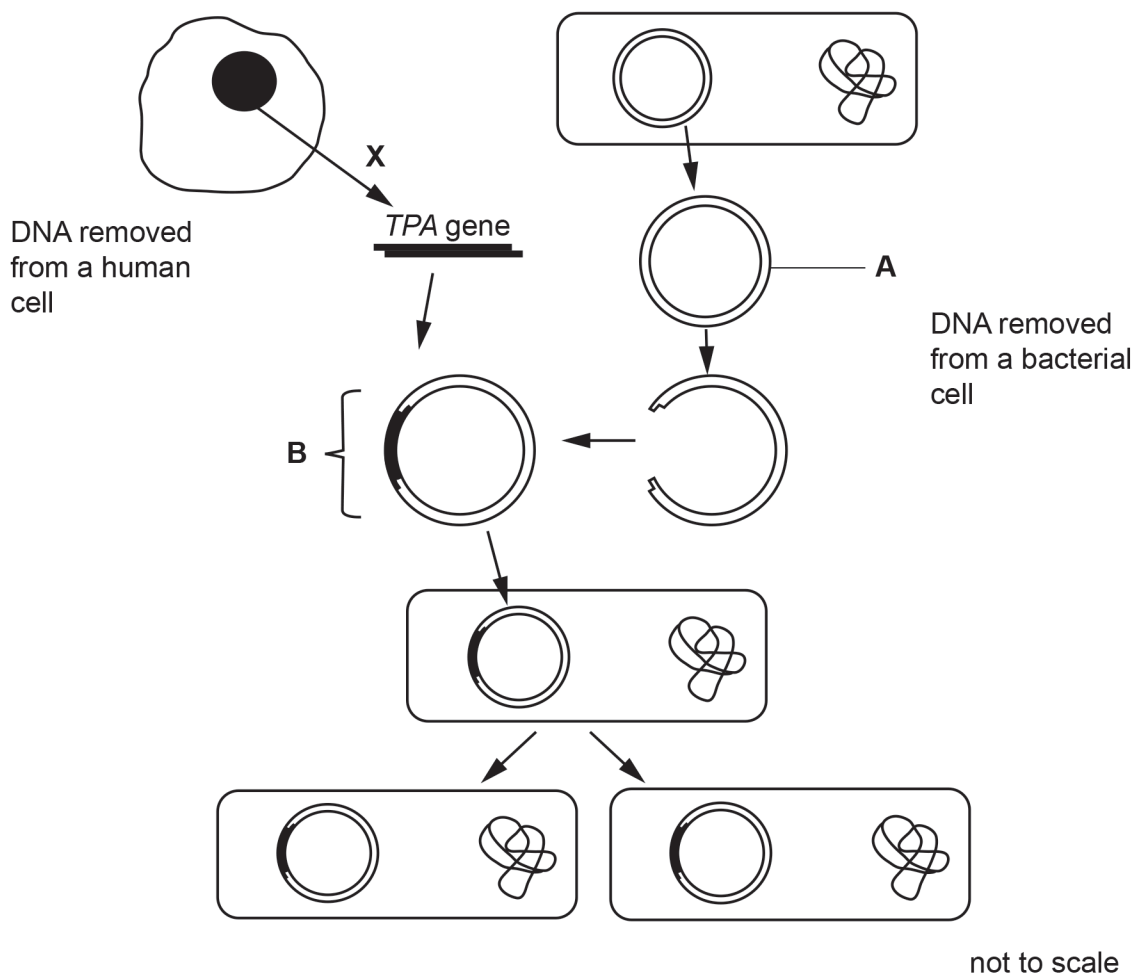
- 10** Tissue plasminogen activators (TPAs) are human proteins that are used as drugs to break down blood clots.

TPAs break down blood clots by activating plasminogen. Plasminogen is a protein that is always present in the blood.

When activated, plasminogen forms a protease that breaks down fibrin molecules.

TPAs can be produced by genetically-engineered bacteria.

The diagram shows some of the stages involved in genetically engineering a bacterium to make a TPA.



Before TPA was made by genetically-engineered bacteria it was only available from blood donated by people.

Suggest **one** advantage of producing TPA by genetically-engineered bacteria.

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[Total: 1]



- 11** A small sample of yeast cells and  $19 \text{ g per dm}^3$  of sugar were added to a fermenter. The population size of live yeast cells and the concentration of the sugar in the fermenter were calculated every day for 10 days.

Explain why it is important that there is a tube in the fermenter that allows gases to escape.

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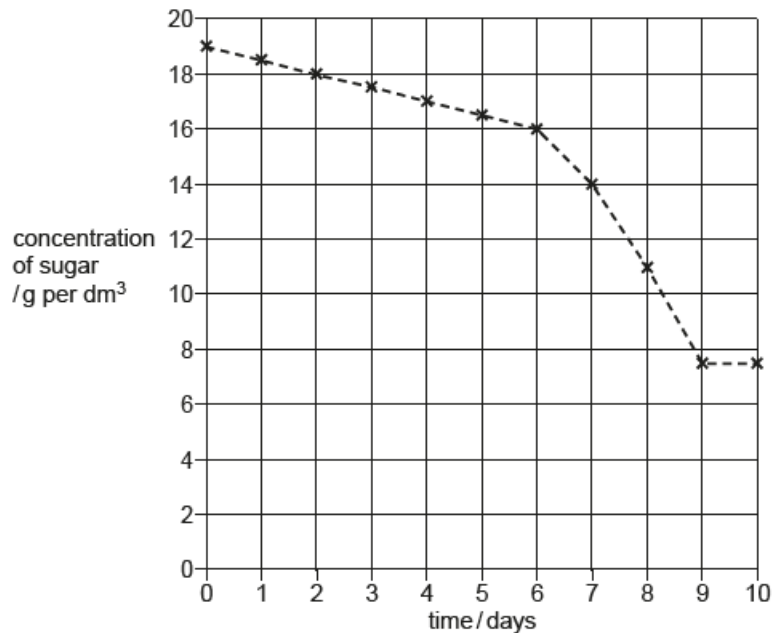
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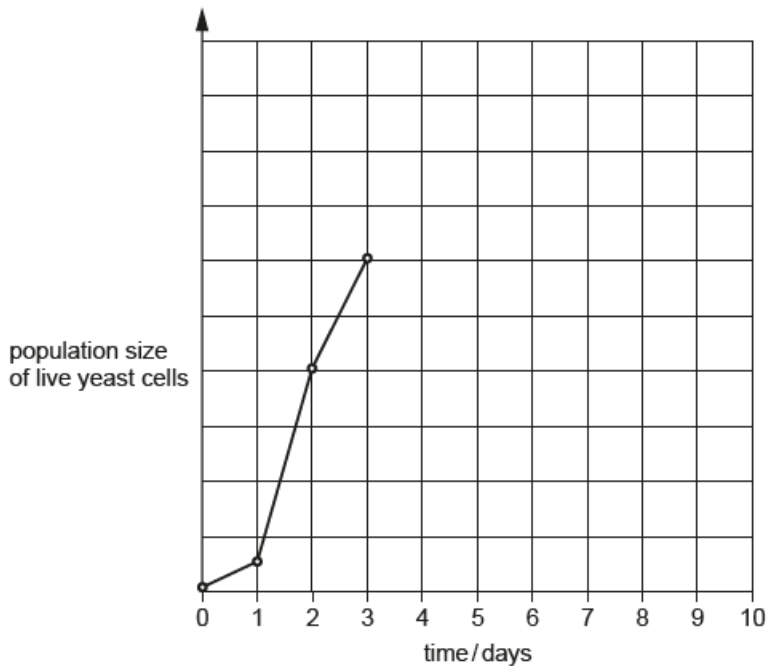
- 12 (a) A small sample of yeast cells and  $19 \text{ g per dm}^3$  of sugar were added to a fermenter. The population size of live yeast cells and the concentration of the sugar in the fermenter were calculated every day for 10 days.

The results are shown in graph 1 and graph 2.

graph 1



graph 2



- (i) Complete the line **on graph 2** to show the expected change in the population size of live yeast cells from day 3 to day 10. [2]

- (ii) Describe **and** explain the changes in the concentration of sugar in the fermenter over the 10-day period.

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[Total: 7]

- 13 Genetically modified bacteria are often grown in fermenters.

State the name of **one** commercial product, **other than** insulin, that is made in fermenters.

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[Total: 1]